THE

GEOLOGIST,

BEING A RECORD OF

INVESTIGATIONS IN GEOLOGY, MINERALOGY, &c.,

FOR THE YEAR 1842.

EDITED BY

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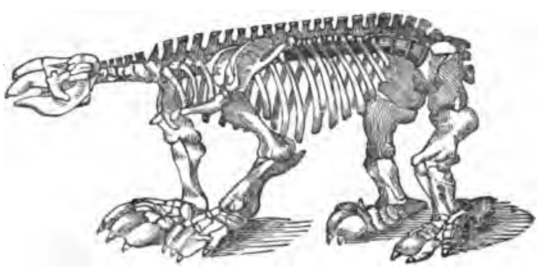
TREASURER OF THE SCIENTIFIC SOCIETY OF LONDON, &c., &c.



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1842.

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ERRATA IN VOL. I.

page	21	line	11	for	*Crinoidea Pentacrinus* read *Crinoidea-Pentacrinus*
—	21	—	28	—	*Kleigh* read *Klugh*
—	92	—	4	—	*exported* read *reported*
—	128	—	13	—	*franklimite* read *franklinite*
—	137	—	30	—	*Christati* read *Cristati*
—	165	—	37	—	*head* read *bead*
—	189	—	5	—	*truine* read *triune*
—	202	—	2	—	*Hall* read *Hill*
—	205	—	30	—	*Parkisoni* read *Parkinsoni*
—	219	—	33	—	*Just* read *Inst*
—	220	—	2	—	*Just* read *Inst*
—	224	—	5	—	*Precopteris* read *Pecopteris*
—	306	—	22	—	*leading* read *leaving*

SKETCH

OF THE

PROGRESS OF GEOLOGY, &c., in 1842.

We have now brought the labours of our first year to a close, and have recorded every fact of importance elicited during that period in the science of Geology, yet, as these have been distributed in different parts of our publication, (a natural defect of all periodical literature) we purpose in the present instance, to recapitulate the principal points of interest deduced from them, in connection.

Not the least important of these, is the able translation of "D'Orbigny's considerations on the Ammonites of the cretaceous period," kindly forwarded by Mr. Johnson; a department of the former gentleman's "Paléontologie Française," to which the president of the Geological Society of London* alluded generally in such marked terms of approval at the last anniversary of that body, whilst, in particular, he states that the considerations on the Ammonites have led him to conclusions of the highest interest, both zoological and geological. In the former respect, his observations on the external character of Ammonites, and on the limits of their natural and accidental varieties, of the differences of sex, and particularly of age, are entirely original. The previous labours of Geologists had contributed to a general knowledge of those of the northern chalk and green sand, whilst the southern tribe was unexplored until recently, and the labours of M. D'Orbigny therein, have proved the successive faunas of the great cretaceous formation of France, and their distinctness from those

* Proceedings Geological Soc. of London, Vol. III., No 86, p. 668.

of subjacent beds. To use Mr. Murchison's own words—"M. D'Orbigny points out the modifications of the species through time and space, and shows the relation which exists between certain forms and the beds which contain them. He recognises three new creations or replacements of the species of Ammonites during the cretaceous period; and thus establishes on zoological data, these divisions of natural groups; the néocomien, the gault, and the upper greensand and white chalk; and he estimates that in this triple succession of deposits, the Ammonites gradually decrease according to the numbers, seventy-five, forty-two, and twenty-seven, to disappear finally with the uppermost chalk or Maestricht beds, *and before the tertiary* epoch."

The second point of interest to which the labours of geologists have been directed, refers to the study of the older stratified rocks, including the Silurian,* Devonian, and Carboniferous series.

We need not recapitulate the general features of so called "Silurian groups," which Mr. Murchison has long since pointed out in his valuable work upon the subject; but during the present year, geologists seem to have arrived at the conclusion, that the term *"Cambrian," must cease to be used in zoological classification, it being synonymous in this sense with "Lower Silurian,"* subsequent researches having proved

* We have recorded our opinions on the above term in the monthly notice for May, 1842; (v. Geologist, p. 120), and although the reason urged by Mr. Murchison for its recognition, seems plausible enough, "that it is liable to no misconceptions, as it is simply a geographical name, derived from a region containing newly deposed types of succession," we still adhere to the opinions expressed in the article alluded to, that a local term cannot be applied for general comparison, and that in fact, it is a fallacy to talk of the "*Silurian* rocks *of Russia*." We must, therefore, endeavour to detract from a British Geologist's boast, "in restoring to general currency the word Silurian, as connected with great glory in the annals of his country."

that the lower Silurian fossils were the earliest created forms, and that this type prevailed during that vast succession of time which was occupied in the accumulation of all the older slaty rocks, until the upper Silurian period, when new creatures were called into existence, and when the earlier forms diminished, and were succeeded by a profusion of chambered shells, which so abundantly characterise that epoch.

This deduction appears to have been founded upon extensive examinations by Professor Sedgwick in Cumberland, where he has traced the same general division into "Upper and Lower Silurian types," in strata equivalent to those of tracts heretofore denominated "Cambrian," and also by Mr. J. Marshall and Mr. Mac Lauchlan, who have recognised the same Silurian types in the so-called Cambrian rocks of North Pembroke.

Mr. Murchison alludes to the establishment of this theory of organic succession, in his late address to the Geological Society of London, in very marked and beautiful language, and rejoices that the British islands have afforded the means of working out the question systematically. Ascending from the lowest types, he says: "The upper Silurian zone is one of great distinctness in England, and in the Baltic, in the northern provinces of Russia, and in North America; the Wenlock, Dudley, and Ludlow fossils having been abundantly found in both hemispheres; as soon, however, as we have advanced through this zone, a new era is announced by the presence of the earliest vertebrata. The minute and curious fishes of the uppermost bed of the Ludlow rock, are the earliest precursors of many singular Icytholites which succeed in that enormous formation, termed from its mineral character in Scotland, and parts of England, the Old Red Sandstone.* But in this, as in nearly every other deposit,

* Vide Miller's Old Red Sandstone, or New walks in an old field.

lithological characters are fugitive, and the red, green, and yellow sands of the north, are found even in our islands, as in Devonshire and the adjacent tracts, to be replaced by black schist and limestones. But, here again geology enables us to interpret the language of nature, for it was by seeing the letters of the alphabet spread out before him in a cabinet, and, without even having visited the country, that Mr. Lonsdale was led to conceive that a large portion of this tract, though very dissimilar in mineral aspect, would prove to be of the same age as the Old Red Sandstone."

The proceedings of the Geological Society of London during the past year, evidence the distribution of Silurian rocks and the associate types in Russia in Europe, and Asia; to which results, Mr. Murchison adds his own opinion, that these may yet be traced in the Altai mountains (from fossils which he has inspected from that locality) and China. That North America abounds in similar types, is proved by the communications of Professor James Hall,* and W. E. Logan,† and Mr. A. Gesner‡ They extend doubtless much further, but as yet nothing more determinate has been ascertained; suffice it to say, that the more extended the examination has been, the more general has the distribution of Silurian types been found, and the more numerous consequently are the arguments that the title is erroneous, although sanctioned by leading Geologists of the day, and the adoption of the term by foreign authors in their works. We may sum up the investigations in this department of geology, by using the words of the author before alluded to, stating "*the results in each instance, as leading to the view of the palæozoic rocks, as a great tripartite series composed of the Carboniferous, Devonian, and Silurian systems.*"

The Glacial Theory—The close of last year found Geologists divided in their opinions upon this subject; their

* Proc. Geol. Soc., Vol. III. p. 416. † Geologist Vol. I. p. 169.
‡ Geologist. Vol. I., p. 301.

respective creeds having given rise to the appellations of "Glacialists," and "Diluvialists," bestowed upon the several parties, Dr. Buckland, whilst occupying the chair of the Geological Society of London, contending as the leader of the former party in this country, that to the agency of ice alone, various important changes in the outward appearance of the earth might be attributed. We have explained the nature of this theory at length, in a "Periodical summary," and have detailed the prevailing opinions from time to time on the fresh discoveries relating thereto, in the Monthly Notices, to which we would therefore refer our readers, who will thereby in a measure be prepared for the position in which matters stand at the present time. Our own distinct opinion has always rested in favour of diluvio-glacial action—in other words rejecting the agencies of ice or water as totally inadequate to produce any of those astonishing effects, which we see recorded in, or affecting the solid rock; and in this the majority of Geologists concur. Professor Agassiz, however, still maintains his original opinion, despite of the opposition of M. Necker de Saussure, and M. Godefroy, the former examining more minutely into those detrital deposits connected with Alpine regions in particular, from which he has arrived at the conclusion, that these are divisable into two classes, the one of high antiquity, the other of comparatively recent origin, and contends that the enormous masses of ancient drift or diluvial detritus have a direct connection with the actual configuration of the surface, because the chief part of them has been derived from the centre of the chain, the flanking and lower mountains, and even the strata upon which they rest, having contributed but little, comparatively, to the great advancing body. Having examined the high valleys about Chamouni, and the foot of Mount Blanc, and finding massive walls from 300 to near 600 feet in height composed of this ancient diluvium in its coarsest form, near the extremities of certain glaciers, he concludes they were once the moraines of glaciers which melted away and retired from them. He then goes on to suppose that when the recession of the glaciers took place, (an effect which he refers to the same cause as De Saussure), such transversal moraines formed dykes standing out at some distance from the mountain, and barred up lakes formed by the melting of the ice and snow. These lakes, at length swollen to excess, are supposed to have burst through the moraine barrier, and to have drifted the materials of which it was composed, into the lower countries. To the same cause he attributes the presence of large boulder stones in the Alps, and he concludes that no such boulder stones are to be found in any localities where there are not permanent glaciers.

This opinion which we have drawn, from the perusal of the author's work, is refuted in the address of the President of the Geological Society of London, by reference being made to the extensive distribution of erratic blocks in the large valley of the north of Germany; nor does he, as Mr. Murchison says, explain how it has happened that the granite blocks of *Mount Blanc* should lie upon the *Jura*.

In fact, the force required to effect changes of that extent as are now visible on the surface of certain districts, must have been much greater that any which could arise from glacial progresses alone. Whilst, when water is added to the agency, power and volume are both gained—both of them essential attributes of any agent.

Mr. Godefroy argues much in the same way. He considers the ancient diluvial deposit as formed in the manner detailed by M. Necker de Saussure, and that the so-called moraines are only re-arranged portions of some pre-existing diluvial deposit, placed in their present position by the downward movement of the glaciers; which, cutting through the deposit, throws up some portions into lateral and terminal moraines. These opinions, however, throw light only upon the present diminished scale of action of glaciers, and tend to prove a diminution in size of the glacial summits of the present day, not of sufficient extent to add weight to M. Agassiz's theories of general centres of glacial action, nor to invalidate the pre-conceived opinions of the conjoint action of water and ice—the former being the agent, to which detrital deposits have, in all times and at all eras in the science of geology, been attributed—the latter being the plausible lucubrations of comparatively modern philosophers. At the close of 1842 it may then be said fairly that the "diluvio-glacialists" have the majority; and that their opinion is, that all those erratic blocks which lie scattered upon the surface, were transported by the associated influences of water and ice, and deposited in their present position, beneath the former, in an age and under circumstances, different *and far removed* from the present.

The *simplification of science* is the last subject to which we shall allude, as one of great importance in every way. We have seen from the previous portions of the Report, that as attention has been more especially directed to the older rocks, so the result has been a recognition of types, by which the line of distinction may in all cases be drawn with accuracy, and hence may fairly be said to have accomplished a simplification of the arrangement of these beds: for, whatever may be the nomenclature, it is to the facts themselves that we must look in the first instance for carrying the point in question. The glacial theory, on the contrary, we leave in a labyrinth whence time alone can extricate it; we repeat again, that we see but small probability of any great light being thrown upon it, in its relation to the ancient phenomena of the earth's structure, for reasons more than once explained.

Lastly, we would briefly advert to the triune system of classification, which we have endeavoured to adapt to the science of mineralogy, with the same intents as those to which we now draw attention, hoping that chemists will be induced thereby to aid mineralogists in this department of research; which, from the present state of the science, and the discoveries made from time to time, will, we are sure, amply repay the labour.

THE EDITOR.

THE GEOLOGIST,

A MONTHLY RECORD OF INVESTIGATIONS AND DISCOVERIES IN GEOLOGY, MINERALOGY, AND THEIR ASSOCIATE SCIENCES.

1st. January, 1842.

In presenting the first number of the present work to the notice of the Geological World, we consider it to be our duty to enter into a short explanation of the principles upon which it will be conducted, for the two-fold reason, that being thus informed of the general design, the subscribers may have no reason to regret that they have given us their support, and contributors may be enabled to transmit their communications and notices in a form consonant with our objects and plans, and thereby save, in many instances, both themselves and us much needless trouble.

It has been our wish to establish a periodical exclusively devoted to the Science of Geology, in all its bearings, in the pages of which all necessary information on subjects of current interest may be found, and which should, therefore, maintain a general equality of geological knowledge.

In contemplating this ultimatum, our attention was necessarily directed to the different methods by which it might be realized; but, profiting by the suggestions of several eminent geologists, we have arrived at the conclusion, that we should best fulfil the obligations imposed upon us, were we to adopt the plan of "*collecting and generalizing such facts as are made known from time to time,*" not neglecting, however, to procure the most recent information on theoretical questions, and stating it in such a manner as to preclude the possibility of our transgressing the line of distinction, which should mark our work as strictly practical.

Mr. Greenough having recommended, among other subjects, that we should devote our attention to "geographic-geology," by procuring, in the first instance, authentic lists of all descriptive works or charts of districts, hitherto published either in this country or elsewhere, and by collating from these, in the second place, such information as should be considered essentially important or useful to the geologist thereby to render these periodical essays on local geology one of the most important features of our work—we feel much pleasure in stating in this place our adoption of his suggestion, and in acknowledging the service rendered us by him, as also by other eminent geologists, as well in communicating their views, as offering us their valuable assistance in their completion.

We have premised thus much in the hope that we may enlist the services of those persons who have opportunities of acquiring information relative to the above, or any other subject in accordance with our design.

The difficulties with which we have had to contend, in determining on any plan for our work were considerable, for being of opinion that scientific periodicals should always contain the most elaborate reports on scientific subjects, calculated to raise, and subsequently maintain their value in the estimation of those persons thoroughly conversant with the subjects, and that it is also necessary that they should be conducted in such a manner that the student may derive benefit from their perusal, it has been our anxious wish to please both parties, and we hope to have succeeded.

THE EDITOR.

PERIODICAL SUMMARY.

ON GLACIERS.

Their nature, formation, and action, with an explanation of the glacial theory of Mons. Agassiz applied to Geology—General observations.

PUBLISHED WORKS ON THE SUBJECT.

1. *Altmann.*—Versuch einer historischen und physischen Beschreibung der helvetischen Eisberge, 8vo. Zurich. 1751.

2. *Agassiz.*—Etudes sur les glaciers, 8vo. (et atlas), Neuchâtel, 1841.

3. *Beaumont* (Elie de).—Sur quelques-unes des révolutions de la surface du globe, 8vo. Paris. 1830.

4. *Bischof.*—Wärmelehre des Erdkörpers.

5. *Biselx.*—Ueber die Schnee und Gletscher der Alpen, (in "Gilbert's Annalen der Physik, vol. 64).

6. *Charpentier.*—Various notices on the Glaciers of the Swiss Alps in the proceedings of the Geological Society of France.

7. *Engelhardt.*—Naturschilderungen aus den höchsten Alpen, 8vo. Basel, 1840.

8. *Gilbert.*—Ueber die Grenzen des ewigen Schnee im Norden. (Annalen der Physik, vol. 41).

9. *Godeffroy.*—Notice sur les glaciers, les moraines, et les blocs erratiques des Alpes, 8vo. Geneva, 1840.

10. *Gruner.*— Die Eisgebirge des Schweitzerlandes, 8vo. Bern, 1760.

11. *Hugi.*—Naturhistorischen Alpenreise. Solothurn, 1830.

12. *Keralio.*—Translation of "Gruner's Eisgebirge &c," 4to. Paris. 1770.

13. *Martin's* Observations sur les glaciers du Spitzberg, comparés à ceux de la Suisse et de la Norvège. Biblioth. Univ. de Genève, No. 55. 1840.

14. *Meissner.*—Notices in "Naturwissensch. Anzeigen," Nos. 11 & 12.

15. *Mousson.*—Geologische Skizze der Umgebungen von Baden in Aargau, Zurich, 1840.

16. *Saussure* (H. B. de).—Voyages dans les Alpes, 4to. Neuchâtel, 1803.

17. *Venetz.*—Notices in "Denkschriften der allg. Sch. Gesellschaft, vol 1.-part 2.

18. *Welden.*—Der Monte Rosa, 8vo. Vienna. 1824.

PART I.

The nature of Glaciers—Their occurrence and situations—Temperature and circumstances under which they exist.

"Glaciers are formed of ice, different from that produced by congelation of water." *Agassiz.*

"The surfaces of glaciers are formed of angular pieces of ice, varying in size from one to three inches square, frozen together, and presenting an uneven surface." *Agassiz.*

"The ice at the *lower portions* of glaciers is always more transparent than elsewhere, from its compactness." *Agassiz.*

"The glaciers of Spitzbergen are formed of angular fragments cemented together by congelation." *Von Buch.*

"Large blocks of very compact and transparent ice occur near the summit of Mont Blanc." *De Saussure.*

"Compact ice occurs at an elevation of 10,000 feet." *Zummstein.*

"Glaciers are throughout only a transformation of snow." *Agassiz.*

"The transformation always takes place at the lower portion; as the first absorption of water takes place there." *Agassiz.*

"The snow which fell at an elevation of 10,000 to 12,000 feet on the icemeer of the Oberland Bernois, was fine and dry." *Hugi.*

"The snow fell in the same state at an elevation of 7,500 feet on the glacier of the Aar." *Agassiz.*

"Hail is frequent at great altitudes." *De Saussure.*

"Rain occurred at an elevation of 10,000 feet." *Zummstein.*

"The snow of the icemeer at the foot of the Gruenhorn is saturated with water to the depth of several feet." *Hugi.*

"The layers of ice and snow are clearly defined in the large chasm of Mount Rosa." *Zummstein.*

"Alternate layers of snow and ice at *Mont Blanc.* *De Saussure.* "And at the glacier of St. Théodule." *Agassiz.*

"The Siedelhorn, 8,524 feet in height, has no glaciers, although its summit is covered with snow during nearly the whole year." *Agassiz.*

"All glaciers do not extend to the same level; some cease at 7,000 or 8,000 feet, others extend to situations of an altitude of 3,000 feet only." *Agassiz.*

"The lower glacier of the Aar, the largest glacier of the Oberland Bernois, descends to 5,728 feet." *Hugi.*

"The lower glacier of Grindelwald, although of less length than the preceding, extends to 3,200 feet; the large glacier of Aletsch, the longest of all those in Valais, descends 4,000 feet." *Agassiz.*

"Large patches of ground, covered with verdure, are often found encircled by glaciers, at an elevation of 7,000 feet." *Agassiz.*

"Glaciers occur in vallies of the temperature of $+5^0$." (Reamur.) *Agassiz.*

"Atmospheric temperature is an essential agent in the formation of glaciers, their extension and movement." *Agassiz.*

"The temperature of the ice constituting the lower glacier of the Aar is constantly below zero." *Agassiz.*

"The result of all examinations which I have made as to the temperature of the small streams of water occurring in the glaciers of Chamounix, Trient, Aar, Aletsch, Zermatt, St. Théodule and Zmutt has established it at 0^0, so long as they flowed over the glaciers; but as soon as their courses were through the gravel beds, the temperature varied from +0.1. to +0.7." *Agassiz.*

We are desirous of placing the observations of careful naturalists before our readers, in this and all other instances, where such a course can be adopted, in order that they may form their own ideas apart from the opinions expressed by other geologists, or by ourselves, and we consider this preliminary remark necessary on that account.

By "*glaciers*," then, we are to understand those sheets of ice which occur in the valleys, and on the slopes of highly elevated districts and mountains, at variable altitudes, and under different circumstances. Their substance differs very considerably, as we may learn from the observations alluded to, as also that they are formed of snow in various stages of congelation, produced by the vicissitudes of climate; this is proved by the bands of snow and ice in the glaciers of Mount Rosa, Mont Blanc, and St. Théodule the angular fragments mentioned by Agassiz, and the gradual transformation is traced not only in the occurrence of these bands, but in the very clear and well-defined example of the glacier of the Gruenhorn.

Their origin is a separate question; from the above facts, we learn that the snow which forms the glacial mass is not deposited in situ (witness the verdant patches of ground alluded to, enclosed by walls of ice) and that the snow of which the glaciers are formed is precisely the same in character as that which has been observed to fall at great altitudes. The effect of variations of temperature must be apparent, and therefore we will not allude to this subject; but when, in addition to the natural thaw produced by heat, we may add the occurrence of rain at these elevations, we may easily conceive the mass of snow to become saturated, as stated by Hugi, and subsequently to become congealed on the return of frost, and hence the appearance which the glaciers present.

The observations of all travellers confirm the opinion, "that elevated districts are those in which snow is most frequent," the degrees being regulated by the altitudes. It is also natural to suppose, that when rain or thawing occurs, the lowest situate portions of the glacial mass would first become saturated, which is proved by the difference observed in the ice in the various regions; thus, the ice which occurs in the most elevated districts is compact and transparent, more closely resembling that which is formed by the congelation of water, than the ice forming the glaciers, which, as we have seen, is derived from congealed snow. These causes would tend to retain the snow, in elevated districts, more or less dry, and whilst producing this effect, would also diminish the retentive or binding quality which it would otherwise possess, and on this account any superabundance of snow which might fall, would slip from those situations, and would naturally follow the inclinations of the country as their course.

Having traced their origin, we will next consider their action and effects, a subject which presents a wider field for observation and inquiry.

PART II.

Changes in Glaciers—Their descent—Occurrence of dirt and gravel beds—Boulder stones—Moraines—Ice-tables—Needles and gravel cones—Chasms—Arched hollows in the lower part of glaciers—Occurrence of lakes and torrents—Striated Rocks.

"The flanks of all glaciers are more or less inclined towards the rocks forming their boundaries." *Agassiz.*

"The flanks of the glaciers are inclined towards the mass of rocky fragments (medial moraine) in the glacier of the Aar." *Agassiz.*

"All glaciers have chasms and crevices." *Agassiz. Hugi. Saussure. Charpentier.*

"I have seen the surface of the lower glacier of the Aar filled with small cracks of an inch in length." *Agassiz.*

"Chasms are formed where a sudden inclination of the bed of the glacier occurs, as in the large glacier of Aletsch." *Agassiz.*

"The chasm in one of the glaciers of Mont Blanc is 100 feet wide." *De Saussure.*

"The depth of a chasm in the lower glacier of the Aar is 120 feet." *Hugi.*

"On the 27th December, 1819, a large portion of the glacier of Randa was detached from one of the rocky walls of the summit of the Weisshorn, and was precipitated with incredible noise over the subjacent glaciers." *Venetz.*

"At the junction of the glaciers of the Finsteraar and Lauteraar, Mons. Hugi constructed a small hut in 1827, which since that period has advanced 200 feet towards the mouth of the valley." *Agassiz.*

"*M.M. Venetz, Charpentier, Hugi,* and *Agassiz,* all observed descents of glacial masses in the elevated districts of the Alps."

"Layers of mud or gravel always occur beneath glaciers." *Agassiz. Charpentier. De Saussure, &c.*

"Raised boulders are frequent near the cascade of Pissevache, and below the baths of Lavey." *Agassiz.*

"They also occur on the glacier of the Aar." *Agassiz.*

"They also occur on the Salève." *De Saussure.*

"The fragments of rock composing moraines are proved to have been derived from the rocks bounding the glaciers, by their mineral construction." *Agassiz.*

"Moraines increase in thickness at their extremities." *Agassiz.*

"Lateral and medial moraines decrease gradually with increase of altitude." *Agassiz.*

"The moraines occurring in one and the same glacier vary much in size." *Agassiz.*

"Medial moraines are frequently *numerous* in one and the same glacier; the glacier of Zermatt contains four." *Agassiz.*

"At the point of junction of any two lateral moraines, the medial moraine formed by them is always depressed, as in the glaciers of the Aar, Breithorn, Zermatt, and Lyskamm." *Agassiz.*

"Beds of fragments of rocks occur near the termination of the glacier of Zmutt, in the valley of St. Nicholas." *Agassiz.*

"The terminal moraines never rest upon the surface of the glacier, but commence from beneath the glacial mass, forming ramparts at the extremity." *Agassiz.*

"Numbers of 'ice tables' occur on the glaciers of Lauteraar." *Agassiz.*

"A table of ice on the lower glacier of the Aar, 15 feet long by 12 wide, and 6 high, slipped from its position in 1840." *Agassiz.*

"Tables of ice rarely occur near the termination of a glacier; they generally occur where the inclination is trifling, and in the neighbourhood of medial moraines." *Agassiz.*

"The greatest number of ice tables that I have seen, are on the lower glacier of the Aar, where the large medial moraine approaches the right lateral moraine, at an elevation of 6,500." *Agassiz.*

"On the glacier of Zermatt a great number of ice tables occur at an elevation of 7,000 feet." *Agassiz.*

"The occurrence of needle glaciers is always a proof of inequalities in the subformations." *Agassiz.*

"Gravelly cones are most numerous in the lower glacier of the Aar, and that of Zermatt." *Agassiz.*

"Gravel cones always occur near the middle, or in the upper portions of glaciers." *Agassiz.*

"Large lakes of water are often collected in ice dikes, as at Pussay at the side of the Adie." *Agassiz.*

"During the warm days of summer, you may observe on the glacier of Zermatt, immense torrents of water disappear beneath the glacier, at an elevation of 8,000 feet." *Agassiz.*

"Caverns are largest and most frequent in glaciers only slightly inclined, as at Zermatt, Zmutt, and Bois." *Agassiz.*

"I have examined a cavern beneath the glacier of Urag, extending a quarter of a league." *Hugi.*

"The lower glacier of the Aar has two caverns or vaults, one on the right, and the other on the left side." *Agassiz.*

"Polished rocks are frequent near the summit and on the sides of the Riffel, St. Bernard, Finsteraar." *Agassiz. Charpentier and De Saussure.*

"The action of glaciers is best remarked in the lias formation of Rosenlaui, where the polish, effected by the passage of the glacier over the rock, is very evident." *Agassiz.*

"Polished rocks occur *beneath* the glacier at Finsteraar and Lauteraar and in immediate contact with the glacier at Bois, Viesch, and Aletsch." *Agassiz.*

"Striæ occur on polished rocks at St. Bernard." *De Saussure.*

"The polished surfaces of the granite in Oberland Bernois are striated." *Max. Braun.* "The direction of these striæ corresponds with the axis of the glacier." *Agassiz.*

"The most remarkable polished rocks which have been observed in the Swiss Alps, are those at the summit of the Riffel, above the glacier of Zermatt. *Studer. Desor.*

Extensive slips of the whole or portions of any glacier, naturally produce an effect upon the remaining portions, or upon the subjacent rock; the alternations of temperature act upon these rocks precisely in the same manner as upon the glacier itself, and from first being cracked in various directions by the absorption and subsequent congelation of water, large pieces next become loosened by succeeding frosts, and in the end, are detached by the first avalanche, or glacial progress; these, in their descent, become gradually diminished in size, and are subsequently scattered; the smaller pieces, for instance, acquire a degree of heat which causes them to melt the ice upon which they rested, and penetrate into the mass; the larger, being impervious on account of their size, often remain isolated upon the ice beneath them, which, from being thus protected, has withstood the heat; whilst the surrounding glacier, from being exposed, has long since melted away; and it is only when the position of these isolated blocks has become less secure from subsequent and gradual changes in the icy pedestal upon which they rested, that they are precipitated by the force of gravitation.

It is from these causes that the glaciers are almost always terminated, and their courses marked by large mounds of fragments of rock, which have received the appellation of moraines, and which exist under determinate circumstances. Mons. Agassiz has classed them under three distinct names, viz.:

Terminal moraines (" moraines terminales"—" Gletscher-shutt") when they form the extremity of a glacier.

Lateral moraines (" moraines latérales"—" Gandecken") when they form the lateral boundary of a glacier.

Medial moraines—("moraines medianes"—" Gufferlinien") when they are formed by the junction of those of any two or more vallies.

These are the most distinct effects produced, and corroborated by glaciers in existence, as well as by similar traces left by those which have retrograded considerably; in addition, the course of a glacier is always marked by numerous characteristic or incidental circumstances, for we find in all situations which are or have been subject to their influence, traces of their action; such as the polished surface of the rocks, and a striated appearance, produced by the rapid passage over them, of quartzose or gravelly fragments which, as we have seen, occupy the lower portions of all glaciers. These effects are natural, for, considering that the influence of glacial action is manifested most distinctly under circumstances when the opposing force is least, it is clear, that where it is so great that it cannot be permanetnly removed by the same cause, some less considerable or remarkable change must take place.

The " gravel cones," of which mention is made by the various authors alluded to, consist of projections in the glacier, composed of gravel stones cemented by ice, by which the influence of the heat has been lessened, and whilst the surrounding glacier has melted in a greater or less degree, has preserved those portions in which they occurred. We also learn that large cavities or hollows exist beneath most glaciers, by which numerous torrents find ready exit from the superincumbent glacial beds, and more elevated regions.

PART III.

On the theory of glacial action; with especial reference to the extended system of Mons. Agassiz.

Present increase in the extent of glaciers.

"The lower glacier of the Aar has increased a distance of nearly a mile since 1811; the glaciers of Grindelwald increase visibly in size; the glacier of Zermatt has increased in size on its left flank; the upper glacier of the Aar decreases whilst the lower glacier of the same locality increases in extent." *Agassiz.*

"The number and extent of glaciers is very considerable; from Mont Blanc to the borders of the Tyrol, there are reckoned about 400 glaciers, some only three miles in length, whilst the greatest number range from 10 to 15 miles." *Pen. Cyclop. Art. "Glaciers."*

Moraines formed by glaciers which have retrograded.

"A great moraine occurs in the valley of Kander; termed the moraine of Kandersteg." *Guyot.*

"The huts composing the small village of Gièta in the valley of Mount Joie in Savoy, are built between three ancient moraines, which were formed by the glacier of Trelatête at that point; this same glacier in 1821, was 7,000 feet distant from those moraines." *Venetz.*

"The glacier of Salénaz in the valley of Ferrat in Valais, has left on the right hand side, an enormous moraine, which is now 8,000 feet distant from the extremity of the glacier." *Venetz.*

"The little village of An-der-Eggen is situated upon one of these ancient moraines, the last of a series, distant 7,000 feet from the glacier." *Venetz.*

"The glacier of Sirwolten has deposited on the left side, below the hospital of the Simplon, three moraines, which are now more than a league distant from the glacier." *Venetz.*

"The villages of Ried, Bodmen, and Halten, in Haut Valais, are built upon an ancient moraine, now situate at least 12,000 feet from the glacier." *Venetz.*

"The traces of longitudinal (i. e. lateral) moraines are less distinct and frequent; they are nevertheless readily defined in the lower portion of the vallies of the Rhone, between Martigny and the lake of Geneva, where several occur ranged parallel to each other, at an elevation of 1,000 to 1,500 feet above the Rhone." *Agassiz.*

"Longitudinal moraines are also very distinct above the baths of Lavey, and the village of Montrey, at the entrance of the valley of Illiers." *Agassiz.*

"Polished rocks are found below the glacier of the Rhone, and above the village of Oberwald." *Guyot.*

"In the valley of Oberhasli, the polished surfaces of the rocks can be traced without interruption from the commencement of the glacier to Meiningen." *Agassiz.*

"The rocks which encircle the hospice of Grimsel are polished from top to bottom." *Agassiz.*

"The erratic blocks of the Jura are similar to those of the Alps, in being angular." *Agassiz.*

Observations on the occurrence of Glaciers.

"The Pyrenean chain, as also the Sierra Nevada, have glaciers, though they are almost all on the northern slopes; in the mountains of Norway there are several glaciers; Spitzbergen has its eminences covered with snow, and surrounded by glaciers; in Iceland the glaciers are numerous and extensive; Greenland, as far as is known, contains innumerable glaciers, many of great thickness." *Penny Cyclop.*

"Along the S. W. coast of South America there are extensive glaciers, as also in the straits of Mengalhaen's and Terra del Fuego." *Capt. King.*

"Dr. Gebler in 1833, 1834, 1835, paid much attention to the formation and movement of the glaciers of the Altai mountains, and it is worthy of remark, that his observations coincide with those obtained in the Alps by Saussure and others." *Penny Cyclop.*

We have deduced these facts with reference to the *former existence of glaciers*, in situations which are now no longer exposed to their influence, and of their general distribution in elevated and cold districts, in order to display the fundamental reasonings of Mons. Agassiz.

We would proceed further in tracing the origin of *erratic*

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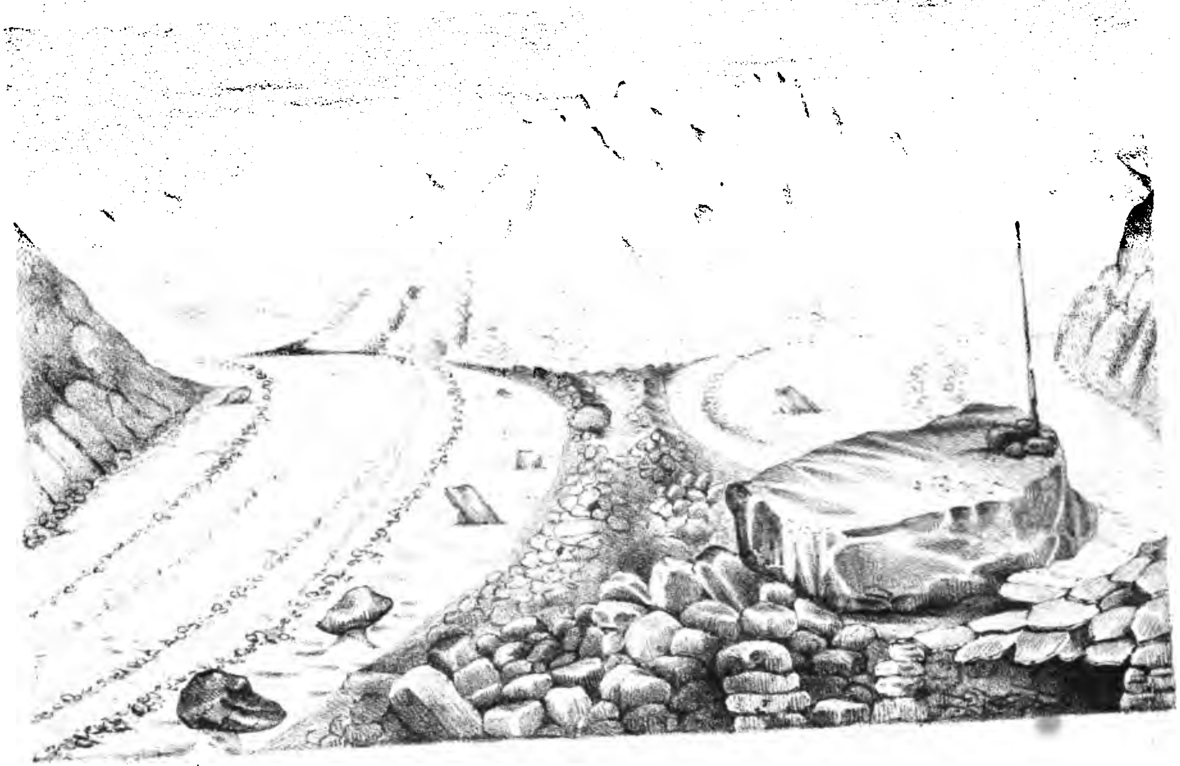
PLATE I.



blocks widely dispersed over the surface of our continents, in other and far remote districts, between which the ocean now exists, was it not that we should be entering upon ground already well explored, and the facts concerning which are universally acknowledged. When we observe immense blocks of stone, analogous in construction with the rocks of far remote regions, and existing in situations different from those into which torrents of water might have brought them, we are naturally induced to seek for other reasonings, capable of explaining these extraordinary effects. We find the erratic blocks are largest, not to say most numerous, in the regions most remote from their original rocks, and so it is that in glaciers, we find the larger blocks most distant from their original localities; the argument which presents itself is, therefore—"the glaciers producing the effect in one instance, may very probably have caused it in the other, at an epoch when their distribution was more general and their effects more remarkable."

Mons. Agassiz is of opinion that the Swiss Alps were formerly the centre of glacial action from which the distribution of erratic blocks and the formation of moraines took place, throughout the north of Italy, Switzerland, &c.; that Norway was the centre from which erratic blocks were distributed throughout England, Germany, Poland, and Russia; and in the same way he conjectures that the present regions of perpetual snows have been, and still are (though on a diminished scale) the centres from which the same effects took place throughout the principal portions of the globe.

The revival of the glacial theory by Agassiz, has induced several Geologists to conduct investigations to trace the former existence of glaciers in our own country.

Dr. Buckland and Mr. Lyell have established, in papers read before the Geological Society of London during their last session, the occurrence of moraines at Loch Traig, the

Firth of Beauly, Muckairn, in the neighbourhood of Inverary, at Dunkeld, and near Creekhope Linn, in a valley in Dumfrieshire. Both Dr. Buckland and Mons. Agassiz observed scored and striated surfaces on the Calton Hill, the Blackford Hill near Edinburgh, and on the left flank of the vale, called the Braes of Foss.

Mr. J. E. Bowman, in a paper read before the Manchester Geological Society, traces their existence on the Eildon Hills, and Mr. Lyell has observed other occurrences, conclusive to himself on this point, near Penrith.

Although a subject of dispute, we will venture to give our opinion, that the evidences afforded in many instances are satisfactory, not, however, in establishing general centres of glacial action, but tending to prove that they were numerous and distinct.

The observations of Agassiz and others, on the subject of the formation and action of glaciers, are more clear and better substantiated, and we have endeavoured to present these in an intelligible form, with the true sense of the respective authors from whom we have collected the information.

We have added a lithographic view of the glaciers of the Finsteraar and Lauteraar, adapted from that given by M. Agassiz, in order to exhibit the nature and effects of glaciers.

ORIGINAL COMMUNICATIONS.

ON THE LIAS BEDS NEAR CHELTENHAM,

BY JAMES BUCKMAN, ESQ.

On examining the district of country, the subject of this memoir, and which is extended to a circumference of ten miles from the town of Cheltenham, the following formations are found:

1st. Clays and marls of the new red sandstone formation.

2ndly. The lias formation, including, { the lower lias beds, the lias marlstone, the upper lias or alum shale

3rdly. The oolitic formation, containing, { the inferior oolite, the Stonesfield slate.

The town of Cheltenham is situated in the S. E. corner of the vale of Gloucester, and is two thirds surrounded by the Cotteswold Hills; a few miles to the N. E. stands the magnificent outlier of oolite, called Bredon Hill, and to the S. W. the lias outlier of Churchdown.

Having premised thus much on the general features and situation of this locality, we will next consider the lias formation, and, in so doing, will examine the different beds in ascending order, and, being convinced that not only may the different formations be distinguished by their fossil contents, but the subordinate beds of which they are composed may also be identified with the greatest precision by the same means, this order of description will be the more intelligible.

I. *Lower lias formation.*

1. In Wainload Hill, an elevation in the range of hills above referred to, the lias flagstone is found resting immediately upon the red marl, which presents evidence that the waters by which it was deposited swarmed with life, as this bed is entirely composed of bones, teeth, and exuviæ of fishes. These teeth of two kinds, are those of a sub-family of sharks, named Hybodonts; and those of a species of the Sauroid family.

At Westbury upon Severn, this bed occurs in the same relative position, but is much better developed, both in thickness and contents. Coprolites are abundant in the bed at this locality; but, throughout our examinations, we have only found one shell, which was much too imperfect to lead to the detection of the genus. We should conjecture, however, that it is allied to *Pantigua.*

2. Passing over a non-fossiliferous bed of stiff clay, we again find a bed of lias flagstone, in layers of about five inches in thickness, and of a brownish colour, the uppermost layer of which abounds in small species of *Modiola* and *Ostrea*, to which beds they seem almost entirely confined, only a few scattered specimens being found in the lower layers of the same bed, and none in the other formations.

3. Another stratum of clay separates this from a third bed of flagstones, in which *Plagiostoma gigantea* occurs. This shell does not occur in any other bed of the lias formation in this neighbourhood.

4. Next in the ascending series, we find some thick beds of lias clay, of variable colours, by which their existence may be readily traced, and the beds identified in all their situations; whilst their fossil contents are also a ready index to their identity. We observe new fossils occurring in every bed, and occupying the places of those occurring in the subjacent beds, so that the upper bed of lias clay contains scarcely a fossil of the same species as the lower one.

A. In the lowest bed we first find *Gervillia*, and amongst other genera, *Pecten* (2) *Terebratula* (8) *Nucula* (2) and *Avicula* (2).

B. The next is a bed of stiff blue clay about twenty feet in thickness, abounding in *Hippopodium ponderosum*, and Lutraria, which are never found in a lower position in this district. This bed contains occasional nodules of indurated clay, which often contain *Ammonites*, and a crustacean, *Astacus glabra*. With regard to *ammonites*, they may be said to commence in this bed, as we have never found one individual lower in the whole district to which this memoir refers, and in this bed alone they are so numerous, that we have been able to identify twenty species, among which the following are those most abundant:

A. Bucklandii (Sow. pl. 130)	A. elegans .. (Sow. pl. 94)
A. Conybeari (Sow. pl. 131)	A. Murchisoni (Sow. pl. 550)
A. Turneri .. (Sow. pl. 452)	A. armatus .. (Sow. pl. 95)
A. Brookii .. (Sow. pl. 190)	A. Johnstoni* (Sow. pl. 449)
A. Smithii .. (Ditto.)	A. communis (Sow. pl. 107)
A. planicostatus (Sow. pl. 406)	A. obtusus .. (Sow. pl. 167)

The A. elegans and A. Turneri are nearly always covered with bisulphuret of iron—with iron pyrites only casually, but more frequently with a brownish red coating of peroxide of iron, originating, in all probability, from a decomposition of the pyrites.

C. A bed of brownish blue tenaceous clay, fifteen feet thick, succeeds, much used in brick-making, in which the first traces of *Belemnites minimus* are found, which subsequently pervades the whole of the lias and inferior oolite. The *Gryphæa incurva*, is also abundant, and the clay nodules of this bed enclose many species of *Terebratula*.

D. Next in order occurs a bed of bright blue clay, exhibiting a tendency to stratification, and in which two undescribed species of Ammonites occur;† as also the *A. Cheltenensis* of Murchison.‡ (This species is identical with A. Henleyi of Sowerby; but from many specimens which we have observed in every possible form and state, we are convinced that the Ammonite thus named by Sowerby, is only a large state of Murchison's A. Chelternensis.) *Inoceramus dubius* is also met with here for the first time.

E. The next is a bed of yellow ochreous lias, containing

* The Ammonites Johnstoni of Sowerby is merely a flattened state of A. Conybeari, the difference in colour resulting from the former retaining its beautiful nacre. I have found the A. Conybeari in many intermediate stages.—J. B.

† To these we have assigned the names of *A. Buckmanii* and *A. Murleyii* in honour of their respective observers.—Vide "Illustrations of British Fossils," 4to., 1841.—*Ed. Geologist.*

‡ Murchison's Mineral Conchology, fig 172.

an immense quantity of hardened nodules; and, whilst the subjacent beds are so prolific in species of Ammonites, this on the contrary, abounds in bivalve shells. It contains indeed a greater number of species than all the other beds united, and amongst the number we have, *Arca* (2)—*Modiola* (2)—*Gervillia* (2)—*Terebratula* (2)—*Ostrea* (1)—*Gryphæa* (1)—*Unio* (1)—*Avicula* (2)—*Pholodomya* (1)—*Lutraria* (2)—*Hippopodium* (1).

The Hippopodium of this bed differs very materially from that found in the lower beds of the lias, in having the beaks of the shell larger and more remote. We have hence called it *H. divaricatum.*

The remaining fossils of this bed include *Belemnites* (2)—*Nautilus* (1)—*Ammonites* (3)—*Pentacrinus* (1).

F. A bed of stiff blue clay, ten feet in thickness, succeeds the characteristic fossil of which is a small variety of *Plagiostoma antiqua.*

II. *The Middle lias.*

The lias marlstone follows next, and is so distinct in its lithological character, and furnishes so many and such varied fossil remains, that it claims a somewhat lengthened notice. It is composed of several beds of marls and clays, and dips at an angle of 12°. It may be traced along the whole range of the Cotteswold, except where it is covered by the debris of the oolite, resulting from the numerous slips which have taken place in that formation. The oolite outlier of Bredon rests upon this bed, and it also appears at the base of Dumbleton Hill, again is lost by the intervention of a valley, after crossing which it crops out in the lower portion of the Cotteswold range during its entire length, until it is again separated by slight valleys, and subsequently re-appears, and forms the base of some small hills to the S., as at Churchdown, Robin Hood's Hill, &c.

The remains of vegetable substances also occur, together with those of animals; the wood is mostly in the form of lignite of a black colour, but so broken that it is impossible to discover the species of plants of which it is formed. Professor Sedgwick, in whose company we found several specimens, distinctly stated several of these remains to have belonged to the genus *Coniferæ*.

The following is a list of the principal shells, etc. found in this formation:

Univalves, ten species—Multilocular-*Belemnites* (1)—*Nautilus* (1)—*Ammonites* (12)—*Crinoidea Pentacrinus*(1)—Bivalves—*Pecten* (4)—*Plagiostoma* (4)—*Lutraria* (3)—*Ostrea* (2)—*Plicatula* (1)—*Cardium*(2).

III. *The Upper Lias or Alum Shale.*

This formation rests immediately upon the bed of marlstone just described, and forms the upper stratum of the two hills of Dumbleton and Churchdown; it is of a light blue colour, one hundred feet in thickness, and contains large concretionary masses of lias of a blue colour, conchoidal fracture, and traversed by veins of carbonate of lime.

It contains abundance of *Ammonites communis*. The upper lias is also traversed by a seam of hard stone, ten inches thick, containing the remains of fishes of the Sauroid family.

The following is an admeasurement of the beds forming the upper lias formation and marlstone beds of Dumbleton Hill by George Kleigh, Esq.:

	ft.	in.
1. Vegetable mould	1	0
2. Stone coloured clay	2	0
3. Dark brown clay	3	0

In the lower portion of the second, and upper portion of the third of these beds, masses of fossil marl are found, containing the remains of fish.

		ft.	in.
4.	Blue clay	3	0
5.	Light coloured clay, containing calcareous nodules, which enclose Ammonites communis	2	6
6.	Blue clay, separated from the above by a very narrow streak of dark blue clay	2	0
7.	Fine bright yellow sand	0	3
8.	Marlstone, of a blue colour	4	0
9.	Thin band of clay		
10.	Marlstone, of a looser texture	1	3
11.	Marlstone, lower beds abundant in fossils	1	8
12.	Light brown	2	0
13.	Clay	3	3
14.	Yellowish clay, containing hard calcareous nodules	2	6
15.	Marlstone	2	9
	Dip. N. N. E. Total	31	2

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY OF LONDON.

Wednesday, 3rd November, 1841.—The meetings recommenced this evening, R. J. Murchison, Esq. President, in the chair. The following communication was read, viz.:

"*A supplement to a paper, entitled 'A Synopsis of the English Series of Stratified Rocks inferior to the Old Red Sandstone,' with additional remarks on the relations of the Carboniferous Series and Old Red Sandstone of the British Isles.*" *By Professor Sedgwick.*

The author commences his paper by stating that his former synopsis is now modified; 1. By the new classification of the stratified rocks of Devon and Cornwall; 2. By a larger knowledge of fossils, derived from some of the groups described; and 3. By new observations made during the past summer in the south of Ireland, the south-west of Scotland, and the north of England.

New Red Sandstone.—The upper part of this series of strata is shown by sections derived from Warwickshire, to be sometimes unconformable to the lower portion which represents the magnesian limestone and inferior beds; and the latter division is also shown to pass into the coal measures, the intermediate strata being loaded with common carboniferous plants. In the neighbourhood of Whitehaven, however, there is no passage from the lower new red sandstone into the coal measures, though the carboniferous flora apparently existed in full perfection during the period in which the former strata were deposited. The new red sandstone of Dumfriesshire is shown to be continuous with that of the plains of Carlisle, but the lower divisions of the series are considered to be wanting. The strata near Dumfries are stated to be mineralogically the same as those of Corncokle Moor, and to contain impressions of footsteps. To the north of the Galloway chain, the new red series occurs at very few localities; and, coupling this fact with the great development in many parts of Scotland of red sandstones of the carboniferous series, the author concludes that the highest stratified beds of Arran do not represent the new red sandstone, but a portion of the coal measures, though there is no counterpart in England of the upper conglomerate of that island.

Carboniferous Series.—The carboniferous series of Scotland is stated to be divisible into the three following groups:—

1. The rich deposits, with numerous beds of coal, presenting in their characters the closest analogy to the English coal-fields, though their exact position in the geological sequence cannot be determined. 2. A great group, forming the base of the most productive coal measures, and containing beds of coal of an inferior quality, also many thin bands of limestone, alternating with sandstones and shales, and having generally thick beds of limestone at the top. 3. A variable deposit of red sandstones, shales, &c., containing, in the higher portions, coal measure plants, with even thin beds of coal, and

passing downwards by insensible gradations into the old red sandstone.

Wednesday, 17*th. November*, 1841.—R. J. MURCHISON, Esq., President, in the chair. Professor Sedgwick continued his remarks on the above subject, viz.:

Old Red Sandstone.—The extraordinary irregularity of this formation in the British Isles is first noticed; the old red conglomerates of Cumberland are then compared with those on both sides of the Galloway chain, and the sections in the south of Ireland, connecting the old red sandstone with the carboniferous series, and constituting a good passage, are next described. The lower carboniferous shales there pass into roofing slates, resembling the black slates at the base of the Devonshire culm measures, and the great coal field, in the west of Ireland, overlaying the mountain lime stone, assumes the characters of the same culm measures. From the details connected with the above statements, Prof. Sedgwick draws the inference, that no new formation can be interpolated between the old red sandstone and the carboniferous series, the sequence of strata being complete; and as the sections in the Silurian country described by Mr. Murchison, show that no member is wanting between the old red sandstone and the Ludlow rocks; there is, consequently, one continuous, unbroken succession from the lower division of the new red sandstone down to the Llandeilo flagstone; and, therefore, that the argument for the true place of the Devonian system is complete, for any formation with fossils, intermediate between the carboniferous and Silurian systems must have an intermediate position—must, therefore, be on the parallel of some part of the old red sandstone, which fills that whole intermediate position.

Sections of North Wales.—The author, after referring to his former description of the great masses of North Wales, states that his Snowdonian fossils have been found to be identical with Silurian species, and that the same result has been obtained from an examination of the organic remains of the Berwyns; hence he concludes, that, in the great section of North Wales, there is no positive geological distinction in the successive descending groups, the only difference being the gradual disappearance of species which occur in the higher beds.

Cumbrian Groups.—The groups exhibited in a section from Keswick through Kendal to Kirby Lonsdale are—1st, that of Skiddaw Forest; 2nd, a group essentially composed of quartzose and chloritic roofing slates, associated with innumerable igneous rocks, and bounded by calcareous slates, which extend from the south of Cumberland to the neighbourhood of Shap Fells; 3rd, a great series of beds, ranging from the calcareous slates to the carboniferous series, and separated provisionally, by the author, into two divisions; the lower consisting of slates and flagstones, with occasionally thick, hard, arenaceous strata, the fossils containing many species characteristic of the lower Silurian rocks, and the upper being composed of arenaceous flagstones, with beds of hard greywacke, calcareous matter occasionally occurring, but no beds of limestone fit for use. The fossils of this division contain numerous species belonging to the upper Silurian rocks of Mr. Murchison, or to the beds which have been considered to form the base of the old red sandstone in Shropshire. From the above specific determinations of organic remains, the author says, the following definite information is obtained, viz., that the lower division is lower Silurian, and that the upper ends at the very top of the Silurian system. Two other sections are then briefly noticed. One from the Shap granite through the fossiliferous slate of Howgell Fell, the beds of which are placed in the upper division of the upper Silurian system, but not the highest part; and the other from the western boundary of the calcareous slates to Ulverston, including, 1, the calcareous slates (Caradoc) of Millom, in Cumberland; 2, quartzose flagstones ; 3, the roofing slates of Kirby Julith; 4, a second band of calcareous slates with lower Silurian fossils; and 5, an upper series of flags and slates which reach to the neighbourhood of Ulverston. The last beds are overlaid by strata of a coarse composition, but which, in a section continued to Morecambe Bay, do not show any upper fossiliferous bands.

Ireland and South of Scotland.—Some sections in the counties of Waterford and Kerry, are then briefly noticed. They exhibit a fine sequence of lower Silurian rocks, but the connection with the older non-fossiliferous slates is not visible.

Mourne Mountains—Galloway chain, &c.—After a few details on the physical features and mineral composition of Downshire, Mr. Sedgwick describes the chain, extending from the Mull of Galloway to St. Abb's Head. The prevailing strike of this range, like that of the Mourne Mountains, is about north-east by east, even in the neighbourhood of protruded masses of granite. The strata consist generally of a hard, fine, or coarse greywacke passing occasionally into roofing slates, and destitute of fossils, except in the finer schists, in which the *Graptolites foliaceus* has been found. The strata which break out from under the carboniferous basin of Girvan water, in Ayrshire, are next described, and shown to contain many Silurian fossils. Lastly, a synoptical table is given of the great groups ranging from the carboniferous series to the lowest beds of the north of England, the classification being as follows:—1. The carboniferous series. 2. The old red sandstone (Devonian system). 3. Silurian system. 4. The sub-Silurian, or Upper Cambrian. 5. The lower Cambrian, including the great groups of North Wales below the Bala limestone and the older roofing slates of Cumberland. 6. The lower-Cumbrian or Skiddaw slates, and containing provisionally the chloritic slates of Anglesea and Caernarvonshire.

The Secretary read a letter addressed by Mr. Lyell to Dr. Fitton, containing remarks "on some of the Phenomena connected with the coal measures and older strata of Pennsylvania."

Mr. Lyell's attention, from the period of his arrival in America to the date of this communication (15th October), had been principally devoted to the great succession of Silurian, Devonian, and Carboniferous rocks of Pennsylvania and New York, but he confines his present remarks more particularly to the phenomena presented by the coal measures, and the extension to America of Mr. Logan's generalisations respecting the beds of fire-clay containing *Stigmaria,* which occur beneath each stratum of coal in the Glamorganshire coal-field. Mr. Lyell first visited the collieries of Blossberg, on the extreme northern frontier of Pennsylvania, and in the examination of which he was assisted by Dr. Saynisch, President of the Mines. The strata, both in detail and as a whole, bear an exact analogy to the British coal measures, and he found beneath every seam, except one, a bed of fire-clay, varying from one to six feet in thickness, and containing abundance of Stigmaria, with their leaves attached to the stem. All the specimens seen *in situ*, with one exception, were parallel to the planes of stratification, but the leaves penetrated the clay in all directions. The roof of the coal seams is usually composed of bituminous shales, but sometimes of very micaceous grits which afford a great variety of ferns and other plants, all of them agreeing, generally, at least, with those common in British coal measures. Mr. Lyell afterwards examined the anthracite deposits at Pottsville, in the southern part of the Alleghanies, under the guidance of Professor H. D. Rogers, also the coal-field of Tamaque, the Lehigh summit mine, the Room Run Mines, on the Nesquahoning, and the Beacon Meadow, or middle coal-field—in all of which districts he found beneath each coal seam a bed of fire-clay containing Stigmaria, and in the overlying sandstone, or roof, various specimens of ferns. Mr. Logan has likewise lately made a series of independent observations on the carboniferous deposits of North America, and Mr. Lyell announced that that gentleman has found beds of fire-clay with stigmariæ under the coal seams of Nova Scotia. The Pottsville district and the Lehigh summit mines were illustrated by sections given to Mr. Lyell by Professor H. D. Rogers, who has been engaged during five years in the Government geological survey of Pennsylvania. The former section extended from the north of Pottsville to the country ranging immediately south of Orwigsburg. At the point where Mr. Lyell's examination commenced, the coal measures are vertical; but, in an excavation from which the anthracite had been removed, the bed occupying the position of the underlay presented impressions of stems and leaves of Stigmaria, unaccompanied, as usual, by any other plants, and the stratum which represented the roof of coal contained leaves of *Pecopteris*, reed-like impressions and *Calamites*. To the south of these vertical measures is a deposit, inclined at an equally high angle, of quartzose conglomerate, beds of which alternate with seams of anthracite at the junction of the two deposits. Proceeding further southward, there are displayed successively—1. A vast series of red shale, grey sandstone, and red sandstone, which Mr. Lyell considers as portions of the old red sandstone; and 2. Olive coloured shales, with Devonian fossils, the strata of the whole of which are nearly vertical. Yet further south, and at a short distance from Orwigsburg, the olive shales are succeeded by highly inclined strata, assigned by Mr. Lyell to the upper Silurian rocks, and through which protrudes an axis of beds, considered by him to be composed of lower Silurian strata. Lastly, on the southern confines of the section is a trough of Devonian or olive coloured shales. The above geological classification differs from that of previous observers, but Mr.

Lyell has been induced to propose it in consequence of an examination of a portion of the state of New York, subsequently to his visit to Pottsville. At the "Lehigh Summit Mines" a bed of anthracite, more than forty feet thick, is quarried in open day, forty feet of sandstone being entirely removed to work the coal. With respect to the long observed fact, that the anthracite coal is confined to the Atlantic side of the Alleghanies, and the bituminous to the more inland and less disturbed region; and with respect to the supposition that the former belonged to the transition, and the latter to the secondary period, Mr. Lyell states, that both varieties clearly overlie the old red sandstone, and contain the same vegetable remains; and he is of opinion, that the change from the bituminous to the anthracitic condition was a concomitant of the upheaval and folding of the rocks, the conversion being most complete where the beds have been most disturbed. Mr. Lyell has also examined the cretaceous strata of New Jersey, accompanied by Mr. Conrad, and he states that the fossils which he collected from its different members, bear a striking analogy with those of the equivalent series of Europe, especially of the traie-tufeau of Normandy. He has likewise examined, in company with Professor Siliman, the new red and intrusive, trap in Connecticut; and, lastly, he has visited the falls of Niagara, and is of opinion that he can prove their recession by new arguments, drawn from the position of a fluviatile deposit which he has traced below the cataract.

GEOLOGICAL SOCIETY OF MANCHESTER.

Thursday, 28th October, 1841.—The third annual meeting was held this evening, Dr. Black in the chair.

In the report which was submitted on this occasion, the Council announced the publication of the first part of the Transactions of the Society; the adoption of the petition addressed by them to the Master General of the Ordnance, inasmuch as he had conveyed to them an intimation of his intention—"that the portions of Lancashire and Yorkshire that have been already surveyed and not engraved, shall be laid down on the scale of six inches per mile, after being again surveyed;" the proposed visit of the "British Association" in June 1842; and the offer of Mr. Looney to lecture on the construction and principles of safety lamps, and the circumstances under which they are really safe or dangerous, at the most important mining towns of Lancashire.

Mention was also made of the additions to the Museum, and the operation of the circulars addressed by the Council to the proprietors of collieries and quarries in the neighbourhood, which had as yet only produced three satisfactory replies. "It is, however, to be hoped that the publication "of the transactions will convince the owners and occupiers "of the collieries in this district, that the Manchester Geolo-"gical Society is worthy of their support."

Lastly, the report contains the particulars of the premiums for the first and second best vertical sections of the coal strata in the districts of Yorkshire, Lancashire, and Cheshire, and the terms of competition.

On the motion of John Moore, Esq., the above report was adopted. Mr. Bowman submitted a communication on the former existence of glaciers in North Wales, which having been duly acknowledged, and the usual votes of thanks presented to the Donors to the Society and the Chairman, the meeting separated.

The officers elected at this meeting for the ensuing year, are as follows, viz.:

President—James Heywood; *Vice-Presidents*—R. Thicknesse; J. E. Bowman; Lord F. Egerton, M.P.; Lord Vernon. *Treasurer*—G. W. Ormerod. *Auditors*—S. E. Cottam; T. Kirkman. *Hon. Secretaries*—E. W. Binney; J. F. Bateman.

Thursday, November 25th. 1841.—J. Heywood, Esq., President, in the chair. Mr. E. W. Binney, one of the honorary secretaries read a letter which he had received from Lord F. Egerton, in which his Lordship stated that, if the members wished to visit the tunnel, he would be happy to provide them with a boat for the purpose.

The chairman then called on Mr. F. Looney to give the outline of the lecture he had promised, upon which the latter gentleman proceeded to explain that his attention had been directed to the subject of safety lamps, by finding, from considerable intercourse with colliers, that the most deplorable ignorance prevailed among them, as to the use of the safety lamp. He was persuaded, he said, that most of the dreadful accidents which so frequently occurred in coal-pits, were owing to the ignorance of colliers on this head; and he thought a few simple lectures, on the properties of hydrogen and oxygen, the nature of the safety lamp, and the necessity which always existed for having their lamps in good order, might be of much use in preventing those accidents.

A desultory conversation followed, in the course of which Mr. Looney stated, that he intended to commence his lectures on Friday or Monday se'enight. The first lecture would be delivered at Flowery Field; his next at Dukinfield, then Oldham, Ashton Road, Ringley, Clifton and Worsley.

A vote of thanks having been given to Mr. Looney, the meeting terminated.

REVIEWS.

Transactions of the Manchester Geological Society, Vol. I. London: Simpkin and Marshall;—Manchester: Simms and Dinham, 8vo. cloth boards, 1841.

We heartily congratulate this young and excellent Society on the publication of their first volume of Transactions, the contents of which augur most favorably for their future success. Established in a district possessing many advantages for collecting information relative to structural Geology, and surrounded with means for acquiring that knowledge, it is to be hoped that the efforts made by this Society, will be as effective as they are energetic, in inducing the owners and occupiers of Collieries to contribute towards the formation of a museum of local geology, of the first importance to the public and themselves; and also towards the special examination of the Lancashire coal district.

In the volume before us, much valuable information on the subject generally is to be found in the essays by Mr. Binney, whilst the papers on other geological subjects, although less intimately associated with the district, possess great intrinsic merit and utility.

Belemnites des terrains crétacés inférieurs des environs de Castellane, (Basses Alpes), considérées Géologiquement et Zoologiquement par J. Duval-Jouve; Paris, Fortin, Masson et Cie. 4to. 1841.

This work, in common with others relating to the Science of Palæontology, which have recently issued from the foreign press, presents the most complete record on the subject to which it relates, and the style in which it is brought forward is alike creditable to the Author and the publishers.

The first portion of the work is occupied with a description of the geological features of the environs of Castellane, the second part being devoted to a statement of the various conclusions at which naturalists have arrived, as to the nature of Belemnites; whilst the remainder of the work comprises an elaborate description of the Belemnites of the Basses-Alpes.

M. Duval-Jouve, intimates in his Essay on the classification of these Cephalopoda, that he recognises the species by the "symmetric forms, *constant in all stages of growth*, or, in other words, constant in their law of development." Therefore, arguing from the relation which always exists between the beak and the position of the siphon, he states, that a knowledge of the general form of the former is sufficient in itself, to determine the division to which the Belemnite belongs.

Next to the general form, he considers the symmetry and invariable features of development. The width of the alveolus, he states to be an excellent distinguishing mark.

The characters of the beak are those next to be observed ;—in the first place he ranks the termination of the edges of the cavity, and secondly, the forms of the region of the alveolus, which is constant both in families and species.

The ventral canal being a form resulting from the presence of an organic structure in the animal, the features which accompany it also furnish distinguishing characters, such as its depth, relative length, form of termination, and the angle of the sides.

The apicial line is also to be considered, as being straight or curved, central or otherwise.

Lastly, the posterior termination furnishes an excellent character, as being more or less central, sudden, or acuminated.

Whilst all parts of the beak furnish characters by which the species may be recognised, their relative value being determined by the part nearest the organs essential to the life of the animal, M. Duval-Jouve attributes a greater degree of value to the general bearing as a distinguishing mark.

Upon these principles the Author of this work has classified the Belemnites, which occur in the cretaceous groups of the environs of Castellane, of each of which he gives a concise, yet comprehensive description; containing the specific characters, their localities, &c. as also remarks on mal-formed species or monstrosities.

We should be transgressing our proposed limit, were we to insert the descriptions given of the characters of the families, groups, and species of the district, but in order to give a correct statement, we have added a tabular view of them from the work before us.

Families.	Groups.	Species.
I. Bipartites.		Belemnites bipartitus. (Deshayes.)
II. Notosiphites.	I Polygonates.	B. isoscelis. (Duval.)
		B. urnula. (Duval.)
		B. trabiformis. (Duval.)
		B. sicyoides. (Duval.)
	II. Plates	B. hybridus. (Duval.)
		B. dilatatus. (Blainville.)
		B. Emerici. (Raspail.)
	III. Semi-plates.	B. latus (Blainville.)
		B. grasianus. (Duval.)
III. Iotriphites.	I. Coniques.	B. extinctorius. (Raspail.)
	II. Cylindriques.	B. Orbignyanus. (Duval.)
		B. subfusiformis. (Raspail.)
		B. pistilliformis. (Blainville.)
		B. platyurus. (Duval.)
		B. semicanaliculatus. (Blainville.)

A geological description of the district is added to the work, accompanied by plan and sections, so that it not only forms an excellent description of the Belemnites generally, but combines the useful appendages of a notice of the geology and the Belemnites of the district.

In closing our short notice of this work, we would direct attention to the plates, both as accurate delineations of the species and specimens of lithography, as also on account of the great variety of forms represented.

MONTHLY NOTICE.

1st. February, 1842.

In the Philosophical Magazine for December last, will be found a short sketch of the Geology of a portion of Russia, as communicated to M. Fischer de Waldheim in a letter from Mr. Murchison; but as the results will shortly be submitted to the Geological Society of London at greater length, we will not attempt more than a brief recapitulation for the information of our friends. The communication relates more immediately to coinciding observations made along the line of the Veronige and Don by Count Keyserling, and along the Koursk, Orel and river Oka by M. de Verneuil and the author, confirming their individual statements, "that a great axis of Devonian rocks or old red sandstone, of the width of 120 miles at least, rises in the heart of the country, between Veronige and Orel, and stretches to the N.N.W.," in which direction it probably connects itself with deposits of the same age in Lithuania and Courland. This statement not only vitiates the hitherto general idea that central Russia presents a regular succession from older to younger deposits as you proceed from N. to S., but also seems to have an intimate relation, with the discovery relating to a band of upper Silurian rocks near Schavli in Lithuania, proving, as it does, the former existence of two vast basins; hence a difference in the currents and circumstances of both, and a reason is also hereby assigned for the great difference in the carboniferous deposits of the Donetz and Moscow regions. It also proves the symmetry of the opposite edges of the Moscow basin, since in advancing from Jula to Kaluga on the S., we see the same ascending order as that in the Waldai Hills; in both tracts the Devonian old red rocks, with many fishes and shells of that system, well known in the British Isles, pass under the lowest strata of the carboniferous era, and serve as the base line for thin beds of coals, associated with *Unio sulcatus*, and *Productus gigas* (hemisphericus, Sow.)

During the past month the newly discovered fossil remains of an immense quadruped, to which the designation, "*Leviathan Missourrii*," has been assigned, have been exhibited at the Egyptian Hall, Piccadilly, to which we propose devoting a short space, so well for the purpose of recording a description of the characters of the animal, as also for examining the circumstances under which it is purported to have been found, and which M. Albert Koch (the discoverer) has presented in the form of a small pamphlet. The bones were discovered near the shores of the river Pomme de Terre, a tributary of the Osage, in the state of Missouri, in a strata of alluvium, abounding with vegetable remains of a tropical character. The skeleton measures thirty-two feet in length, and fifteen in height, and from the extremity of the head to the spine of the neck six feet. The number of teeth is eight, four in the upper and four in the lower jaw, in addition to two tusks ten feet in length, formed of coarse ivory, forming somewhat of a semicircle from both sides. The fore feet are larger than the hind feet, and the former consists of four toes and a thumb, whilst the latter are deficient of the thumb. All the bones, without exception, are firm, and contain no marrow, the vertebræ are remarkably narrow, and must have given the animal a superior degree of action in the back; this is more strikingly exemplified in the vertebræ of the neck, which gives it the appearance of being very short; the ribs are remarkably small and slender in proportion to the size of the animal, and have had a great deal of cartilage attached to them; whilst this animal is quite distinct from the Mastodon, on account of its having no trunk, and its toes being armed with claws or nails. From these circumstances M. Koch presumes the aquatic character of the animal, in addition to its terrestrial adaptations. The pamphlet is closed by a detail of the relations which this animal bears to the Scriptural account of the "Leviathan," and which has led in part to its designation, and also by statements of Indian traditions relative to its existence and destruction, which is confirmed by the occurrence of rude weapons, &c. The animal appears to have occupied this hitherto disputed place, and we should be inclined to follow the arguments of the discoverer of its fossil remains, were it not, that we considered the concluding paragraphs, detailing the presumed exact date of its destruction, and the like facts, too superficial and as yet not fully substantiated. We understand that the result of more critical examination of the skeleton will, ere long, be submitted to the Geological Society of London, by Professor Owen.

We regret to record the death of John Eddowes Bowman, Esq. F.L.S., F.G.S., &c. on the 4th December last, at his residence Elm Lodge, near Manchester, after a week's illness, in the 57th year of his age. He was indefatigable in the pursuit of knowledge, and his time and talents were most willingly devoted to its advancement. In his geological and botanical investigations he displayed a perseverance, activity, and acuteness, seldom surpassed. Soon after the commencement of his residence in Manchester, he became intimately acquainted with the different cultivators of kindred studies, and, by the activity of his mind and his zeal, no less than by the accuracy and solidity of his own acquirements, proved one of the most valuable and efficient members of the principal scientific institutions of that town and neighbourhood. His exemption from the absorbing avocations of business, enabled him to concentrate his whole attention on objects of science, and to afford a degree of assistance which few have it in their power to give, and the loss of which will long be felt. To those who had the happiness of his private friendship, he was endeared by the amiable cheerfulness and simplicity of his manners, by his unaffected readiness to communicate information, and his generous ardour in behalf of every object and institution connected with the diffusion of knowledge, and the extension of human virtue and happiness. By his associates in the Literary and Philosophical, the Natural History, and Geological Societies of Manchester, his memory will be warmly cherished, and his death will be deeply regretted by the most distinguished members of the British Association, especially when they assemble in that town next year. His communications to the Transactions of the Linnæan, Geological, and other Societies, will form lasting evidence of his acquirements; and we may mention, as one proof of his industrious research and inquiry, that the recently published volume of the Transactions of the Manchester Geological Society, contains no fewer than four able articles from the pen of Mr. Bowman, all of them read before that Society within a few months; namely, on the origin of coal; the characters of the fossil trees on the Bolton railway; a white fossil powder found under a bog in Lincolnshire; and notices of the upper Silurian rocks, in the vale of Llangollen.

THE EDITOR.

ORIGINAL COMMUNICATIONS.

ON THE BONES OF THE OX IN BLUE CLAY.

Notice of bones of the ox, found in clay at Gayton Thorpe, Norfolk; communicated by C. B. Rose, Esq. F.G.S.—"In the summer of 1840, I discovered in a clay pit at Gayton Thorpe in West Norfolk, numerous portions of bones so much decomposed, and broken into so many fragments, that, but for two vertebræ in tolerable preservation, I could not have determined that they belonged to a *ruminant* of considerable size. The occupier of the pit being an intelligent man, I informed him what I had met with, and requested him, when he should again require clay for his land, to instruct his men to look out carefully for more bones, and particularly for teeth. This year (1841) they renewed their digging, and had the good fortune to disenter a few more fragments of bone, also the molar teeth complete of the upper jaw, with the incisors, and one molar of the lower jaw; the jaw bones crumbled to a brown dust immediately upon exposure, but by the teeth I was enabled to determine the animal to have been one of the two species of ox, i. e. *Bos taurus* or *B. urus*. The pit is of considerable size, and exhibits a large mass of "till," composed of beds of light coloured clay, having a large proportion of sand (probably from the inferior greensand formation) mixed with it; large chalk flints also occur which have suffered no attrition, and a small assemblage of brown gravel, lying upon the flints. There is no stratification apparent; the bones were found in the sandy clay, about four feet below the surface, which accounts for their decomposed state. The pit is situated on the side of a narrow transverse valley, and upon the lower chalk stratum; the opposite side of the valley is occupied by an extensive accumulation of "Drift" of blue clay, from the Kimmeridge and Oxford Clays, which evidently entered it from the west, and is stratified; it contains a great abundance of minute crystals of selenite.

The bones of ruminants are rarely met with in the drift of this division of the country.*"

* "In the "Hertford Reformer," of the 11th September, 1841, an account was inserted of some fossil remains of the Bovine race having been found in Scotland. We are indebted to our friend George F. Fordham, Esq. for another account of a similar occurrence in the neighbourhood of

Zoological, Geological, and Geologico-geographical considerations on the Ammonites of the Cretaceous period; translated from the "Paléontologie Française," of A. d'Orbigny. Communicated by T. Johnson, Esq.

The study of fossil organic remains is frequently confined to imperfect descriptions of species, without entering into enlarged zoological or geological views on the subject; and these descriptions, often incorrect, served notwithstanding as a base for geological applications, which, on that account, might not only perpetuate errors, but might also induce geologists to attach to them less importance than they really deserved. The ammonites were especially in this condition, and the genus was in an inextricable state of confusion, notwithstanding the figures of Sowerby* and the monograph of M. de Haan,† when Leopold von Buch recognized in these organized bodies, the internal important characters, which had until then been neglected, but which he considered might be usefully applied to the determination of the species. In three successive memoirs,‡ this illustrious naturalist occupied

Sandon Bury, Herts, and in whose possession they now are. These remains consist of two perfect horns, and a part of the skull of a large animal belonging to the Genus *Bos*; the horns are 27½ inches long, and measure 15 inches in circumference at the place they are inserted in the skull. At the same time were found portions of the antlers of the Reindeer. The whole of these specimens were discovered at one spot, and in the chalk, a few feet below the surface. They do not appear, however, to have been actually imbedded in the chalk strata, but to have fallen into a large fissure or rent, which was subsequently filled up.—*Ed. Geologist.*

* Mineral Conchology of Great Britain.

† Monographiæ Ammoniteorum, 1825.

‡ Annales des Sciences Naturelles, 1829, tome 17, p. 267. Loc. cit. tome 18, p. 417, et tome 19, p. 5.

himself in describing the lobes and saddles of the septa of ammonites, and applied them to the formation of groups, divided according to these characters. Nevertheless, owing to the perishable nature of these fossils, and the difficulty of studying them collectively and with general views, Naturalists have been prevented occupying themselves usefully in their study. The publication of the "Paléontologie Française" having placed an immense stock of materials at my disposal, I have been engaged, for a whole year, in a minute examination of ammonites, in a zoological and geological point of view. The comparative study of a *hundred and forty-four species* of ammonites from the cretaceous rocks, and of at least an equal number from the Jurassic formation, and of thousands of individuals of all ages, have enabled me to discover many facts which appear to me interesting by their application to Geology, and on account of the zoological characters of species, where examined with reference to the external and internal modifications arising from age, sex, or change in individuals. I intend to give the results of this extended research, in the hope of enlightening science relative to beings which have totally disappeared and which are only found enclosed in the beds of the earth's crust.

ZOOLOGICAL CONSIDERATIONS.

§ 1.—THE EXTERNAL CHARACTER OF AMMONITES.

Composition of the shell.—The shell amongst the ammonites, and I may also remark in all the family of *Ammonidæ*, is very different in its texture from that of the *Nautilus* and *Spirula*; for example, in the latter genera, it is composed of two very distinct portions, the one internal, always nacreous, and brilliant, of which the septæ are always formed; the other external, thin, opaque, ornamented, (amongst the Nautili) by coloured zones. From collecting a great number of fragments of Nautili, Ammonites, and Hamites, from the beds of clay and gault of the Boulonnais, where these fossils are admirably well preserved, and studying them on the spot, I observed that fossilization had not changed the two distinct coats of the shell of the Nautili in the least, whilst the ammonites always presented the nacre uncovered, without the opaque external pellicle. As I have observed in *A. denarius, lautus, auritus, splendens, cristatus, Bouchardianus, tuberculatus,* etc. and have found the nacre is always uncovered in *Hamites attenuatus,* and it shews externally the lines of growth; so, besides the distinguishing character already observed, the Ammonites have a very distinct structure in their shell, which appears to be common to all the genera having a dorsal siphon, and sinuous or foliated septæ (cloisons découpées) composing the family of the Ammonidæ.

Thickness of the Shell.—In general the shell of the Ammonites is thin; but there are many exceptions to this rule, and I possess some, the thickness of which, especially on the sides, is not less than five millimetres. The thickness is exceedingly variable according to the species and the particular part of the specimen. If there are ribs, transverse points of junction, tubercles, spines, or no matter what asperity or salient portion, the shell is always thickest at that part and often double the thickness of the rest. I think I can explain this fact by the necessity the animal would feel of levelling, by an internal addition, the internal surface of the shell, so as to render it more commodious, in the same way as we observe amongst the gasteropodous and acephalous mollusca.

Differences between the internal mould and the external appendages of the shell, determined by the irregularity in thickness of the shell.—What I am going to observe as to the unequal thickness of the shell according to the parts, amongst the Ammonites, is not of limited interest, but is applicable to very important considerations on the enormous differences which we remark between the internal cast of the shell and the various external appendages. If the internal deposit of matter which thickens the shell within was uniform, it would follow that the extraneous matter deposited therein, after the death of the animal would give an exact representation on the cast of the external appendages of the shell; the ribs would there appear as angular, the spines as salient; but the best proof I can adduce of the inequality of this internal thickening by the animal, is, that such species as have the shell strongly striated, are frequently entirely smooth in the state of a cast, as we see in *A. Velledæ, latidorsatus, Mayorianus, Duvalianus, Juilleti, Calypso, Guettardi, etc.;* the sharp spines which likewise ornament the shells of others disappear entirely in the cast, where they are sometimes represented by a faint appearance of a tubercle, as we observe in *A. Clementinus, mammillaris,* and *Lallierianus.* It follows from this difference, between the cast and the shell, that the greater or less saliency of the ribs or spines, their presence or absence ought not to authorize the creation of a new species unless we are enabled to study a great number of individuals in different stages and states, or unless it is authorized by very marked characters in the lobes or form of the spiral coil-or arch.

Modifications of the external characters of Ammonites.—These modifications arise from many causes, from the natural variable limits of species or varieties, from accidental circumstances, and from age or sex. I shall treat of these different questions under separate heads.

Natural varieties.—The limits of true varieties amongst the Ammonites are more or less extended, according to the species. There are some of which all the individuals present identically the same external appendages, when they have arrived at the same stage of growth, and this is the general rule; whilst others offer remarkable differences, leaving at the same time similar characters in the lobes and convolutions. In the first class may be placed *A. Beaudanti, grasianus, quadrisulcatus, semisulcatus, Mayorianus, etc.*, where I have not observed the slightest difference in hundreds of specimens; but I will only quote a few amongst the species which vary most according to age or sex. If, at the same diameter, the number of ribs or tubercles be generally the same, as in *A. Fleuriansianus, denarius, etc.*, there is at least a marked difference in the greater or lesser degree of compression of the shell. In the second series there are many Ammonites which, when arrived at the same diameter, have the ribs more or less salient, or on the contrary attenuated, as in *A. lautus, Rhotomagensis, varians, Mantellii, cristatus, verrucosus, etc.*, or a greater number with alternating ribs, as we find in *A. Mantellii, Rhotomagensis, varians, Astierianus, inflatus, interruptus, Martinianus, mammilaris, etc.* Other modifications which are more rare and entirely exceptional, are those which we principally observe in *A. latidorsatus*, in which species certain individuals, when arrived at the same diameter, are smooth sometimes, and at others furnished with transverse ribs. This ammonite is also one of the few species in which I have observed remarkable differences in the convolutions, in individuals of the same age and diameter. There is therefore no fixed rule as to varieties, as their number is greater or smaller according to the species. It remains for the observer to search for the true limits of these varieties or species in the internal characters of each.

Accidental varieties.—This series of modifications gives rise to the most extraordinary changes. They originate from injuries or wounds received by the animal during its existence, which interrupt the regular construction of its shell, entirely remove certain external appendages, and cause new ones to appear, or render the two sides of the shell very unequal. When these modifications deform the shell and destroy its symmetry, it is easy to perceive that they arise from an injury received by the animal; deformed specimens of *A. serpentinus, Brogniartii, radiatus,* and *Humphreisianus, etc.,* which I possess, furnish sufficient proof of this; but when these changes take place on the mesial line of the back, and change the form of this part entirely, the shell being to all appearance quite regular, we do not then possess any means of distinguishing the malformation, and we run considerable risk of making an useless extension of species, unless we have sufficient courage to break the specimens to assure ourselves whether the internal whorls are the same. The most extraordinary example which I can cite of this latter mode of change is an individual of *A. interruptus* (Pl. 2. Fig. 1.), where a species having a dorsal canal and the ribs terminating in the middle of the back and alternating on each side of the mesial line, has become an Ammonite having a round back, with the ribs passing entirely over from one side to the other. Some doubts having been expressed on this extraordinary anomaly, I broke the specimen, and found that the internal whorl instead of having the ribs passing over the back, as in the last whorl, was provided in the preceding whorl with the dorsal canal and the alternating ribs common to *A. interruptus.* This exemplifies the need of extreme caution; it is therefore indispensable, when we find in any formation, an Ammonite of anomalous form, to be well assured that all the whorls have the characters proper to each period of growth, and that this anomaly is not caused by an accidental deformity.

Varieties from sex.—All who have studied Ammonites carefully have remarked that individuals having externally the same ribs, spines, and distributions of ornaments, have at equal diameters, sometimes a very tumid and at other times a greatly compressed form. Superficially observed, these differences have sometimes been made a motive for the creation of species purely nominal, as we may judge by compressed or tumid individuals of *A. interruptus, denarius, Mantellii, varians, etc.* In the examination of a great number of specimens of each species, the distribution of the lobes convinced me that no alteration in this important character was caused by the greater or less degree of compression, and that these individuals belonged to the same species. The idea then struck me, from the analogy to what we observe in Oliva and the other genera of the Gasteropoda, where the sexes are separate, that these modifications might depend on the difference of the animals inhabiting the shells; that the most compressed specimens doubtless had belonged to the males, whilst the tumid ones were those of the females. The animals of the latter sex being always larger and shorter among the acetabuliform Cephalopods, on account of containing the eggs, I thought it probable that it was the same amongst the Ammonites, of which the shell had necessarily followed the volume of the sex which had inhabited it. Once convinced of this fact it remained to assure myself of the other external modifications which generally accompany the sexes, and their limits. I remarked, for example, that the shells of the males at the same diameter have almost always the ribs more numerous, and that the inner tubercles approach much nearer the umbilicus, whilst, among the females on the contrary, the ribs are wider apart, and the tubercles further removed from the umbilicus and more salient *(A. interruptus, denarius, Mantellii, varians, Rhotomagensis).* The difference of the sexes also produces some modifications in the convolutions in some species; I have observed that *A. denarius, interruptus, latidorsatus,* have the external whorl much larger in proportion to the entire diameter in compressed individuals than in tumid ones, nature having doubtless thus given a slight compensation of internal volume. Thus the difference of the sexes may cause a greater or less compression of the shell, approximation or separation of the ribs and tubercles, render them more numerous on a whorl, and sometimes change the relative size of the last whorl to the whole diameter.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY OF LONDON.

Wednesday, 1st December, 1841.—R. J. Murchison, Esq. President in the chair. The following papers were read, viz.:

"*An account of the destruction of the town of Praya de Victoria in the island of Terceira on the 15th June,* 1841." *By J. Carew Hunt, Esq., Consul, communicated by the Earl of Aberdeen.*

"The town of Praya was situate at the east end of Terceira, and consisted of 562 houses. Since 1614, when Angra (the capital of the island) was damaged and this town totally destroyed, it had sustained no injury from earthquakes, although several had been felt. On the 12th June 1841, at 4 p. m. and at 20 m. past 5 p. m., violent shocks were felt at Praya, as also during the whole of the 15th. At 4 p. m. on the 14th, an undulation of the ground was perceived which threw down several houses. During the remainder of the day the island was undisturbed, save by a few slight shocks, but at 3 p. m. on the 15th violent tremblings accompanied by horizontal movements commenced, and continued at intervals of ten minutes till half past 3, when a strong vibratory motion destroyed every building which had escaped, as well as several houses and public buildings in other parts of the island. The ground remained comparatively at rest till 20 minutes to 3 p. m. on the 16th, when another violent shock was experienced, and since that period no further damage has been done, although the island did not resume a permanently quiet state till the 26th June. The effects were felt most violently at Praya. Mr. C. Hunt infers, that the shocks having been less and less severe as they ranged westward, from the minor ones not having been observed at the islands of St. George and Graciosa, situated to the west of Terceira, from only those which destroyed the town of Praya having been noticed at the capitals of Pico and St. Michael's to the S.W. and S.E. of Terceira, and from the shocks having been preceded by noises which appeared to come from the eastward, that the centre of action was situated in that direction, at no great distance from Praya; and he further infers, from the shocks which accompanied submarine explosions between St. Michaels and Terceira, and the throwing up of the volcanic island of Sabrina in 1811, that the earthquakes of June were attended by submarine volcanic eruptions."

2nd.—*Geological remarks made during a journey from Delhi through the Himelaya mountains to the frontier of Little Thibet. By the Revd. Robert Everest.*

The route of the author, after leaving Delhi, lay through Seharumpore, the Keeru Pass in the Sevalik Hills, and thence over a tract of country ranging nearly N. by W. to Rampore, in the valley of Sutling; it afterwards followed the course of that valley to the junction of the Leo River, and terminated near the Kealghur Fort, in Little Thibet. Delhi is at the N.E. extremity of a vast quartzose sandstone formation in which no organic remains have been found. From Delhi to the Sevalik Hills (100 miles) the surface consists of an alluvial soil, similar to that now brought down by the Jumna, composed of the detritus of granitic and other ancient rocks. The tertiary strata of the Sevalik Hills are noticed by Mr. Everest only because the mammalian remains found in them do not include any portions of the modern wild elephant of that region. The strata of the Himalaya, upon which the traveller sees across the valley of the Dhoon (15 miles), consist of clay slate, dipping at a high angle to N.E., with dark limestones and indurated sandstone traversed by greenstone veins, in which no organic remains have been found. The road from Mussoori to the Jumna traverses similar rocks, with the addition of greywacke. On the opposite side of the river argillaceous slates again occur, dipping in general to the N.E. Thence to the heights of Deobun, the strata alter but little in character, except that 2000 feet of the summit are composed of a dark limestone, similar to that of Mussoori. The descent towards the Tonse presents slate rocks, intersected by greenstone, dip varying between N. and E.; at the village of Bundah limestone reappears. Mr. Everest noticed numerous boulders of gneiss in the beds of the Tonse and Paber, extending upwards to the height of 200 feet.

Near the confluence of the Nuggur with the Sutling, the author noticed strata of crystalline white quartzose slate, traversed by a mass of greenstone. Two miles above Rampore both sides of the valley of the Sutling consist of quartzose slate, alternating with chlorite and talc slates. Before reaching Seram gneiss appears and extends to Tranda and Nasher, with occasionally intervening masses of granite. A white granite, with mica slate and gneiss extends to Akhbah, at which place is a promontory of clay slate and dark flinty slate. Beyond this point (at which the Sutling bends northward) the clay slate reoccurs.

From Lipi (a short distance from Akhbah) to Leo the clay slates predominate, which at the latter point are traversed with veins of granite, and are converted near the point of contact into mica slate. The descent to the village is nearly 2000 feet, and as lower levels are attained, the granite veins and masses increase, until near the river only mica slate, gneiss, quartzose slate, and granular limestone are visible. Beyond Leo the road ascends over granite and dark mica slate, and the opposite side of the river presents a net-work of granite veins, crossed by black stains derived from the carbonaceous layers. Mr. Everest's journey terminated at the entrance to the hollow in which the village of Chauzo is situated, as they were not allowed to proceed, and therefore could not examine the locality where the *Ammonites* are found, but which he infers, from information derived from the natives, to be situated in black compact limestone and earthy carbonaceous shales.

3rd.—"*Description of the remains of six species of Marine turtle* (*Chelone*) *from the London Clay of Sheppy and Harwich. By Professor Owen, F.R.S.*

Of the six species described, the remains of the first consist of two specimens, one nearly a perfect cranium, and the other a cranium with the carapace and plastron. The almost complete cranium wants only the occipital bone, and presents a strong uninterrupted roof, extended from the parietal spine on each side, over the temporal opening; the roof being formed chiefly by a great development of the posterior frontals. This unequivocal testimony of the marine genus of the animal is accompanied by similar evidence afforded in the large size and lateral aspect of the orbits, the posterior boundary of which extends beyond the anterior margin of the parietals; by the absence of the deep emargination which separates the superior maxillary from the tympanic bone in fresh water tortoises, in the laterally expanded spinous plate of the parietal bones being united by a straight suture to the post frontals along three fourths of its extent, and for the remaining fourth with the temporal or zygomatic element; and still further by the conformation of the base of the skull. The lower jaw exhibits two proofs of the marine nature of the turtle, the dentary piece forming a larger proportion than inland or fresh water tortoises; and the under part of the symphysis being slightly excavated. The outer surface of the carapace and plastron has the same finely rugous character as that of the cranium. The carapace is long, narrow and ovate, and is widest in front, tapering towards a point posteriorly. It is not regularly convex but slopes from the median line in the same manner as in the carapace of the turtle. Eleven of the vertebral plates are preserved, only the two last being deficient, and eight pairs of expanded ribs, the six anterior pairs exhibiting sufficient portions of the narrow tooth-like extremities to determine the marine character of the fossil; it is shown that the last pair of ribs articulates with the ninth, tenth and eleventh vertebral plates, as in the *Cheloniæ*. The sternum though more ossified than in existing marine turtles, yet possesses all the essential characters of the genus. The evidence thus afforded, proves that these fossil remains belonged to a true *Chelone*, but specifically distinct from any now known to exist; and he purposes to designate it, from the shortness of the facial part of the skull as compared with its breadth, *Chelone breviceps*.

The second species is indicated by a cranium possessing a peculiarly prolonged pointed muzzle; but these modifications are proved by the author to demonstrate the marine nature of the fossil as strongly as in the first species; and the palatal and nasal regions to afford further evidence of affinities to turtles. It is distinguished from existing *Chelone* by the narrowness of the spheroid at the base of the skull, and by the form and grove of the pterygoid bones. This fossil Mr. Owen names *Chelone longiceps*.

The third species has been established from a considerable portion of the bony cuirass of a young turtle three inches in length, including the second and the seventh vertebral plates, with the expanded parts of the first six pairs of ribs, and the hyosternal and hyposternal elements of the carapace. It differs from all known chelonites in the greater relative breadths of the vertebral scutes, which are nearly twice as broad as they are long; he therefore proposes the name *Chelone latiscutata*.

The fourth species is indicated by a nearly complete cuirass, and is considered by the author to occupy a somewhat intermediate position between *C. breviceps* and *C. longiceps*, the carapace being narrower and more convex than in the latter, and broader and with a concavity arising from a more regular curvature than in the former. The true marine character of this specimen is shewn in the small relative size of the entire femur, which is attached by the matrix to the left xiphosternal. This fossil Mr. Owen has named *C. subconvexa.*

The fifth species is separable from others by its carapace *more nearly approaching* to that of the *C. mydas* in the vertebral form of the scutes; but still more strongly by the sixth and eighth vertebral plates supporting a short, sharp, longitudinal crest. Mr. Owen proposes to designate this fossil *C. subcristata.*

Besides these remains Prof. Owen describes a skull from the same formation at Harwich, in the collection of Prof. Sedgwick. Its marine nature is proved by the great expansion of the osseous roof of the temporal fossæ; and the share contributed to that roof by the post frontals; but in the oblique position of the orbits, and the diminished breadth of the interorbital space, this Chelonite, is known to approach more nearly to *Tryonix* and *Emys* than the previously described species. From all known existing or extinct Chelones it differs in the greater antero-posterior extent and remarkable flatness of the under part of the symphysis of the lower jaw. This fossil Mr. Owen has named *C. platygnathus.* The author also notices a portion of the carapace of a marine turtle, also from Harwich, preserved in the British Museum.

A review of the facts detailed above leads to conclusions of much greater interest than the previous opinions respecting the Chelonites of the London Basin could have originated. It is obvious, when we consider that the Sheppy Chelonites belong to the true marine genus *Chelone*, and that the number of species of the Eocene extinct turtles already obtained from so limited a space as the Isle of Sheppy exceeds that of the species of Chelone now existing, and that of these only two (*C. mydas, C. caretta*) are known to frequent the same locality, that the ancient ocean of the Eocene epoch was less sparingly inhabited by turtles, and that they presented a greater variety of specific modifications than are known in the seas of warmer latitudes of the present day.

December 15*th* 1841.—R. J. MURCHISON, Esq., President, in the chair. A copy of the great geological map of France, by M. Dufrenoy and M. Elie de Beaumont, accompanied by a letter from those gentlemen, and the 1st vol of the Description of the Chart, was presented to the Society, in their name, by the President.

1. A paper was read, entitled: "*On diluvio-glacial phenomena in Snowdonia and the adjacent parts of North-Wales.*" *By Dr. Buckland.*

Dr. Buckland and Mr. Sopwith state that many evidences of the action of ice may be observed upon the sides and bottoms of all the principal valleys in Snowdonia. In 1824, Mr. T. Underwood made drawings of polished, striated, and furrowed surfaces in the vales of Conway and Llanberis; Mr. Joshua Trimmer also pointed out, in 1836, similar surfaces on slate rocks in the Nantle valley, on the West of Snowdon. Subsequently Mr. J. E. Bowman published an account of striated surfaces of slate rocks near Llangollen and Pen Tre Voelas, although he states that he was unable to discover in North-Wales any evidences of lateral moraines.

Seven principal valleys, taking as many different directions have their origin in that highest district of Caernarvonshire, which forms the district of Snowdonia; viz. the valleys of the Conway, Lugwy, Ogwyn, Sciant, Gwyrfani, Llyfni and Gwynant, and nearly all of these have their sides and bottoms rounded and polished, and scored with striæ parallel to the mean direction in which either a glacier or overwhelming current of water descending each valley would assume under the existing contour of their respective surfaces. High up the valley of the Conway Dr. Buckland and Mr. Bowman found extensive congeries of lofty mounds and ridges of gravel, one of them slightly stratified, which they both thought must have been either diluvium or lateral moraines, modified however by water.

From the falls of the Conway downwards nearly to Llanrwst, the rocks on the right side of the valley exhibit polished, striated and furrowed surfaces wherever it has been laid bare, as well as boss-like outlines similar to those in the beds of existing glaciers in the Alps. Below Llanrwst, on the left side of the Conway, fluted and striated surfaces were noticed in 1824 by Mr. Underwood, on the lofty mountains between the Conway and the Ogwhyn, in a high valley that discharges the water of Llyn Cwlyd, as well as on the limestone of Great Brueshead, in front of the estuary of the Conway.

At the point where the Llugwy, which descends South-West from Carnead Llewelyn, turns at right angles to the S.E., a series of mounds of earth and gravel occur, covered at their summits with hundreds of blocks of stone. The waters of the Gwryd fall into the Llugwy near a lofty mound of gravel resembling a terminal moraine, and just below this junction the rocks are rounded, striated, and polished.

The right flank of the valley of the Ogwhyn near the village of Bethesda presents abundant examples of polished surfaces, fluted and striated in the direction of the valley.

From the summit of the pass of Llanberis to the lower end of the lake Llyn Padaru, the left side of the valley presents a succession of naked rocks rounded by attrition, and striated.

In the same way the table land immediately subjacent to Snowdon on the W., presents numerous polished rocks. The valley of the Llyfni exhibits a few striated surfaces at its upper end, and a finer example of them occurs on the surface of the Dorothea slate quarry at Tal-y-Sarn, near the West end of this valley, below the lakes of Nanty-y-Uef and Llynian. Half a mile N. W. of this quarry, groves and furrows appear on a large horizontal surface of slaty porphyry. Polished and striated surfaces likewise occur on the left side of the valley of Gwynant, and the rocks which occasionally protrude from the bottom and sides of this valley are ground to the condition of huge domes or bosses.

Thus in each of the vallies here described we find two common evidences of glacial action, viz.: the rounded surfaces or striæ and the mounds of gravel, bearing the forms of moraines, and probably modified by water.

Diluvium or Drift.—In the mounds of gravel that have been noticed near Pen Tre Voelas and Llyn Ogwyn, we have as yet found no trace of those two strong evidences of diluvial currents from the north, which consist in the presence of erratic blocks from distant regions, and of fragments of marine shells amidst vast masses of clay and gravel;—both these evidences abound along the N. W. base of the mountain chain of Snowdonia. Mr. Trimmer has found shells mixed with pebbles of Cumberland granite on Moel Tryfan, near Caernarvon, 1,392 feet above the level of the sea, and at more than 1000 feet on Moel Faban, near Bethesda, in the valley of the Ogwhyn. The same shells occur in diluvium along the coasts of Caernarvonshire, Denbigh and Flintshire. Similar shells have been found in the cave of Cefn, near St. Asaph, above the bones of elephants and hyænas; but neither shells of this kind, nor blocks from distant regions have been found on the S.E. flank of Snowdonia. On the N.W. flank a large plain is covered with gravel intermixed with granite and chalk flints from Cumberland and Ireland.

Dr. Buckland attributes all this diluvium or drift to inundations by marine currents from the north, bearing with them floating ice, loaded with detritus from the coasts of Cumberland and Ireland, and he thinks that by referring the glacial and diluvial phenomena of North Wales, as Murchison and Lyall have referred those of northern Europe and North America, and Maclaren those of Scotland, to the combined action of glaciers moving on dry land and marine currents and icebergs drifted chiefly from the north, and depositing their loads of pebbles in more southern latitudes, we may assign to each of these great causes its proper function, without assuming the exclusive agency of either of them. Dr. Buckland concluded with noticing a recent discovery of Mr. Sopwith of striated and polished surfaces of carboniferous limestone covered by drift, and of parallel striæ on a limestone boulder in this drift, at Langley near Haydon Bridge.

2.—A paper was also read: "*on the Bristol Bone bed*" (*in the lower lias near Tewkesbury*). *By Mr. Strickland.*

After some preliminary remarks on the existence of this stratum (consisting chiefly of remains of fishes and saurians) at various places between Westbury Cliff on the Severn, and Watchett in Somersetshire, as also its occurrence at Goldcliff and St. Hilary in Glamorganshire and near Axmouth in Devonshire, Mr. Strickland proceeds to point out its presence between Tewkesbury and Gloucester, at many miles further north than any yet described. The first locality is Coomb Hill, four miles S. of Tewkesbury, where a considerable portion of the bone bed was exposed in 1841, and its contents preserved by Mr. Dudfield of that place. The bone bed which was laid open consisted of the following beds.

	feet	inches
Alternations of lias, limestone and clay . .	30	0
Ditto sandstone and black laminated clay .	2	8
Bone bed	0	1
Black laminated clay	3	6

	feet	inches
Green marl	25	0
Red marl	3	—

The bone bed rarely exceeds an inch in thickness, and is often less. Mr. Strickland is of opinion that the organic reliquiæ were washed into a previously rippled bed of clay, on account of their being broken and worn in many cases.

The next locality is Wainlode Cliff, on the banks of the Severn—the order of the beds is as follows:

	feet	inches
Bone bed	0	1
Light green marl	23	0
Red marl	42	0

The bone bed is far less rich in organic remains, and in this as well as the former only one bivalve has been found, very imperfect.

The third locality is near Bushley, 2½ miles West of Tewkesbury; the black laminated clay of the two other points is there exposed, and includes a bed of white micaceous sandstone, containing impressions of the same bivalve as that above referred to. The lowest part of the laminated clay, rests upon a 20 feet deposit of greenish marl, succeeded by red marl. That this bed of sandstone occupies the position of the bone bed, is proved, Mr. Strickland observes, by the Wainlode section, where the organic remains are for the most part wanting, and replaced by white micaceous sandstone. The stratum at Dunhampstead near Droitwich, consisting of a white micaceous sandstone containing the same bivalve, is also considered to occupy the same position. It appears that, as the bone bed at Axmouth, Watchett, Aust and Westbury, and other southern localities, occupies the same position as the sandstone of Worcestershire, that we have a remarkable instance of a thin stratum ranging in one direction about 112 miles, from Dunhampstead to Axmouth. Mr. Strickland concludes by stating his opinion that this bone bed belongs to the lias and not the triassic series.

GEOLOGICAL SOCIETY OF MANCHESTER.

Thursday, December 16th 1841.—James Heywood, Esq. President, in the chair. The President opened the proceedings by noticing the great loss which this Society had sustained in the lamented death of its Vice President, the late John Eddowes Bowman, Esq. (vide p. 35), and communicated, that a letter of condolence had been forwarded to Mrs. Bowman from the council.

Mr. Binney read a letter from Sir P. de Grey. M. Egerton, Bart, M.P. offering to present a suite of European rocks (510 in number) to the Society. Various donations were also announced from Messrs. Heywood, Westhead, and Black, to whom a vote of thanks was duly passed.

A paper was read, entitled "*Observations on the fossil fishes found in the Manchester coal field*," *by Mr. E. W. Binney*. The Bradford and Clayton coal field, generally known as the "Manchester coal field," is a wedge-shaped area, commencing at a point in Kirkmanshulme, and gradually extending in width till it reaches St. George's Church, and the works of Mr. John Andrew, below Harpurhey, in a line between which two places it appears to have been thrown down by a fault, and covered with the new red sandstone formation. The total thickness of the strata is about 700 yards. Beginning with the upper strata and proceeding in the descending order, in the red marls in the bed of the Medlock, specimens of the bivalve shell (*Unio ?*) so common in those deposits occurred; no traces of *Cypris* or *Microconchus* were observed associated with them, whilst the contrary takes place in the limestone beds and black bass on the small coal. The bass lying above the three quarters coal, is very rich in the remains of fishes mingled with the above named fossils; a few detached scales were found in the basses above the new and two feet coals, as well as in those above the two small seams in the bed of the Irwell. The remains of fishes are shown to occur in strata amounting to 500 yards in thickness; the specimens consist of the genera: *Diplodus, Ctenoptychius, Ctenodus, Gyracanthus*, and many other rays, belonging to Professor Agassiz's *placoid* order; and the *Megalichthys, Holoptychius, Platysomus, Palæoniscus, Cælacanthus* and *Diplopterus*, belonging to the *ganoid* order. Fishes of the latter order were much more plentifully found both in the Manchester coal field, and the bituminous schists of Pendleton, than those of the *placoid* order. After noticing the different proportions in which the above genera occur in the two coal fields named, Mr. Binney observed that the remains of the fishes found in the limestone were nearly in the same condition in which they were first deposited; with the exception of their animal matter, which had entirely disappeared. Their phosphate of lime remained, as well as a great portion of their original carbonate of lime. In the bituminous schists, the specimens were merely casts, having a much brighter appearance than the matrix; all the specimens were fragments, scarcely two of which were met with together; and in no instance had he yet met with an entire specimen in the Manchester coal field. The best he had seen was part of a small *Cælacanthus* met with by Mr. G. W. Ormerod; but in the four feet mine at Pendleton, fishes occurred in nearly an entire state. From the teeth of the fishes there could be no doubt that they were all of predatory habits; hence probably not many died natural deaths; and he had formerly given his reasons for believing that the Pendleton fishes had been poisoned by impure water; he now stated the same opinion with respect to those of the Manchester coal field. Mr. Binney next stated the result of certain experiments made by him, suggested by the occurrence of fossil *Cypris* in connection with the remains of fishes in these strata; having procured specimens of *Cypris ornata*, and placed them in a jar of water, with two live sticklebacks (*Gasterosteus tracharus*, *Cuv.*) he found that the latter commenced devouring the cypris; on reversing the experiment, he obtained the opposite result; hence he concludes that the genus *Cypris*, not only afforded food to fishes, but it acted the part of a scavenger in removing putrid animal matter from our fresh waters; hence also he deduces a satisfactory argument as to occurrence of detached scales, teeth, &c. of fish; but whether the *Cypris*, of the fossil remains of which he had found such abundance in the carboniferous strata, lived in fresh or salt water, it was difficult to say; but the occurrence of *sauroid* and *squaloid* fishes appeared to indicate a marine rather than fresh water origin. It was, however, interesting to discover the provisions made by the Creator to have been then the same as now. From the occurrence of the same fossil fishes, from the Ardwick limestones to the lower coal measures of this deposit—strata 500 yards in thickness—we must conclude that they existed during the vast length of time necessary for the formation of the whole of these strata; but that some causes came into operation at intervals during the formation of the beds of limestone and bituminous schists, which caused their destruction.

On the motion of Dr. Black, seconded by Mr. J. Moore, F.L.S. a vote of thanks was passed to Mr. Binney for his valuable and interesting paper; and the usual forms having been complied with, the meeting adjourned.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.

The first general meeting of the members and friends of this society was held in the Free Grammar School, Dudley, on January 17th, 1842. The Rt. Hon. Lord Ward in the chair.

The noble president being absent at the earlier stages of the proceedings, C. Cartwright, Esq. was called to the chair, and after briefly alluding to the business of the meeting, directed Mr. Blackwell to read the report of the Committee, which detailed among other subjects, the purchase of a suitable building for the valuable Museum of the Society, which comprises a series of the fossils of the district of considerable extent and interest. The report was adopted on the motion of Viscount Lewisham seconded by H. Mathews, Esq., after which the rules of the Society were read and confirmed, and the officers elected for the ensuing year.

Mr. Murchison then proceeded to deliver the inaugural address, in which he alluded, firstly, to the gratification which he felt in the establishment of this institution, which he hoped would confer a lasting benefit on geological science. He next proceeded by stating,

That the two conditions essential to the success of any association were to be found in their town and neighbourhood,—namely, a sufficient number of subjects to excite research, and the existence of persons adequate to their investigation. The value and importance of local museums had already been tested in various parts of Great Britain; and such bodies would, in his opinion, best attain their end, if they endeavoured to illustrate perfectly their own neighbourhood, instead of encumbering their rooms with objects of general interest or curiosity. The attempt to form, in a provincial town, a miniature British Museum must necessarily fail, and could not advance science, for, with every effort to establish a collection which must after all be very imperfect, the time and attention of the active members would be too much withdrawn from the consideration of the natural phenomena which surrounded them. He would therefore encourage them in the course which they had so well begun—a course which promised to render the Dudley Museum the normal school of whatever was most interesting in the geology of the Midland Counties. Amongst the points of geological inquiry to which he would direct their attention, in reference to the interesting district around them, he would mention—first, the illustration of the probable range and extent of the productive coal field beneath the adjacent red sandstone, by the analogy of the structure of the northern counties;

secondly, the importance of extensive geological knowledge in those who sought for coal, in order to prevent local associations of strata from leading to futile undertakings; thirdly, an enquiry into the whole succession of palæozoic strata, and the probable formation of the coal beds, with the formation of which that era terminated; fourthly, by a reference to the boulder stones and gravel which encumbered large portions of this neighbourhood; he would endeavour to show how isolated phenomena were, by geological reasoning, connected with great questions of physical science; and lastly, reverting to the foundation of the society, he would conclude by summing up its useful relations. In no part of England were more geological features brought together in so small a compass than in the environs of Dudley, or in which their characters had been more successfully developed by the labours of practical men, exhibiting the records of the past, the types of primeval life, and the evidences of the mighty operations which marked the more ancient conditions of their planet; or, if they turned from pure geological views to subjects of mineral value, in no region of the globe of the same extent had more wealth been extracted from the earth. If such were the case, then came the questions, to what extent had the means placed in their power been neglected? how far had resources been wasted? and ought not the failure and success of various mining operations to have been registered?

Mr. Murchison next proceeded to notice the coal series of the district, and entered into an interesting comparison between the northern coal fields and those of the central counties, and the opinions entertained by Geologists as to the extent of those strata in the Dudley district. He next alluded to the claim which the society had upon agriculturalists, for, said he, every Geologist holds in his hand the two great elements upon which the advancement of agriculture mainly depended, namely, the principles of drainage, and the decomposition of rocks. It was a difficult matter to convince the practical miner, who had never worked out of his own district, that there was not some connection between the coal of the Dudley country and the silurian limestone with which it was there in contact, so very remarkably did the beds and folds of the one adapt themselves to those of the other. It was indeed a curious fact, that in no one instance which had come within his knowledge were the silurian strata of the Dudley country more highly inclined than the carbonaceous strata which overlie them. If these rocks were in discordant positions, they would be all well aware that geologists would then assume that the lower of these two deposits had undergone great dislocation from its original condition before the accumulation of the overlying strata. After entering into an elaborate and interesting description of the peculiarities belonging to the coal fields of Britain, as compared with those of Russia, and different parts of Europe, exhibiting throughout a beautiful harmony with the principles of geological science, Mr. Murchison proceeded to remark that he had been induced to advert to these facts, which were probably known to most present, by the circumstance, that even recently, attempts had been made in their own district to pierce through silurian rocks in search of coal; and hence the necessity of some indisputable evidence of the age of rocks, which geologists held out as beacons against improvident and foolish speculations. He then passed on to notice the beautiful fossil remains with which their district abounded, and of which the collections in their museum afforded abundant evidence. But what, after all, was the British Association, and what was their own society, but scientific emblems of the whole framework of their social condition? Every Englishman who had been a traveller in distant climes must, he thought, return to his own land impressed with the conviction, that in the virtue and intelligence of her proprietors and middling classes England contained the true elements of her greatness; and looking around him, and judging from the experience of the past, he was convinced that so long as good and patriotic leaders were found mingling with the many, and urging on their improvement, so long would their island, confiding in her own moral strength, stand up as the chosen citadel of well-balanced liberty and intellectual attainment.

At the close of the address, which was warmly applauded, H. Best, Esq. moved a vote of thanks to Mr. Murchison.

The noble Chairman, in submitting the proposition to the meeting, congratulated the town of Dudley upon the establishment of an institution like the present. He could only say with Mr. Murchison, as an excuse for not having commenced their society sooner, that this did not arise from any indifference to the importance of the subject of geological investigation, as was shown by the many private collections which had now been thrown into one, but solely from the want of a spirit of vitality to concentrate and direct their pursuits.

A vote of thanks to Lord Ward having been proposed by Joshua Scholefield, M.P., and carried unanimously, the meeting separated.

REVIEWS.

Geognostische Beschreibung des Landes zwischen der untern Saar und dem Rheine, von J. Steininger. (*Geognostic description of the district between the Lower Saar and the Rhine, by J. Steininger*). *Trier, F. Lintz, and atlas, 4to.* 1840.

This volume contains a general description of the coal series and trap rocks which occur within the district above referred to, as submitted to the " Society for the prosecution of useful Researches, established at Trier," (Gesellschaft nützlicher Forschungen). This district is bounded on the N. (from Mersig on the Saar to Bingen on the Rhine) by the transition shales of the middle Rhine; on the S. (from Kaiserslautern by Homburg and Saarbrücken) by the sandstone of the Vosges; on the W. (from Saarbrücken to Mersig) by the same sandstone and Muschel-kalk, and on the E. (from Kirchheimbolanden to Bingen) by tertiary chalk and sea-sand, being, in extent, about twelve German miles from E. to W., and five German miles from N. to S.

Having premised thus much as to the general boundaries of the district under consideration, we will follow the author in his geognostic description, with a view to detail the more important occurrences recorded in his work; and firstly, with reference to the slate rocks of the middle Rhine, he states that:

" These rocks consist of quartz, clayslate and greywacke, which form the highest elevations, where they are nearest to the coal-measures. These slates were originally deposited horizontally, as proved by layers of fossil remains, consisting principally of *Orthis protensa*, *O. compressa*, *O. lata*, and *Spirifer alatus*, but their present position is at an angle of 60°—90°; this elevation is general, proving the same cause to have effected the change throughout the system."

Passing over the more elaborate details of this series, consisting of relative comparisons between these and other corresponding though remotely situate rocks, which, on that account possess but little intrinsic value, we find the following interesting notice on the Silurian rocks of the district.

"The lower division of the Silurian system is recognised in the greywacke of the environs of Prüm and Daun, whilst the limestone of Schönecken and Gerolstein is, if we may judge from the fossil contents, a part of the middle division of that system; but the upper portion has not yet been traced. As the roofing slates and the quartz rocks of the Hündrücken belong to the Cambrian system, and as the coal strata of Saarbrücken is deposited on these, there is a deficiency, not only of the whole Silurian system of the Eifel, but also of the old red sandstone and the mountain limestone; with this proviso, however, that the limestone in the neighbourhood of Stromberg, and to the N.E. of Kirn, and the fossiliferous quartzose slates of Abentheuer near Birkenfeld leave grounds for supposition, that the Silurian system on the S. side of the Hündsrücken was lowered by convulsions in the line of the quartz rocks, and subsequently covered by the coal strata, and perhaps that it was again disturbed by their formation."

With reference to the coal formation itself, our author gives the following description:

"The stratification of the carboniferous series is generally parallel with that of the slate from Metlach to Bingen, with a fall of 18°—20° S; whilst in the southern portion of the district in question, namely from Saarbrücken to Lebach, and from Münchweiler on the Glau, to Odernheim, the stratification is in the same angle to the north. The only deviations from this rule occur in the neighbourhood of the porphyry and trap rocks, so that the system is most complete at the greatest distance from those rocks."

"The coal series consists principally of grey schist and greyish white sandstone, the former contains bands of dark grey iron stone, generally only a few inches in thickness, separated from each other by many feet of schist, and containing many remains of fish, amongst which are found: *Acanthoides Bronnii, Amblypterus macropterus, A. eupterygius, A. lateralis, A. latus, Palaeniscus Duvernoy, P. minutus, and Pigopterus lucius,* of which the second named is the most plentiful."

"The beds of coal are sometimes 8—14 feet, but are most frequently under two feet in thickness. The sandstone, grit, and iron clay of this series, contain the carbonized remains of extinct plants. In the limestone which occurs occasionally within the limits of the coal series, impressions of plants are rare."

"In the strata of the coal series these impressions are generally more or less parallel with the time of stratification, but occasionally they are found vertical."

"In the Saarbrücken Gymnasial Programme for 1835, M. Goldenburg enumerates one hundred and two species of plants."

M. Steininger states that he has not been able to examine the accuracy of this estimate, but he enumerates sixty-nine species which are in the Museum of the Society at Trier, which we insert, for the information of such of our readers as are interested in fossil botany.

I. Algæ.	*Fucoides filiformis*		
II. Marsiliaceæ.	*Rotularia marsileæfolia*		
III. Filices.	i. *Sphenopteris obtusiloba*	*S. alata*	*S. trifoliata*
	ii. *Odontopteris minor*	*O. Steinbergii*	
	iii. *Neuropteris lanceolata*	*N. smilacifolia*	*N. tenuifolia*
	N. flexuosa	*N. conferta*	*N. decurrens*
	iv. *Pecopteris aquilina*	*P. Grandini*	*P. lonchitica*
	P. Davreuxii	*P. Cistii*	*P. affinis*
	P. Cyathea	*P. polymorpha*	*P. Miltoni*
	P. abbreviata	*P. Pluckenetii*	*P. bifurcata*
	P. dentata	*P. nervosa*	*P. pennæformis*
	P. plumosa (delicatula)	*P. microphylla*	*P. arborescens*
	P. aspera	*P. unita*	
	v. *Glossopteris microphylla*	*G. coriacea*	
	vi. *Gleichenites Neesii.*		
IV. Lycopodiaceæ	*Lycopodites elegans*	*L. Bronnii*	
V. Lepidodendreæ	i. *Sagenaria aculeata*	ii. *Aspidiaria undulata*	
	iii. *Lepidostrobus*	iv. *Sigillaria alveolaris*	*S. elegans*
	Sigillaria mamillaris	*S. Cortei*	
	S. pachyderma	*S. Subrotunda*	*S. pyriformis*
	(Lepidofloios laricinum)	*S. Brochantii*	*S. reniformis*
	S. lævigata		
	v. *Syringodendrum sulcatum*	*S. pes capreoli*	*S. organum*
VI. Calamites.	i. *Calamites Cistii*	*C. Suckorvii*	*C. pachyderma*
	C. distans	*C. approximatus*	*C. cannæformis*
	C. nodosus	*C. cruciatus*	
VII. Euphorbiaceæ	*Stigmaria ficoides*		
VIII. Plantæ ignotæ sedis	*Trigonocarpus Noeggerathii.*	*Cardiocarpus ovatus*	
	i. *Knorria imbricata*		
	ii. *Annularia fertilis*	*A. longifolia*	
	iii. *Bruckmannia rigida*	iv. *Musæites annulatus*	

The third and concluding portion of the work is devoted to a description of the plutonic rocks of the district, not without interest, but too lengthy for us to enter minutely into its details. We will briefly state that M. Steininger concludes, "that the carboniferous formation existed prior to the intrusion of the red porphyry and felspathic porphyry," (which are the rocks in question) "and that an upheaving of those strata took place consequently."

MONTHLY NOTICE.

1st. March, 1842.

THE perseverance which has been displayed by both British and Foreign Geologists in tracing the evidences of glacial action, affords a very striking proof of the high opinion in which the theory is held, not however, be it understood, as regards the problematic views which offer the widest scope, but in respect of glacial action having been one of the most prominent agents in certain transformations of the rocks composing the earth's crust. Since our periodical summary in January last we have become acquainted with observations made in various parts of this country and abroad, adding valuable testimonies to those already advanced in support of this interesting theory. The report by Dr. Buckland on evidences of this agency in Snowdonia, and confirmatory observations made in the same quarter by the late Mr. Bowman, so shortly before his death, are perhaps the strongest evidences of any heretofore adduced, as to the real effect, or to speak more correctly, the *common* effect of glacial action. When we advance this opinion, we would premise for the benefit of those less informed on this subject, that it is in contradistinction to the theory of *general* centres of glacial action, which met with very doubtful approval at the meetings of the Geological Institutions of this country; it was there argued, with reference to the position of these centres, and the intervention of certain elevations between their position and that of the present localities of erratic blocks, that the elevation of the centres referred to must have been so great, in order to afford the inclination required for the descent of the glaciers and the accompanying blocks of stone, that without better substantiated evidence it would be next akin to folly to assume their existence, when the origin of these blocks can, according to their opinion, be traced in an equally plausible manner from other causes, requiring the assumption of less startling data, but which would tend to produce a precisely similar effect, as regards the distribution of the blocks, so far removed from their parent bed. The existence of the gravel beds in the valleys of North Wales, their curious relations, and their lines of deposition, apart from the usual effects produced by ice, and the universal occurrence of such traces in the vallies of Snowdonia, offer important facts for the consideration of the Geologist, as to the real circumstances under which glacial masses were locally formed and the variety of causes which facilitated their descent. We would therefore call particular attention to these interesting statements, leaving our readers to deduce their own conclusions, and to verify the theoretic assumptions which we gave in the summary above referred to. The paper submitted to the French Academy of Sciences by M. Durocher, which we have reported in this month's "Geologist," adds another fact to the store of data on this subject, which from its novelty will doubtless continue to occupy the attention of the geological world for some long period yet to come.

THE EDITOR.

ORIGINAL COMMUNICATIONS.

Note on the occurrence of a tooth of the extinct genus Lophiodon, in the shelly conglomerate beneath the London clay. Communicated by — Allport, Esq. author of the History of Camberwell.

A well sunk on Sydenham-common near the Croydon Railway, passed chiefly through the blue clay. At the depth of one hundred and fifteen feet, the lighter sandy soil which came up was supposed to indicate the proximity of water, but after boring through a conglomerate of broken shells, about eighteen inches thick, these indications disappeared, till it was carried to the depth of about two hundred and forty feet, where a fine spring was reached in the black gravel and sand.

This black gravel stratum is supposed by some of our well-sinkers to be the reservoir of the medicinal waters so common in the neighbourhood, and is said to extend in a circuitous band about half a mile in width, from Streatham to the river Thames.

In this shelly conglomerate was found the tooth of a thick-skinned animal belonging to the extinct genus *Lophiodon*, the first that has been discovered in the London basin, though it has before produced a solitary specimen of one of the smaller pachyderms from the neighbourhood of Herne-bay.

The tooth was some time since submitted to the inspection of Dr. G. A. Mantell, who pronounced it to be the canine of some pachydermatous animal; adding, "it is a very fine specimen of its kind, and I believe has not been found in the London clay before." Dr. Buckland says, "it is certainly new, and extremely interesting."

It has since been subjected to a more rigid examination by Richard Owen, Esq. of the Royal College of Surgeons, who describes it to be "an inferior canine of the *Lophiodon*, one of the extinct genera allied to the tapir, which occur in the Eocene strata near Orleans, Buchsweiler, and other parts of the Continent."

The tooth, discovered on Sydenham-common, resembles, both in form and size, the upper part of a man's finger, as far as the second joint; the root of the tooth being slightly curved and tapering. Its extreme length, measuring round the curve, and over the face of the tooth, is two inches, seven-eighths: its circumference at the butt of the root, two inches and three-quarters: greatest diameter across the face of the tooth, seven-eighths of an inch. The enamel, which is perfect, and of a deep brown colour resembling the polished shell of a cocoa nut, extends about an inch up the tooth from the present crown which is irregularly broken, completely surrounding it. The transverse section of this portion of the tooth inclines to a semicircular, or rather a horse-shoe figure, the angles being slightly curved outwards. The enamel at the back of the tooth has a peculiar, reticulated appearance like the body of a snail: on the inner side, a considerable portion is worn away in mastication, appearing as if it had been scraped to a polish by the knife.

The root is striated down the back and sides, but this character is not apparent in front.

The crown of the tooth exhibits very clearly the radiating structure so characteristic of the herbivorous animals, as distinguished from the concentric arrangement common to those which are carnivorous.

Ammonites Zoologically and Geologically considered.

(Continued from p. 45.)

*Varieties from age.**—The modifications produced by age amongst the ammonites, are so extended that they completely change the appearance of species. They have given rise to the greatest errors, both in the description of species, and in their positive application to Geology. We might almost say that these modifications were true metamorphoses, to which almost all ammonites are more or less subject. Convinced for a long time, of this truth by many facts, I wished to state it on the evidence of a great number of spe-

* No one has yet noticed this fact.

cies. The ammonites, which had become changed into an oxide or hydrate of iron, have principally furnished me with the means, by breaking the shell and taking out the whorls successively, one after another, up to the first stage of growth of each species. It is thus that after many researches and comparisons, and after sacrificing a great number of specimens, I have determined that the growth of ammonites, may generally be apportioned into five principal modifications according to age, as follow:

First modification which I shall name the *Embryo period* (*période embryonnaire*). As a general rule, ammonites commence, at a very young period (when only a few millimetres in diameter), by being entirely smooth, and by having the back round, even when they ought, at a more advanced period, to have a keel or sharp back, as we find in *A. bifrons*, (Walcotii) *cordatus*, *cristatus*, &c. and then they might all be confounded together, if the convolutions were not different in this embryo state. We can conceive nevertheless, that this character, which is very limited, being aided by no external appendage, nor even by a keel, the number of distinct forms at this age is very small, and that their distinction into species is almost impossible.*

Second modification which I shall name *the first period of growth* (*première période d'accroissement*). To this smooth state, of the first age of ammonites, succeeds another amongst those species which become furnished with external ornaments; for as regards ammonites which remain always smooth, they necessarily continue their growth in a uniform manner. In this period of growth, the appendages which we observe on the ammonites, that ultimately become striated or ribbed, are the presence of salient portions or

* M. Milne Edwards has observed this singular character, amongst the crustacea. So that it may prove a general law in zoology.

slight tubercules which shew themselves on the arch of the umbilicus. These, at first scarcely visible, gradually elevate themselves and remain single for a shorter or longer period, according to the species; it is generally at this age that the keel commences to shew itself. In some ammonites which have no other external ornaments, as *A. Lallieriensis*, (*A. inflatus*, Reineck), *A. peramplus*, for example, this appears to be the complete state, but the greater number undergo still further changes of form (*A. interruptus*, *Martinii*, *asperrimus*, *Denarius*, *auritus*, *Lewesiensis*, *Camatteanus*, *Insignis*, *Deshayesi*). Sometimes when there are no tubercules it is the ribs or striæ which appear at this period of the growth of ammonites.

Third modification which I consider as the *last period of growth* (*dernière période d'accroissement*). Whilst the tubercules and the ribs on the arch of the umbilicus become more strongly marked and raised, we observe sooner or later, according to the species, on the back or sides, the simple and interrupted ribs, nodosities, and tubercules which are to receive the modifications proper to each species, gradually appear. If an ammonite be only destined to present a single range of tubercules on the middle or sides of the back, it is complete; but if it bears many, as we remark in *A. mammillaris* and *Lyelli*, these succeed each other from the exterior to the interior to the full number fixed by nature. When the ammonites commence to join the ornaments of the back to those of the arch of the umbilicus, all develope themselves during a certain period and then the species are covered with all the richness of ornament they can attain. This state, which is the most durable, since it occupies generally three fourths of the existence and growth of the ammonites, may be regarded as the *adult state*. It is this period which we must choose to describe, a species with its maximum of specific characters (*A. Leopoldinus*, *interruptus*, *dis-*

par, denarius, splendens, bicurvatus, inflatus, Camatteanus, Vernenilianus, and a great number of species from the Jurassic formation, such as A. Lamberti, Banksii, &c.) But the ammonites do not preserve these external characters beyond a certain period, the external appendages, although remaining virtually the same, become diminished in size, the salient portions are less strongly marked and are gradually effaced; the shell, although still growing is no longer so perfect; it degenerates.

Fourth modification. *First period of degeneration* (*première période de dégénérescence*). — Most Ammonites remain, until the period of their greatest growth, in the third state of modification (*A. interruptus, Denarius, Astierianus, auritus, mammillaris, &c., &c.*) the ribs only become more apart, and the tubercules more prominent. It frequently happens also, that at a more advanced age, the ribs and striæ of the back gradually become effaced, and finally disappear, whilst the lateral tubercules, where the ribs of this portion are wide apart, become much more salient, and remain thus isolated, during a longer or shorter period of growth. This period which corresponds in all to the first stage of growth, since it represents the Ammonites in the state in which they were at that age, may be called the *first period of degeneration,* the Ammonites already losing some of their external characters. (*A. dispar, Clementinus, radiatus, bicurvatus, Lewessiensis,* of the Cretaceous period, and in the Jurassic Formation, *A. Lamberti, mutabilis, Plicomphalus, triplicatus, decipiens, Murchisonæ, Banksii, insignis.*)

Fifth Modifications, which I shall call *the last period of degeneration (dernière période de dégénérescence.)*—Amongst the Ammonites which I have named, there are many which attain their greatest known diameter, in the last state; but there are also a great number, which, after having retained this modification for a longer or shorter period, ultimately change it. The ribs or lateral tubercules separate more and more, and gradually becoming lower, ultimately disappear entirely, leaving the shell as smooth, in its last Whorl as in the first, i. e. the embryo state. It is then, at the maximum of its growth, returned to what it was at its birth. (*A. Dispar*, *Clementinus*, *bicurvatus*, *Lewessiensis*, *radiatus*, in the cretaceous rocks, and *Lamberti*, *mutabilis*, *Murchisonæ*, *insignis*, *Banksii*, *&c.*, of the Jurassic Formation.)

In conclusion, according to age, amongst the Ammonites, there is evidently a limited number of modifications of *growth* and *degeneration*. These modifications are not the result of chance, but are the consequences of certain and regular periodical metamorphoses, which the greater part of Ammonites undergo and which operate invariably in a regular order of succession. Each, in fact, smooth at an early age, becomes covered at a more advanced period, in the course of its growth, by tubercules around the Umbilicus, then with ribs, striæ or tubercules on the back. It is then in the *adult state*. Arrived at the maximum of external perfection, all these ornaments commence to change; it degenerates. The striæ and dorsal ribs disappear in the first place; it then loses the lateral ribs and tubercules and becomes, in its *old age* (*vieillesse*), as simple in external appearance as it was in the embryo period.

The enormous differences between the internal cast and the external appendages of the shell, the natural and accidental varieties, the varieties arising from sex and especially the great number of variations, arising from age, not being sufficiently known, we may easily conceive into what inextricable confusion the great Genus of the Ammonites has been thrown, each person wishing to establish species on isolated specimens, without having previously studied them in detail, and without knowing on that account, when to stop. We can also easily conceive, that even if we had recognized all these causes of error, we should often feel embarrassed, even in entering on this undertaking with the most scrupulous attention, if we had only had at our disposal the external characters. We should have seen each inquirer arbitrarily extend or restrict the limits of species; and the most beautiful, the largest and the most useful of all the genera of fossil shells, would have lost its importance in its application to Geology, remaining more an object of simple curiosity for Collectors, than a means of just reasoning for Paleontologists. Happily, it is not thus. A character long unknown, that of the foliations of the Septa, and the form and number of the lobes and saddles, have presented themselves to determine these limits in an indisputable manner, and to clear away all uncertainty. We owe the first application of this feature to Leopold von Buch. This celebrated Geologist knew how to appreciate, in his first Memoir* all the importance that this character ought to hold in fixing the limits of species amongst the Ammonites; and in many subsequent publications†, he added to it several interesting facts. Nevertheless, no one has since ventured to undertake the study of the lobes or Septa, and we can scarcely, beyond the excellent works of Von Buch, find that any Ammonites have been studied in this latter point of view, and these, without much exactness. It is certainly necessary to pay scrupulous attention to the undertaking, and the Zoologist who wishes to study the Ammonites thoroughly, ought to apply himself strenuously to the elucidation of these difficult characters, to examine them in detail, in order that he may not proceed to correct errors on false principles, at the risk of perpetuating them indefinitely. I have followed this plan,

* Annales des sciences naturelles, 1829, tome XVII, p. 267.

† Annales des sciences naturelles, 1829, tome XVIII, p. 417, tome XXIX, p. 5.

and the study of the lobes and saddles, for the purpose of fixing the limits of varieties such as I have described them, has, as we shall see hereafter, furnished me with a great number of additional observations.

MOUTH OF AMMONITES.

Among the external characters of Ammonites, there is one which although it has already been the subject of notice, still requires much examination: it is that of the Aperture or mouth. M. Defrance first figured some perfect margins*, and I then had the pleasure of furnishing him with some materials; but, from a want of the means for study, the isolated facts collected in this first essay, cannot be applied to general views, and these remains being rare in collections, no one has since undertaken the enquiry. After having examined a great number, I have I think arrived at interesting results as to the connexion which exists between the form of the aperture and that of the dorsal keel, and the natural sections into which the Ammonites may be classed. I find that the modifications of the margin are of two kinds. They follow the external lines of growth and the curve of the ribs at all ages, and we can then see them externally on the shell; or otherwise they have no connexion with the ordinary lines of growth and curve of the ribs, thus constituting a part entirely unconnected with the forms of the other portion of the shell. In the first instance I shall name them *regular apertures* (*bouches constantes*); in the second *irregular apertures* (*bouches momentanées*).

Regular apertures or mouths may be classed in three series;

In the first class we may place such as are provided with

* Dictionnaire des sciences naturelles.

a single median dorsal tongue prolonging itself on the back considerably beyond the last ribs (see figure, Pl. 2. Fig. 2.) in the form of a long beak. This disposition, which I have observed in a large number of Species, is common to two very different modifications of external form: 1st. to Ammonites provided with a salient dorsal keel, as in all the species of the Group *Arietes* (in the Jurassic Rocks *A. Turneri, multicostatus, rotiformis, Bucklandi, obtusus,* &c.); all those of the Group *Cristati* (of the Cretaceous rocks, *A. cristatus, Bouchardianus, Roissyanus, varians*); and some of the *Falciferi* of the Jurassic formation; 2nd. to Ammonites provided with a deep canal independant of the ribs, characterising the Group of the *Tuberculati* (of the Cretaceous rocks, *A. lautus, tuberculatus*). Thus Ammonites provided with a dorsal keel or a deep canal, belong to the same division of apertures, and are much more nearly allied by this character, than one would have supposed by their external form.

In the second series of *regular apertures*, the margin not only forms a tongue or dorsal beak, corresponding to the mesial line of the back, and to the keel or canal; but there is, moreover on each side of the shell, another tongue, equally salient, corresponding to the angles or deep inflections which we observe on the ribs or lateral striæ of the shell. This form of margin is found in the two Groups which I have already noticed. Amongst the *Falciferi* (*A. bifrons* (*Walcotii, Sowerby*), *serpentinus, &c.*) and the *Tuberculati* (*A. falcatus*); it appears then to intimate the near alliance of these two Groups.

A third series of *regular apertures*, the most simple of all, is that which appears to exist amongst a great number of Ammonites, in which, hitherto, we have not recognised any other margins than those of the lines of growth, more or less curved or straight, of the edges of the shell, as in the group of the *Heterophylli* (of the Cretaceous formation *A. Heterophylli, Velledæ, infundibulum, semistriatus, Alpinus, &c.*), the *Ligati* (*A. Beaudanti, &c.*), the *Clypeiformi* (*A. Clypeiformis, Gevrilianus, Requienianus, &c.*), the *Compressi* (*A. Largylliertianus, Vibrayeanus, Beaumontianus, &c.*). This series of margins appears the most numerous and least restricted, as it is found in a great number of species. The margins belonging to it, although approaching those of the Nautili, differ in this respect by being invariably salient anteriorly, instead of being inflected.

I name *irregular* or *transient* (*momentanées*), those margins, which, instead of being, at all ages, guided by the exterior lines of growth, only appear at certain intervals of time, whether they leave, at certain distances, traces on the shell or not. When they leave traces, they are intermediate between *regular* and *irregular* margins, and they then present an analogy to the Varices of *Cassis, Murex, Ranella* and *Triton* amongst the Gasteropoda*. One might suppose that these old margins were points of repose during the growth of periods when the animal would fear less the shocks to which it might be exposed in this state, on account of having a thickened rim, and I am inclined to suppose that these periodical thickenings of the species, coincided with the epochs of fecundation when it was necessary for the animal to proceed to a greater distance from the shore and thereby become more liable to injure its frail shell. Whatever may be the cause, I have observed these remains of margins at the points of termination (*points d'arrêt*) in a great number of Ammonites belonging to different groups, but all to Species having a round back, and never in those whose back is keel

* This has been noticed by von Buch and Sowerby.

shaped, grooved, interrupted, tuberculated or canaliculated, which gives greater value to the different modifications of this part.

I have observed these old margins in the *Ligati (A. latidorsatus, Parandieri, Mayorianus, raresulcatus, subfascicularis, ligatus, Cassida, Emerici, Royerianus, Belus); amongst* the *Heterophylli* (*A. incertus, tortisulcatus, Guettardi, Calypso,* and amongst the *Capricorni* (*A. inæqualicostatus, subfimbriatus, Honnoratianus, Lepidus, Mathesoni, quadrisulcatus, striatisulcatus, Duvalianus.*) We find them also in some of the Ammonites of the Jurassic formation, but only in a very small number. These remains of the ancient traces of the margin, are inflected anteriorly, forming a salient point on the dorsal mesial line, the examination, of a great number of specimens, has proved to me that they are always accompanied by a rim which is thicker than the neighbouring portions of the shell.

Accidental apertures (*bouches accidentelles*) which leave no trace, are the most extraordinary; they cause great embarrassment, where we endeavour to connect their presence and the regular growth of the shell. Before expressing my ideas on the subject, I will endeavour to describe them. They consist of two series of forms; in the first they present a very strong thick rim, often oblique to the lines of growth and the ribs, and curved outwardly, as we see in *A. Asterianus* of the Cretaceous formation, and in a considerable number of Ammonites from the Jurassic formation, such as *A. Brongniartii, Gervilii, &c.,* all having the back round, and belonging to the group of the *Coronarii.* Their second modification, still more at variance with the regular growth of the species, is that which we remark, in the species having transverse ribs, and a large tongue on each side o the margin, as in *A. Macilentus* (see fig. 3, Pl. 2.) of the Cre taceous rocks *A. Brackenridgii* and many others which I po sess and which I shall describe in my Fauna of the Jurassic formation.

If we found these apertures in Ammonites of the same size, in each species, one would imagine that they belonged to the adult age, and that they were formed as in *Cyprea*, at the time of the shell arriving at its greatest growth; but this is not the case; and many examples have convinced me that these apertures are found at all ages on individuals quite perfect. We must believe then that, to increase its shell, the animal is obliged to destroy this first margin, which it afterwards reconstructs, when it becomes necessary. This appears more probable, as the open portion of the last Whorl appears to be constructed provisionally, as it becomes modified after forming chambers, as in most Ammonites. I shall be able to demonstrate this in the Jurassic formations, by many examples, where the growth is always regular in the chambered portion; whilst in that part in which there are no chambers, it recedes, the last Whorl becomes smaller and has not, near the margin, more than half the diameter of the parts which are entirely perfect. I wish to draw particular attention to this singular character, which will perhaps explain the strange forms of the other Genera of Ammonites of which I intend to treat.

We see then that the different forms of margins of Ammonites coincide always with those of the back of the species, according as this part is keeled or canaliculated, tuberculated, smooth or ribbed. These diversities in the form of the back are of great value in forming groups in the Genus of the Ammonites, in confirming many groups already formed by Von Buch, and will serve me as a base for the creation of many others, when I shall study Ammonites with regard to classification.

Before proceeding to the examination of the internal characters of Ammonites, two distinct subjects remain to be noticed; their convolutions, and the connection of its modifications with the other characters; and the limits of growth proper to the species.

The *spiral convolutions* of shells (*enroulement spiral*) has already occupied the attention of many scientific men, amongst whom I may mention Messrs. Moseley of Cambridge and Naumann of Freiburg, who have observed that the spiral of shells follows logarithmic curves. M. Elie de Beaumont* by the suggestions of Leopold von Buch, has successively measured a Goniatite and three Ammonites from the Jurassic formation, and he has also found that they were curved in spirals of nearly the same nature. Nevertheless, he observed that the spiral of two of these Ammonites was a re-entering one, towards the termination of the convolution, a little within the logarithmic spiral. Without having studied the convolutions of Ammonites mathematically, I have observed in a great number of species that in adults they are invariably the same, but that they vary two or even three times according to age; 1st. If we take an Ammonite in the embryo period, for example, at the instant when the spiral commences, we shall observe that it increases more rapidly in the first whorls, and departs from the convolution which it ultimately arrives at. 2nd. After this period which is usually very short, the convolutions become regular and continue so in most cases, during the remainder of the animal's existence. 3rd. At other times, as M. Elie de Beaumont has observed, the spiral, instead of increasing regularly, during the last period of degeneration, at the time when the Ammonites begin to lose their last remaining external ornaments, re-enters, frequently within the regular curve that it had hitherto followed. We should say that at

* Société philomatique de Paris 1841, p. 45, séance du 17 avril, 1841.

this epoch, when the animal had no longer the energy or the faculty of reproducing the numerous ornaments with which the shell was provided externally, it ceased also to increase in a regular volume and degenerated in every respect; thus from what has been already stated, there are certainly three distinct periods in the progress of the spiral convolutions of Ammonites; at the embryo, stationary or adult and degenerate periods, we may readily conceive that the adult state is the proper period for measuring an Ammonite.

It must be understood, that in these proportions, I am only speaking of those whorls which are provided with septa; for the last two thirds of the convolutions, which is always destined to receive the animal, and on that account, unprovided with septa, rarely follows the regular curve, except in certain particular species. It is almost always narrower than the rest (as I have already mentioned in treating of the mouth) and narrows gradually, from the last septum to the mouth.

It may perhaps be remarked that, in my descriptions, I do not take the size of the last whorl, in comparison to the entire diameter of the species, on the height of the central line of the mouth, compared with the diameter, as if the Ammonite were cut in two, but rather on the external portion of the whorl, taken from the edge of the Umbilicus, comparing its size to the entire diameter. I find two great inconveniences in measuring the spiral curve mathematically on the central line, or the comparative size of the first and second whorl; first, from being often obliged to break or cut the specimen, to arrive at a correct measurement, and not being able to do so with specimens which were lent to me, I should not on that account have been able to gather a number of facts; the second and more important one, consisted in what I have observed that measurements are taken in this way, differ so little from each other, that they would not be sufficiently distinctive for Geologists, who were not able to devote much time to the study of species, and further, this mode of measurement does not shew the enormous difference which exists externally between the species having the whorls enveloped and those having them free. These last considerations determined me to take as a base the external and the internal size of the last whorl, relative to the entire diameter, and which has afforded much wider limits of variation, and shews in succession the differences which exist amongst the species; but to render it more complete, I have always shewn the relation of this diameter to the envelopment of the whorls, and scrupulously noticed it.

If, in regard to the greater or less envelopment of the whorls of the spire of Ammonites, I cast a rapid glance over the species, I shall find great varieties. We see, in fact, in certain species, the whorls simply in contact. (*A. subfimbriatus, Honnoratianus, Lepidus, quadrisulcatus, striatisulcatus, Strangularis, Juilleti*) ; at other times the whorls gradually become so far enveloped, as to conceal a quarter of their bulk (*A. Cryptoceras, fascicularis, Duvalianus, Lyelli, &c.*). From this point they proceed, until only half their bulk is uncovered (*A. Leopoldinus, interruptus, tuberculatus, mammillaris.*). They are still more enveloped in some Ammonites, where less than a quarter of the whorls is visible. (*A. Beaudanti, fortisulcatus, Belus, latidorsatus, &c.*) In other species the umbilicus gradually narrows, the last whorl envelops all the others, and the spire becomes entirely embracing (*A. pulchellus, semisulcatus, Velledæ, Largilliertianus, &c.*). If we compare the two extremes, there is a complete disparity of form, whilst there is an evident and uninterrupted passage, from the whorls which are entirely free, to those which are completely embracing, and this greater or less envelopment of the whorls is not always connected with the characters which serve us as a base for the distinction of groups, they being, as we shall see, always relative to the number of lobes of the Septa.

In speaking of the differences of the sexes I have also remarked that the envelopment of the whorls, and for the same reason, the size of the last one, with respect to the diameter, varies according to sex and that the whorls, which are larger in the males than in the females, are almost always so on account of the compression of the shell.

Size of Ammonites.—The growth of Ammonites stops at different periods, and has no connection with the complication of the external ornaments, or the internal characters of the septa. I am not even certain that it would be easy to establish any relation between the volume which some attain and the probable duration of their existence; nothing can reveal to us the time which elapses between the formation of each Septum or external point of termination, even were it identical in all the species. It is therefore a question which will doubtless remain always undecided, and in every instance quite hypothetical. It is not so as to the size proper to each species, and from that compared with external and internal modifications, always being careful to render this comparison subordinate to the varieties arising from age, which I have already noticed, I can affirm that each species appears to attain a certain diameter which it never exceeds. For instance in the Cretaceous formation: 1st. *A. striatisulcatus, Belus, Calypso, picturatus, pretiosus, verrucosus, crassicostatus, asperrimus, Bravasianus* and *Itierianus, &c.*, always retain a small size, that is to say a diameter below three centimetres. 2nd. *A. Dufrenoyi, ligatus, Parandieri, macilentus, Emerici, Duvalianus, tuberculatus, regularis, &c.*, are larger, but do not exceed five centimetres; 3rd. *A. Asterianus, fascicularis, subfimbriatus, latidorsatus, Denarius, falcatus, &c.*, and many others never attain two centimetres in diameter, though they always exceed five; whilst, 4th. *A. Clementinus, Lewesiensis, peramplus, clypeiformis, Bidichotomus, Rhotomagensis, rusticus, &c.*, arrive at a diameter of thirty centimetres. There are some amongst them, which, like *A. Lewesiensis* attain a metre in diameter. Thus, when regarded in this point of view, each species of Ammonite appears to have a fixed limit of growth; otherwise all would arrive at the same size, which is not the case.

I have mentioned that the size which is proper to the species, has no connection with the external modifications or the ornaments with which they are provided. To convince oneself of this fact, it is only necessary to compare the smallest *A. pretiosus, striaticulcatus, verrucosus, asperrinus* and *Braviasianus*, the ornaments of which are exceedingly complicated with larger species which are destitute of them, as *A. peramplus, clypeiformis* and *Lewesiensis.*

I have also stated that the complication of the foliations of the septa is not always in connection with the size of the species. The numerous foliations of *A. Belus, Calypso, picturatus, &c.*, will prove this, as their parts are exceedingly complicated, and thus nevertheless of small size.

[*To be continued.*]

Tabular View of the Melting Points of Metals, as determined by different Experimenters. By Professor Gordon, of Glasgow, communicated by Theodore F. Moss, Esq.

Tin melts at	228°	centigrade	according to	Crichton
do.	267°	do.	do.	Guyton
do.	228°	do.	do.	Rudberg
do.	230°	do.	do.	Kupffer
do.	222.5°	do.	do.	Ehrmann
Bismuth	246°	do.	do.	Crichton

Bismuth melts at	241°	centigrade	according to	Guyton
do.	265°	do.	do.	Rudberg
do.	264°	do.	do.	Ehrmann
Lead	322¼°	do.	do.	Crichton
do.	322.2	do.	do.	Guyton
do.	325°	do.	do.	Rudberg
do.	334°	do.	do.	Kupffer
Quicksilver boils	350°	do.	do.	Dulong & Petit
Zink hardens above	400°	do.	do.	Rudberg
Zink melts at	411°	do.	do.	Daniell, measured with an iron rod
Antimony do.	512°	do.	do.	Guyton
Silver melts at	1023°	do.	do.	Daniel measured with iron rod
do.	1034°	do.	do.	Guyton do.
do.	999°	do.	do.	Prinsep
9 parts silver, 1 part gold	1048°	do.	do.	do.
3 do. 1 do.	1121°	do.	do.	do.
Copper 1132° C. corrected to	1091°	do.	do.	Daniel with platinum rod
do. melts at	1207°	do.	do.	Guyton
do. do.	1173°	do.	do.	Plattner
Gold 1144° corrected to	1102°	do.	do.	Daniel
do. melts at	1163°	do.	do.	do. with iron rod
do. do.	1380°	do.	do.	Guyton
Cast iron 1587° corrected to	1530°	do.	do.	Daniel with platinum rod
Platinum	2534°	do.	do.	Plattner

MISCELLANEA.

On the chemical constitution of Sillimanite.

This mineral is found at Saybrook in Connecticut, and has been described by Mr. Bawen, who has recognized the following constituents.

Silica	42.666	99,286.
Alumina	54.111	
Oxide of iron	1.999	
Water	0.510	

Mr. Hauidinger judges that the "Sillimanite" is a variety of Disthene, from the constituents being the same and in like proportion as those afforded by an analysis of that mineral (or Kyanite), and the similarity of crystalline forms. (*Edinburgh new Phil. Journal.*)

Anthosiderite.—A new mineral.

The colour of Anthosiderite is ochreous brown inclining to grey, and it occurs in masses, distinct concretions, fibres, and grouped in the same way as flowers; and it is from this latter cause added to the iron it contains, that it has received the above name. It is opaque or slightly translucent at the edges, and contains:

Silica	60.08	98.57
Oxide of iron	34.99	
Water	3,50	

(*Edinburgh New Phil. Journal.*)

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY OF MANCHESTER.

At the monthly meeting held on the 27th of January last, Mr. Binney reported that Mr. Francis Looney, F.G.S. had commenced his lectures to the working miners of this district, on the nature and properties of the different gases found in mines; the causes of their generation and accumulation; the structure and principles of the different safety lamps; and the circumstances under which they are really safe or dangerous. This gentleman had visited the Hyde, Dukinfield, Middleton, and Irlam's-o'th'-Height coal districts, and addressed very numerous audiences at each place. It was highly gratifying to learn, that the working colliers, flocked to hear him, and evinced the greatest desire to become thoroughly acquainted with the nature and principles of the different lamps now in use for lighting mines. Mr. Looney was also delighted with the intelligence and love of knowledge exhibited by this class of workmen, who have often been represented to the public as an ignorant and disorderly body of men; and he is convinced, that they only need the means of instruction to be given to them, so as to become as intelligent a body of workmen as any in the British dominions.—Mr. James Heywood read an Introductory Sketch of the Geology of France, by the Rev. H. L. Jones, M.A.:—

France, it was observed, was one of those countries in Europe where geological phenomena were developed on the largest and most striking scale. The tertiary basins of Paris, of Auvergne, and of the Gironde; the oolitic formations of the Jura, the volcanic formations of Auvergne and the Cantal, and the primary formations of Brittany, Dauphiny, and the Pyrenees, present fields of research to the student which are almost inexhaustible, and are, at all events, calculated to occupy the time and attention of many careful observers, whether from the formation of valleys, the cuttings of rivers, the action of the sea on the coast lines, or still more from the dislocations attending the lines of the principal mountain chains. Most of the geological phenomena of France lie ready to the hand and hammer of any one who chooses and knows how to observe; and the works published on the various districts, with the public collections of the capital, open to every body's examination, render the study of French geology doubly attractive from its facility. Thus, the hills of Montmartre and Grignon, in the Paris basin, are, in themselves, museums and books which anybody can readily study who can approach them; and the volcanoes of Auvergne are still fresh in appearance, and preserve all the usual phenomena of past igneous action. It is, however, from the similarity and geological connection subsisting between the French formations and those of the British islands, that the study of the former becomes of importance to the British geologist; it forms the complement of his previously acquired knowledge of his own country's geological condition; and, from its being of ready access, a knowledge of it becomes almost indispensable. The object of the paper was stated to be, to give only some general indications of the extent and nature of the principal formations of France; which were enumerated, as follow, in a descending order, according to their dates, more or less recent.

1. *Tertiary formations.*—The basin of the Gironde, including a wide extent of country, on each side of the Gironde; and all that extensive portion of ancient Guienne and Gascony, known by the name of the Landes. The tertiary basin of the delta of the Rhone, and the neighbourhood of Arles. The Paris basin, which is divided into two not very unequal portions, by the Seine; but is not so extensive as that of the Gironde. The Lyons basin, including a long tract, through which the Saone flows; and also along the eastern bank of the Rhone, after its junction with that river. The Strasburg basin, on the Rhine, between Basle and Mayence. To these may be added part of the great tertiary formation of the Netherlands, in the immediate neighbourhood of Dunkirk; but this can hardly be comprised among the French formations, properly so called, however closely connected with them it may be in a geological sense.

2. *Secondary formations.*—The great chalk formation of the north of France, including the greensand, and associated formations, with gault, wealden clay, etc. which surrounds the Paris tertiary basin; and extends through Normandy, Touraine, and Champagne, into Artois. A similar formation, but on a much smaller scale, to the north of the basin of the Gironde, extending from Saintonge into Perigueux; another skirting the Pyrenees, and a fourth to the east of the Rhone. The oolitic formations of the Jura, which commence near Grenoble and extend, north-easterly, to the neighbourhood of Strasburg on the Rhine. This is one of the most important and best developed in France. The oolitic and other formations above the carboniferous series, which intervene between the chalk series of Normandy, and the primitive district of Brittany. A similar series, which commences near Poictiers, and extends north-eastward through France, in an irregular manner to Metz, the Moselle, and the Rhine. And another series, of the same kind, forming great part of ancient Languedoc, and Provence, with a long tract, skirting the Pyre-

nees on the north. There are smaller formations of the same nature, such as those at Boulogne, in Picardy, &c.

3. *The carboniferous and mountain limestone formations* of the north-east of France, at Valenciennes, &c. forming part of the same series in the Belgian and Prussian territories. The coal field of St. Etienne and its environs south-west of Lyons; the coal and iron field of Nevers and parts of the Limousin, &c.

4. *The older formations,* including all beneath the carboniferous or mountain limestone series, the Silurian system, the schistose, the granitic, and the other primitive systems. The district of Brittany, which is one of considerable extent, terminated towards the east, by a curved line extending from Angerson, the Loire to Cherbourg on the British Channel, on the south by a line from Mort to the ocean, and on the west and north by the coast lines of La Vendée and Brittany. The granitic district of the Pyrenees, which includes the whole of that stupendous range of mountains, and is of peculiar interest to the geologist and mineralogist, from its phenomena of dislocation, and from the great variety of mineral products to be met with throughout the whole line; the primitive district of Provence and Dauphiny, which forms part of the Alpine chain, and can hardly be studied without connecting the general series of the Alps with it; the great central granite plateau of Auvergne, one of the most remarkable formations in Europe, from its being in immediate juxtaposition with the tertiary formations of the Limagne, of Auvergne, and the sundry formations of Berry; and also from its being pierced by the number of immense volcanoes, which must have made this district, in former ages, one of the most extraordinary spots of the globe. This great central formation, which is of vast extent, is connected with similar formations in the Cantal, Rouergne, Velay, Forez, and the Nivernois; throwing out into these latter provinces branches or arms, which connect it with almost all the other formations of France. The granitic district of Alsace, and the schistose districts, on the north-eastern or Belgian frontier, complete the transition and primitive formations.

5. *The volcanic formations* of Auvergne of the Cantal, Velay, Languedoc, and Provence, may all be studied separately from the formations through which they have pierced; and they are second to none in Europe for extent or richness of mineralogical treasures.—The paper then continued with observations on the extent, &c. of the tertiary basin of the Gironde; the great cretaceous formation of the North of France, and those of other portions of the kingdom; the Oolitic or Jurassic series

(including all the associated beds, with the lias); the new red sand-stone formation, and the coal series (which last, as being interesting in this neighbourhood, we give):—Coal fields do not exist in France on any thing like the same scale as in the British islands. The principal are at St. Etienne, near Lyons, in the midst of the granitic district of Le Forez, and on the Belgian frontier near Valenciennes and Mons. The coal field of St. Etienne is of small extent, not greater in superficies than the Isle of Wight; but it is very productive, and furnishes iron, of bad quality, as well as combustible materials. The measures are much dislocated by faults, and the district is very hilly; the coal is highly sulphurous, and rich in fossil remains. There is a small formation of the same kind near Nevers; but this is worked more for the iron-stone it yields than for the coal. The coal field of the Belgian frontier belongs, geologically speaking, to Belgium rather than to France. The coal is of excellent quality, and very abundant. The measures are in general deep, and more horizontal than at St. Etienne. Coal is worked near Boulogne-sur-mer; and ironstone of good quality exists in the same formation. Near Montpellier coal is also extracted, and it may be said to exist in formations of very different epochs in many localities throughout France; but the only coal fields of any real importance are those of St. Etienne and the Belgian frontier.—To these succeeded notices of the Silurian and schistose series; the granitic series, including all the igneous rocks, not, properly speaking, volcanic; and, lastly, the volcanic series. In conclusion, it was remarked, that the geological changes now in progress, whether from the abrasion of torrents, the shifting of water courses, the inroads of the sea, the formation of marshes, &c. are, from the great extent of surfaces where they take place, of no small weight in the geological annals of Europe. Thus the late floods of the Rhone, acting over a space of 150 miles in length, the alterations of its channel, and the deposits left by such a deluge, are well worthy of study, and will no doubt be carefully observed by local geologists.

ACADEMY OF SCIENCES, PARIS.

January 10—17, 1842.—A paper was read by M. Durocher, giving an account of his geological researches in the North of Europe, and especially of the phenomena of erratic blocks. He observed that the streaks found on the surfaces of rounded rock, were in Norwegian Lapland always accompanied by heaps of diluvial matter. The erratic blocks were generally either of granite or gneiss; but between St. Petersburg and the Niemen, no less than fourteen different kinds of rock were found, all the known sites of which were in Finland. These blocks were sometimes twenty and twenty-five feet in thickness, and their angles by no means rounded or worn. The Volga is the most eastern limit in which these blocks are found. The granite blocks, however, appear to have been carried to greater distances than those formed of limestone. Another circumstance to be remarked was, that these blocks lie either in or upon vast deposits of sand, or diluvial matter regularly stratified in nearly horizontal layers. This showed that the sand had been deposited in a sea not greatly agitated, and therefore, the supposition that the blocks had, in all cases, been carried by a violent diluvial current, was not admissible. It was probable, Mr. Durocher thought, that these blocks had been floated on ice fields, and had been deposited at the bottom of the sea by the melting of the ice. At the same time, he thought it evident that an immense diluvial current, the origin of which there was as yet no means of conjecturing, had taken place; that it had commenced very far north; that it was probably accompanied by an immense quantity of floating ice, and that it had spread over all that part of Europe comprised between Greenland and the Ural mountains in Russia. The current had been turned southwards covering Sweden, Norway and Finland, breaking off rocks from the mountains as it passed along; polishing the surface of the rocks, and leaving streaks on them from the action of the sand, stone, and rocks when it rolled onwards. The current had extended into Germany, Russia and Poland, but its force had apparently become weaker as it went further south; towards the east it had been lost in the plains of Russia and in Germany, has been stopped by ranges of mountains. Long lines of *Osars* (or heaps of detrital matter) were found accompanying the erratic blocks, and their prevalent direction was from N.N.E. to S.S.W.

REVIEWS.

Description des coquilles fossiles de la famille des Rudistes, qui se trouvent dans le terrain crétacé des Corbières; par Oscar Rolland du Roquan. Carcassonne, 1841. *4to. with plates.*

During the last few years of the present era of geological discovery, great zeal and talent have been displayed in the examination of peculiar tribes of extinct animals, with a view to trace their identity or affinity with recent productions possessing apparently a similar external appearance and construction. Amongst the most striking of these productions, and at the same time those which have been the most imperfectly understood are the lower orders of Mollusks so common in the older secondary strata of the earth's crust, and it is therefore a source of pleasureable duty to contemplate the supervision of any work relating to a subject, possessing so much novelty, and so many attractions. The work before us embraces one of the groups and contains an elaborate account of the distribution of the species in the district of Corbières in the department of Aude.

The fossils of which the family of "Rudista" is composed, are confined to the cretaceous system: the lower strata does not contain any organic production in any way resembling them, and they seem to have entirely disappeared at the period of the deposition of the most recent secondary or oldest tertiary rocks. In addition, a particular geographic distribution is assigned to these fossils in the district of Corbières; for although the chalk formation of central Europe contains abundance of them, they are so rare in the northern districts, that with the exception of three or four examples, not a specimen of any species of Rudista has been formed in the chalk formation beyond 47°—48° north latitude.

M. D'Archiac in a memoir exported in the Bulletins of the Geological Society of France, recounts all the localities in which these fossil remains have been found. "Species of this family have been found in the environs of Lisbon (Portugal), in the south of Spain, in the strata of the Pyrenees, and the prolongation of that range in the Asturias. Their abundance in the south-west of France is well known, and they are again traced at Corbières (at the foot of the eastern Pyrenees), then in the departments of Gard, Vaucluse, Bouches du Rhône and Var, in the province of Milan, in the neighbourhood of Verona, in the Tyrol, Salzburg, Styria and generally in the eastern Alps; in Illyria, Transylvania, the Carpathian chain, Dalmatia, Albania and the Morea." Mr. C. Prevost notices their occurrence in the chalk of Mount Erix in Sicily, and further east, they are again found in Asia Minor, at Lebanon and Mount Sinai. This proves, as has been mentioned, their particular distribution; and, if an isolated Hippurite has been found in England, a Spherulite at Maestricht, and another at Brighton, their occurrence is so rare that sufficient proof is thereby afforded that these animals could not have lived and multiplied in these parts.

But again, Mr. Roquan observes, as their distribution is peculiar to the cretaceous formation of central Europe some particular cause must have existed to produce this result, and it remains for us to trace the reasons.

Thus, as an example, we first find a number of species at present abundant in the Mediterranean, whilst they are absolutely unknown in the ocean, although the conditions of the two localities are found to be the same, such as temperature, &c. It is evident, therefore, although the strata differ in paleontological aspect, that the lithological character of the two thus remotely situate being the same, they must have originated from the same geological agency.

Having devoted the first divisions of the work to a review of the classification of these fossils, and assigning their position, and subsequently, as we have endeavoured to report in a succinct manner above, their distribution having been considered, M. Roquan proceeds to impart to us his examinations with reference to their division and arrangement, which we will add after the insertion of a few remarks.

M. Roquan states that having collected an immense number of specimens of all forms, ages, and in different degrees of fossilization, he was enabled to observe several important facts. Amongst these, he states that having been impressed in favour of Lamarck's reduction of the total number of species of *Spherulites* from the *seven* recognised by Lapeirouse to *three* species only, possessing, as he said, distinct forms and characters, he endeavoured to recognize those characters as the means of classifying the species occurring at Rennes; but after close examination he found that all the specimens he obtained at that locality merged into one general specific character, however apparently different they might have seemed on first sight. Not willing, however, to change an opinion upon these grounds; without closer examination, Mr. Roquan deputed a friend, to examine the species in Lamarck's collection, labelled in his own handwriting; and from an inspection of these he was convinced that his first judgment was right, and that M. Lamarck had been misled by the variety of forms and aspects under which the Spherulites occur. He therefore includes those found at Corbières under one denomination only—*Spherulites ventricosa.*

Our author states that he followed in the same course with reference to the Hippurites, and states that he recognized six species in the strata of Corbières, entirely distinct and marked under all circumstances.

The summary of the arrangement is as follows: viz.:—

Rudista.	Hippurites.	H. bioculata.	*Lam.*
		H. canaliculata.	*Roquan.*
		H. striata.	*Def.*
		H. sulcata.	*Def.*
		H. turgida.	*Roquan.*
		H. organisans.	*Montf.*
	Spherulites.	S. ventricosa.	*Roquan.*

Having arrived therefore at the sum and substance of this work, and devoted some space to the arguments deduced by the author in support of his views, we will, in conclusion offer a few remarks as to the merits of his investigation, displaying a vast amount of perseverance and knowledge, and as to the conclusions at which he has arrived with reference to the classification of individuals occurring in this deposit. Our author evidently observed prototypes of Lamarck's species in the strata of Corbières, and it was on the score of his opinions only, that he hesitated to assign a place to those, which, possessing apparently the same specific distinctions, might have been severally referred to Lamarck's divisions; yet the minutiæ of structural differences are often so confounded that, by insensible gradations, *truè species* become connected together and emerge into one general type; and the natural system of arrangement, as recognized in modern times, however averse in principle to the introduction of new species without sufficient authority or reasons, is, on the contrary equally subservient to the adoption of an *infinitude of gradations,* connecting the one specific form with the next; and reasoning by analogy also, it is obvious that no fixed limits can be assigned to the operations of nature. We could not, however, attempt to decide on the particular merits of this case, yet we should hesitate to give our assent to the reduction of species especially when we consider the multiplicity of individuals which came under the author's observation, without great care and caution.

PLATE II.

FIGURE 1.—*Ammonites macilentus.* *D'Orbigny.*

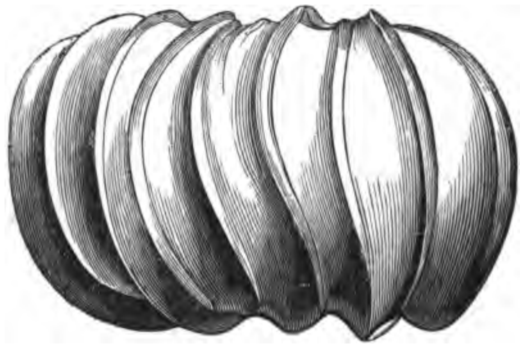
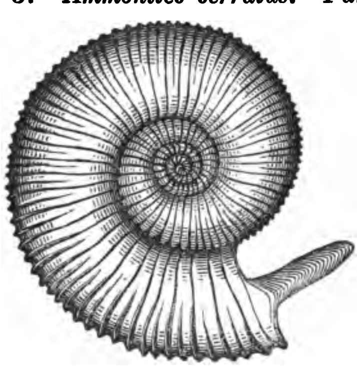


FIGURE 2.—*Ammonites cristatus.* *Deluc.*

FIGURE 3.—*Ammonites serratus.* *Parkinson.*



MONTHLY NOTICE.

1st. April, 1842.

The long expected report of Professor Owen on the remains of the so-called "*Leviathan Missourii,*" of which we gave a brief account in our February notice, has at length been submitted to the public, through the medium of the Geological Society of London, and although nullifying its distinction as a new species, it has proved the identity of the several portions of which it is composed. In the memoir to which we refer, a very exact examination is recorded of the dentition, and position of the tusks in this animal, and Professor Owen, having by this means recognised its identity with either the *Tetracaulodon* or the *Mastodon giganteum*, proceeds to a minute dissertation on the peculiar characters of each. He states that Dr. Godman founded the former genus upon a fossil lower jaw, which contained molar teeth, agreeing with those of the Mastodon; but which possessed two tusks projecting from the symphysial extremity. Now from the examination of the extensive series in Mr. Koch's collection, as well as of those specimens which are preserved in other quarters, it seems clear, "that an animal of the same size and molar dentition as the Mastodon, was characterized in the adult state, by a single tusk or incisor projecting from the symphysial extremity of the right ramus of the lower-jaw, and that the assumed peculiarity of the Tetracaulodon, namely the two inferior tusks, one in each ramus, is manifested only by immature animals," and hence the subversion of the latter genus. We will not offer any lengthened remarks, as to the reasoning by which Professor Owen was enabled to prove his opinion, but will merely add that Professor Owen has referred all the remains of Proboscideal Pachyderms in Mr. Koch's collection, with the exception of a few bones of the mammoth, to the *Mastodon giganteum* of Cuvier, and that he considers this collection as illustrative of the true and very remarkable characters of that extinct animal, in a more complete manner than has ever before been done, and to clear up all doubts which the inspection of solitary specimens had occasioned.

We have elsewhere noticed the establishment of a branch of the "*Dudley and Midland Geological Society,*" and regret much we cannot report the proceedings at greater length, on account of their general character, and the circumstances of local interest by which they were marked; yet we hope to have recorded our opinion, in so far as our gratification on its establishment is concerned, proving, as it does, the increasing claims of geology on the public at large, and the rising interest attached to the phenomena which it diplays. The main argument in support of the establishment of this society, as stated at the meeting, we must, however, record in this place, as we consider it demonstrates an activity which must prove useful to the science. The Dudley Society, the first meeting of which we reported in our February number, having rapidly progressed in the estimation of the country and the neighbourhood, it was found that many members from their non-residence at the locality where the periodical meetings are held, would be debarred of the pleasure which they might otherwise enjoy, and rather than that such an objection should exist, or that any deterioration from the interest of the original Institution should occur from the interference of a distinct society, the members resident in Wolverhampton determined to form a branch society to aid the original Institution in its progress. We commend the harmony and good taste which dictated this course, and in wishing the society every prosperity, hope that their labours will contribute to the advancement of true science, and add increased interest to the pages of our journal.

We cannot refrain from noticing, in conclusion, the insertion of the first paper on "*Geology applied to Civil Engineering*," in our present work, and which will be followed, from time to time, by others bearing on the same point; we do so in the hope of giving greater publicity to our views, as to rendering the science of Geology popular on account of its utility, as well as interest, and to solicit the co-operation of all persons whose employments may enable them to make observations connected with this subject.

THE EDITOR.

ORIGINAL COMMUNICATIONS.

Ammonites Zoologically and Geologically considered.

(Continued from p. 83.)

INTERNAL CHARACTERS OF AMMONITES.

Every Ammonite is composed internally of a greater or less number of Septa, succeeding each other in regular order in several whorls of the spire; and, beyond these, of an open space, always occupying about two thirds of the last whorl. All Zoologists are agreed as to the functions of this large cavity superior to the Septa, destined to contain the animal.

Functions of the Septa.—Nothing is more simple than the functions of the Septa amongst the Ammonites and all other chambered shells. When we see them so complicated in structure, we are tempted to attribute to them great importance in the animal economy, whilst they are only analogous to the air bladders of fishes. As I have elsewhere remarked,(1)

(1) Histoire générale et particulière des Céphalopodes acétabulifères. Introduction, and at the article *Belemnites* of the Paléontologie Française, p. 24.

respecting *Sepia*, *Spirula* and the *Belemnites*, these Septa, are used for the purpose of retaining air, and are destined to sustain the animal, to render it lighter in the water, and facilitate its progression; thus we see the number of chambers, formed by the Septa, augment as the animal increases in size, so as always to compensate for its increasing weight, and maintain a perfect equilibrium, at all periods of its existence, between the animal and its shell.

Form of the Septa.—The edges of the Septa, in the Ammonites, are formed of *lobes* and *saddles*, (see figs. 1 and 2.)

FIG. 1.

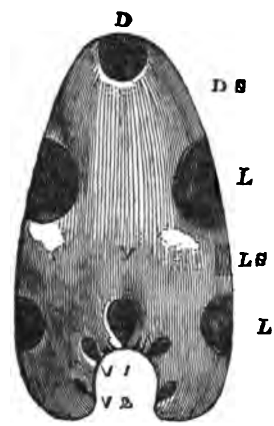
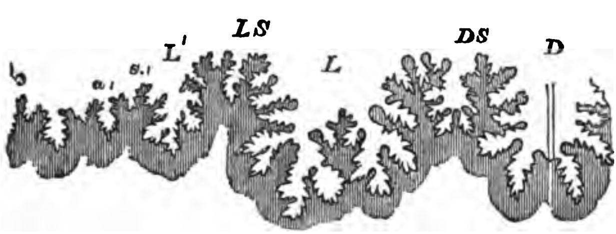


FIG. 2.



(2) The following letters which are the same as those employed by

The first directed backwards, as regards the volutions, are as M. von Buch has judiciously imagined, representatives of the numerous digitations which existed around the mantle of the animal; and have served to fix it to its shell; without them, the syphon being dorsal, the animal would have been liable to be tossed to and fro in its shell; that this is the case is unquestionable as the lobes are invariably acute in form, whilst the saddles and their ramifications, which are always directed forwards, are not, on the contrary, anything more than the intervals comprised between the large or small divisions of the lobes, and therefore always assume an obtuse form fre-

Leopold von Buch indicate the different divisions of the lobes and saddles.

D. Dorsal lobe.

L. Superior lateral lobe.

L. Inferior lateral lobe.

a^1 First auxiliary lobe.

a^2 Second auxiliary lobe.

a^3 Third auxiliary lobe.

a^4 Fourth auxiliary lobe, &c.

V. Ventral lobe.

* v^1 First latero-ventral lobe separating from the ventral lobe.

* v^2 Second latero-ventral lobe, and so on.

D. S. Dorsal saddle.

L. S. Lateral saddle.

* s^1 First auxiliary saddle (the ventral saddle of Von Buch). I have named it thus because it is frequently lateral when there are many auxiliary lobes.

* s^2 Second auxiliary saddle.

* s^3 Third auxiliary saddle, and so on.

* $s\,v^1$ First latero-ventral saddle (the saddle which separates the ventral from the first latero-ventral lobe.

* $s\,v^{11}$ Second latero-ventral saddle.

The asteriks indicate the parts to which I have myself given names.

quently rounded into large foliations, as we see in *A. Calypso, Guettardi, Thetys, Velledœ, Alpinus, &c.*

Causes of error in the study of the Septa.—The lobes and saddles of the Septa being formed by the edges of the *mantle*, and attached to the internal sides of the shell, they are covered and entirely concealed, whilst the shell exists, and their appearance on the exterior is occasioned either by the alteration of a portion or the disappearance of the entire shell. Whenever they are visible, we may rest assured that we are examining an internal cast, and not a perfect shell; and that therefore the external appendages are diminished. The outline of the Septa are apparent in the cast on the foreign matter, which filled all the cavities, when the shell was still entire, and took the impression of all the parts. As the foliations of the Septa are directly in contact with the shell, it follows that they become more divided or multiplied, as they approach the external parts, since the centre of the Septum is smooth, and the trunks of the main divisions separate from this point, and ramify towards the circumference. I wish to draw particular attention to this disposition, which might lead a person who was not aware of it into error. If the cast is in good condition, and has suffered no alteration, the divisions of the Septa will be presented in all their details; but if on the contrary, any portion of the exterior of the cast has been removed by abrasion, then a great number of the details disappear, and with the same general disposition, we find Septa essentially different from what they ought to be; the dissimilarity of the Septa augments with the progress of the external alteration, until it becomes complete. Thus, when examining the Septa, it is always indispensable to assure ourselves, that no alteration has taken place in the external parts, before we can pronounce on their true form.

Natural varieties of the Septa.—I have not observed any natural varieties in the Septa. All taken at the same age afford precisely the same general characters, and do not vary but within very narrow limits, and simply in the ultimate details of the small foliations of the lobes and saddles. I shall nevertheless adduce an instance which determines some slight variations, not in the general form or details, but in the elongation or shortening of these parts, without producing any other modification. This instance generally takes place in the last Septa, which an Ammonite has formed before its death, and appears to be caused by disease or old age. It takes place in the Septa which approach nearest each other. These, instead of maintaining the regular increasing distance, approach suddenly, and in a considerable degree in the three or four last ones; and then, all the ramifications of the lobes and saddles not being able to attain their usual extension, it follows that these parts become considerably shortened, still preserving the same width. We may say, as a general rule, that the larger the chambers in a species, the more the foliations of the lobes are elongated. I look upon the increasing separation of the Septa, as the sign of a perfect state of health in the Ammonite, whilst their approximation clearly indicates an unhealthy condition. I have not remarked any difference arising from sex.

Varieties of the Septa from age.—Though the general form of the Septa is invariable in the six *primitive lobes*, (the *dorsal, ventral,* two *superior lateral,* and two *inferior lateral* lobes,) it is by no means so, as regards the complication of their ornaments, and the number of the auxiliary lobes, which all vary according to age, but within very different limits from those of the external appendages.

1.—An Ammonite taken in the embryo state, for example, whatever may be the ultimate number of the auxiliary lobes, is always furnished with the six primitive lobes I have mentioned. At this period, the lobes and saddles indicate the grand divisions they ultimately attain; they are equal or unequal in their ramifications; but the ramifications are in the most simple condition, frequently shewing but a single point for each future main branch, or a large festoon, to represent the division of a saddle, which ultimately becomes deeply foliated. Thus, all the component parts, as in Ammonite itself, are in their most simple state, with this difference, between the external and internal characters, that the Ammonite already presents all the indications of the characters of the lobes it ultimately obtains, whilst it does not present any of its ultimate external ornaments.

2.—From this period until death, the Septa do not undergo the same alterations as the external appendages. They become more complicated as the Ammonites increase in age, and never degenerate. There is then, in this respect, a complete dissimilarity between the internal characters, and the external modifications arising from age. On the sides of the advancing points of the lobes of the embryo period, which represent a main branch, we see other points gradually appear, which represent the ramifications. Each becomes more and more divided; the branches become formed; the ramifications develope themselves; the foliations of the latter successively appear and multiply, and the simple point of the embryo period is represented, in the adult state, by a large branch, often ornamented by numerous ramifications, and a large number of foliations. It is the same as regards the saddles; they become more and more subdivided by the auxiliary lobes; the simple festoon of the embryo state is divided and subdivided, the auxiliary lobes increase and ramify to infinity, and at the adult period, the simple festoon is replaced by a number of foliations, and frequently by the most complicated ornaments. It is remarkable, that the complication of the ornaments continues to increase during the existence of the Ammonite.

Number of lobes.—I have already stated, that the Ammonites are always provided with at least the six primitive lobes. Amongst those which are only provided with these, are, *A. subfimbriatus, Honnoratianus, quadrisulcatus, striatisulcatus, strangularis,* and *Juilleti* of the Cretaceous rocks, and *A. fimbriatus* of the Jurassic formation, the lobes and saddles are at their greatest number, and only become more complicated in their ornamental parts; but this is not the case with those Ammonites, which ultimately acquire a larger number of lobes. They have frequently, one or two auxiliary lobes in the embryo state, as we find in *A. interruptus,* and the number at this period, is always dependant on the number they ultimately attain. The others appear successively at different periods of the growth, till they arrive at their maximum number, which generally takes place at the *adult* period, or the second period of growth.

In conclusion, age produces no changes in the modifications of the septa except 1st. in the complication of the ornaments of the divisions, which exist in the embryo period, and become more developed during the existence of the Ammonite; 2nd. in the number of the auxiliary lobes, which takes place chiefly during the earlier period of the animal existence: thus, by always comparing individuals of the same size, as to the number, form and details of the lobes, we shall acquire certain information as to the identities, or differences which exist, and we shall be positively assured, whether the individuals are the same, or distinct species. By always choosing an adult individual, when examining the septa, we shall find the divisions complete. The variations arising from age will entirely disappear, and the internal characters of the septa, may always be applied in determining the limits of species.

Dependance of the number of the lobes on the greater, or less envelopment of the whorls.—If we find the number of the lobes very variable, according to the more or less rapid growth of the species, it is much less so, when we compare it to the envelopement of the whorls by each other, or rather to the size of the whorls themselves. In fact, having examined all the species comparatively in this respect, I find that:—

1.—In those Ammonites whose whorls are simply in *contact*, as (*A. subfimbriatus, Honoratianus, quadrisulcatus, striatisulcatus, strangularis* and *Juilleti*) their number is invariably at a minimum. These species have, on each side, the *two primitive* lobes (the *superior*, and *inferior lateral*).

2.—In those Ammonites, of which about the fourth of each whorl is concealed, *(A. Cryptoceras, Duvalianus, Lyelli, varicosus, regularis,)* the lobes are generally three on each side, that is to say, the two primitive lobes, with one auxiliary lobe; they vary nevertheless as far as the maximum of five.

3.—Amongst the Ammonites, in which only half of the whorls is visible in the umbilicus, *(A. Leopoldinus, Parandieri, interruptus, tuberculatus, Michelinianus, mammillaris, Gevrilianus* and *auritus)*, the lobes vary from three to six, the limits being already greater.

4.—Amongst those Ammonites, where only a quarter of the whorls is apparent in the umbilicus, (*A. fortisulcatus, impressus, splendens, Beaudanti, Belus, latidorsatus, Guettardi, Quercifolius, &c.*), the number of the lobes, varies from five to nine, the number evidently increasing with the greater envelopement of the spire.

5.—Lastly, in those Ammonites where the last whorl envelopes all the others, *(A. semisulcatus, Thetys, picturatus, Terverii, alpinus, Largilliertianus, &c.)* the number varies between eight and ten, the latter number being the highest I am acquainted with amongst the Ammonites.

Thus amongst the Ammonites, the number of lobes has certainly a connection with the envelopement of the spires by each other, as we find species whose whorls are only contiguous, and not enveloped, have only two on each side; the species having the whorls half enveloped, vary between the limits of five and nine lobes, on each side, whilst the species whose whorls are entirely embracing, are provided with eight or ten, attaining the maximum number at present known. The reason of the increase in the number of lobes, in proportion as the whorls become enlarged, is self-evident. The animal would have a larger surface to cover with ramifications in those whorls which were embracing, than in those which were not so; and it would, therefore, be requisite, either that the lobes and saddles should be increased in size, or that there should be a larger number of lobes. Nature has preferred the latter method.

IRREGULAR SEPTA.

It has always been thought, that the septa of Ammonites were placed in symmetrical order, and corresponded perfectly with the admirable regularity of the shell; that the dorsal lobe for example, was invariably placed on the mesial line, and that the others appeared at equal distances on each side. This is not, however, the case, as I have found exceptions to these rules in four instances, *A. denarius, splendens, Fittoni,* and *Lyelli,* in which the dorsal lobe, instead of occupying the mesial line, is placed sometimes to the right, and sometimes to the left of it, indifferently, the middle lobe corresponding to the sides of the back.

Being struck with this anomaly, I was desirous of ascertaining, whether it took place from an early age; and I found (more curious still), that in the embryo period, the above named species have the septa symmetrical, like other Ammonites; that the dorsal lobe does not diverge on one side until the shell commences to form the tubercules on the back; this is an uncommon example of a true metamorphosis, in the position and form of the septa. Whilst I look upon this irregularity as exceedingly curious, I by no means consider that it is of any great value in the classification of groups; all the other characters being similar in form to those of the allied species. It is but anomaly.

Another series of irregular septa, equally interesting, but which cannot serve as the base for any group, is that which we remark in *A. Vibrayeanus* and *Morensis*. In the first instance, the lobes and saddles are entirely without any division, or ramification; they are all rounded and entire, but not angular, as in the Goniatites. In the second instance, the divisions of the septa are less uncommon; we can recognise distinct lobes, and saddles in the midst of numerous confused foliations.

Regular Septa.—The regular Septa may, by their forms, and ramifications, be divided and subdivided to infinity, as they undergo a large number of modifications. I have already mentioned the number of the lobes, and their connection with the external form; we will now examine whether the other modifications are affected by the same cause. The Septa are composed of lobes and saddles, and the lobes are divided into equal or unequal parts.

*Lobes divided into equal parts**.—I give this name to

* Von Buch does not appear to have been aware of this mode of division; at least I find no trace of it in his works.

those lobes, which, with the exception of the dorsal lobe, (which is always so,) are formed at their extremity, by two equal branches separated at the lower part, on the mesial line, by a small accessory saddle, *(Am: Duvalianus, Vernieulianus, Mantellii, Rhotomagensis, Juilleti, quadrisulcatus, striatisulcatus, &c. &c.)*

Lobes divided into unequal parts.—These lobes, instead of being divided into two equal parts, by an accessory saddle at their extremity, are, on the contrary, formed by a single conical branch, which terminates in a point; if there are auxiliary saddles, they are lateral and equal, *(A. denarius, Cryptoceras, Leopoldinus, auritus, Mayorianus, varians, Lewesiensis, &c).*

Saddles divided into equal parts.—The same divisions, as in the lobes, form the saddles divided into equal parts. They have, at their superior extremity, two equal parts separated by an auxiliary lobe; they belong in the first instance to all the species having the lobes equal, (*A. Duvalianus, Mantellii, Rhotomagensis, Juilleti, quadrisulcatus, striatisulcatus;*) and to a great number of species having the lobes unequal, (*A. denarius, lautus, Dupinianus, Leopoldinus, Diphyllus, Velledæ, Lewesiensis, Mayorianus, varians, &c.*); thus, on the one hand, all the species having the lobes of equal parts, have invariably the saddles formed of equal parts, whilst the greater number also having the lobes formed of unequal parts, have also the saddles formed of equal parts. In eighty-one species having the lobes of unequal parts, sixty-two are provided with saddles having the parts equal, and nineteen only unequal.

Saddles divided into unequal parts.—The saddles I have thus named, are those which, instead of being divided in the middle by a single auxiliary lobe, are divided by two, so as to have a median foliation, (*A. Deshayesi, verrucosus, Martinii, pretiosus, Leannotti, impressus*); or otherwise the auxiliary lobe, instead of dividing the saddle into two equal portions, is placed on one side, and thereby, the saddle is divided into two very unequal parts, (*A. regularis, tuberculatus, auritus, lautus, &c.*)

From these grand divisions, we may imagine that there are many others arising from combination, according as all the saddles or lobes are formed of equal, or unequal parts, or when only the first are found in this condition. But these divisions are entirely confined to species, and cannot be applied in a general manner. To render them more easily understood, I attach the following tabular view, taking the lobes formed of unequal parts, as the point of departure.

Lobes formed of unequal parts.	Saddles equal.	In all cases.	The first only equal.
	Saddles unequal.	In all cases.	The first only unequal.

Besides these characters of lobes formed of equal, or unequal parts, there yet remains another important one, which adds to their complication, and multiplies their combinations; it is that of the relative length of the *dorsal lobe*, compared with the *superior lateral* one; thus in certain cases, the dorsal lobe is longest; and 1st. the lobes are equal, (*A. striatisulcatus, strangularis, Vernieuliensis, Mantelli, Rhotomagensis, Fleuriansianus, Woolgari*); 2nd. the lobes are unequal, with unequal saddles, (*A. varicosus, Delarnei, Bouchardianus, Roissyanus, inflatus);* with equal saddles, (*A. Largilliertianus*).

The dorsal lobe is equal to the superior lateral lobe, 1st. with equal lobes, (*A. Juilleti, Duvalianus, quadrisulcatus, Requienianus*); 2nd. with unequal lobes; (A) the saddles unequal, (*A. simosus, pretiosus, Belus, ligatus, regularis, Martinii, &c.*); (B) the saddles equal, (*A. crassicostatus, semisulcatus, latidorsatus, mammillaris, &c.*)

The dorsal lobe is shorter than the superior lateral lobe, 1st. with the lobes equal, (*A. Ophiurus, sumfimbriatus*);

2nd. with the lobes unequal; (A) the saddles unequal, (*A. Clypeiformis, Jeannoti, Deshayesi, Gonpilianus, &c.*); (B) the saddles equal, (*A. denarius, Grasianus, Dyphyllus, Mayorianus, Velledæ, &c.*).

[*To be continued.*]

GEOLOGY APPLIED TO CIVIL ENGINEERING.

On the recent slips of earth on the Brighton and Croydon Railways; the Geological reasons of their occurrence; and hints for the prevention of earth slips. By the Editor.

As long as Geology remains a science of pleasure and intellect only, so long we fear, must it be considered as liable to an unfavourable reception from the public generally of the present day; but fortunately, the various purposes for which it is so aptly designed, and the number and value of the objects which have already been gained by a successful adoption of its principles in the rule of action, have contributed not a little to its popularity, and to its general study.

We have been forcibly struck of late by the various opinions which we have heard expressed as to the successive slips of earth which have taken place on the Croydon and Brighton Railways, many of them arguing solely upon mechanical, many more upon Geological hypotheses only, whilst both only arrived at their surmises by a tolerable infusion of doubtful assertions, founded upon fewer observations than reports. The subject being one of very general interest, not only to the Geological world, but to railway capitalists generally, we have taken this favourable opportunity of offering an opinion upon the subject, from a careful examination of the facts, as well as of the respective localities of the slips in question, which we hope will contribute to a more general observation of the sub-soil in cases where the harmony of nature is required to be disturbed by the wants or frivolities of mankind.

We will treat each of these "slips," as they are commonly called, separately, in order that the respective details may not be confounded; but previous to so doing, we will consider the causes from which these effects originate, in order to show the practicability of Geological reasoning in such causes. The natural cause of a "slip" may be:

1.—The destruction of the general equilibrium of a mass of earth, by the removal of any portion in such a manner, that the quantity remaining, falls from its own weight—being unsupported.

2.—The complete saturation of a mass of earth by constant rain or wet, whereby the equilibrium is destroyed, and the effect may be traced to a gradual weakening of the soil on which it rests, added to the weight attained by the portions next the surface which receive the greatest share of moisture.

3.—The intersection of the strata of any district in such a manner, as to interfere with the natural drainage, whereby the above cause (No. 2) may have originated.

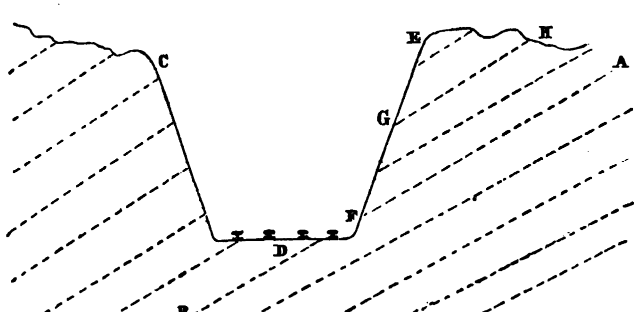
4.—The like intersection as in the preceding case, interfering with the equilibrium of those portions of earth left exposed above or below the dip of the strata.

We will not offer any remarks on the first case, which must be apparent to every person; the second is determined by local circumstances only, such as the nature and situation of a particular stratum, whether it is the lowest point of drainage of a district, and hence the greatest receptacle of natural moisture, under which circumstances, it is clear that if a cutting or embankment was made in that part, it would be more liable to slip than in any other situation of that district; in the third case, we find the knowledge of the

Geologist required, in proving that by interference with the natural line of drainage (in other words, the dip of the strata) in a manner to throw the surplus of water from the surface soil, along a natural slope, into an exposed mass of earth beneath, the engineer has disturbed the natural drainage which is beneath the several beds, in the direction above referred to; and fourthly, whether the intersection of the strata has taken place in such a manner as to leave a portion of earth unsupported, on the slope of the natural dip of the strata, and hence facilitated its descent, however accurately the mechanical laws for slopes in earth work have been observed. These reasons will at once suggest the value of Geological knowledge in the enquiry, and as in this instance we hope to prove that the "slips" in question originated from Geological causes, so to speak, that so on future occasions, our work may be made the medium for similar enquiries, and for preserving the records of the Geological appearances on the various lines of railway in this country.

On the Croydon Earth-slip.—The deep cutting in which this slip occurred is formed in the London clay formation, which is a portion of the great London basin, and possesses a laminated structure in the direction of the line of deposition; although without apparent stratification. In Fig 1,

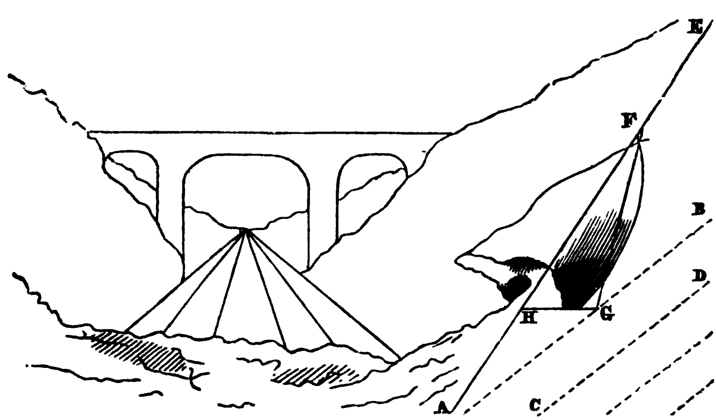
FIG. 1.



the lines, A, B, G, H, represent the direction of the laminated bed, with reference to the sectional view of the excavation C, D, E. It will be seen that these beds are intersected at an angle by this excavation, leaving various triangular masses of earth on the right hand side (E. G. H, E. F. A,) the base lines of which are at an angle considerably elevated from the horizontal line. Now from an examination of the causes which are conducive to the occurrence of slips, which we have recorded, it will be found that these circumstances may be classified under the second and the third divisions; for the line of deposition A. F, being as stated, the line of drainage, and the moisture percolating in that direction, so soon as the position of the super-incumbent mass of earth is rendered insecure by the removal of any portion of the earth at its base (along this line) a slip necessarily takes place.

We have given a perspective view of the deep cutting on the Croydon line (Fig. 2) in order to demonstrate these

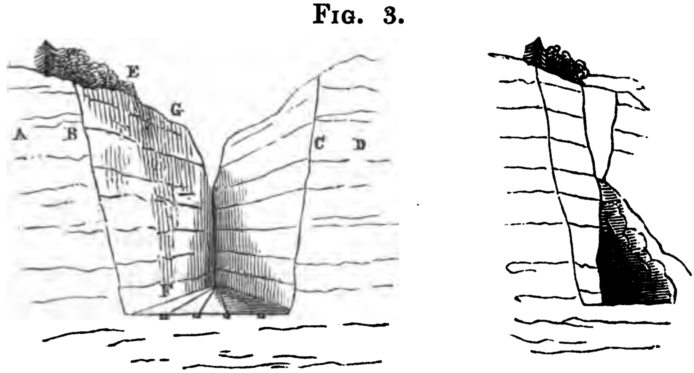
Fig. 2.



arguments yet more clearly. The line A. E is that of the slope of the embankment, and the lines A. B, C. D the lines of the dip: the first slip occurred in that portion, and was of the comparative extent denoted by the triangle F. G. H. The obvious reasons of this occurrence must therefore have been a defect in the security of the mass on the line A. B, and the first displacement was that of the mass of earth, the sectional extent of which is represented by the letters G. F. H, forming a portion of the larger triangle A. B. E, situated between the line of dip and that of the slope of the cutting. Under ordinary circumstances this slip would have extended to the whole triangle A. B. E, but the cubic quantity of earth displaced, and precipitated below, having added to the security of the subjacent portion A. G. H, the slip was confined to the upper portion, as stated. We have thus endeavoured to explain the invariable rules of nature, in subverting the most careful mechanical calculations; for under ordinary circumstances, no greater security could have been required beyond that which the angle of the slope presented. We have shown how prominently the atmospheric changes influence the security, independent of any internal disintegrating causes; but in this particular instance, the composition of the clay itself offers additional illustration. We are indebted to R. S. Young, Esq., the Secretary of the Croydon Railway, for the following extract from the report on the causes of the slip, prepared some time since for the Board of Directors, and as it demonstrates other accelerating causes which existed in the case in question, we feel much pleasure in inserting it. "On examining the clay," it is stated, "at the embankment of the Croydon Railway I find that it contains minute crystals of sulphate of lime *(Selenite)* and these appear to be formed and continually forming by the action of air and moisture on bi-sulphuret of iron, which the clay also very usually contains; this, by the action just mentioned, is converted into sulphate of iron, with excess of sulphuric acid, and this coming into contact with carbonate of lime, commonly existing in clays, appears to produce, though slowly, the crystals of sulphate of lime, by well known chemical changes; this must be accompanied with extrication of carbonic acid gas, which if the quantity be sufficient and the production rapid enough, would certainly account for the rising of the earth. Other concomitant circumstances may increase this effect; these are, that the bisulphuret of iron and carbonate of lime, would occupy more space than in their original state. It also happens that the sulphate of lime (unlike the carbonate of lime which yields its lime) is dissolved by water; so that the minute crystals of this substance, when the clay is pervaded by water, would be dissolved by it, and the clay rendered additionally loose in its texture, and more readily subject to removal by rain water. It is further to be observed, that this effect of rain water is increased by the difficulty with which it sinks below a certain depth, on account of a hard stratum of earthy matter which occurs at some feet below the surface."

On the Brighton Railway Slip.—This slip occurred in the chalk formation, at a locality where the beds of the chalk are perfectly horizontal, and hence, free from all the dangers above referred to. We have endeavoured to represent the circumstances in Fig. 3, the line A. B. C. D, showing the

FIG. 3.



continuity of the beds of chalk. The slip, as will be seen in the small sketch annexed, took place on the left hand side, and in the triangular form denoted by the letters E. F. G; which upon examination was found to be a faulty portion of the chalk, the component parts of which had become disintegrated by the rainy summer preceding the slip. These faults are frequent in the chalk, and hence, where they are not observeable on first sight, the horizontal beds are perpendicularly intersected, with every apparent security, and the fault first appears upon exposure. No caution can therefore guard against such occurrences.

We have received numerous letters on other "land slips" along the coast, especially in the chalk of Western Norfolk, and the sands of Kent and Dorsetshire, but we will merely state that they may all be referred to the first class, and therefore require no particular comment; but in our character as journalist, we have considered it a duty to dwell at greater length upon those two occurrences, which have for so long a time occupied the thoughts of Railway proprietors and engineers.

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY OF MANCHESTER.

February 24th. 1842.—James Haywood, Esq., in the chair.—Previous to the business of the evening, Mr. Binney informed the members that Mr. Looney had delivered lectures to the working miners at Miles, Platting, and Oldham, in addition to those places noticed at the former meeting. Mr. Phibbs also exhibited a portion of a fossil human jaw, alleged to have been found in the solid chalk near Winchester, seventy-six feet from the surface, but as no satisfactory evidence had been produced to verify these statements, nothing further could be urged as to the occurrence.

Mr. Binney next proceeded to read a brief notice of the Geology of South Australia, connected with the exhibition of some beautiful fossil shells sent him by a friend at Adelaide.

In the province of Australia, a vast marine fossil formation extends from about 139° 15′ of longitude, with an imperfectly known width towards 141°, the western boundary of the province; and from about 32°

40′ of latitude, to at least the latitude of the sea mouth of the Murray. Its strata are horizontal, and its surface generally quite level, or very slightly undulated. Its greatest elevation may be stated at 400 feet above the level of the sea. Its upper strata are beds of three or four feet in thickness, composed entirely of common oysters and oyster-shells, not broken or exhibiting marks of attrition. Below, there are much deeper beds of mixed coral, echini, pectens, spirals, and other small marine shells, generally much broken, and deposited in sand, limestone, and sometimes selenite, alternating with beds of sand without shells. At the base of these, or beneath them, are vestiges of fishes, teeth, and nautili, of 4 or 5 inches in diameter. In the valley of the Murray, about at. 35° 6′, are several points of granite projecting a few feet above the surface of the flats: one of these, eight feet in diameter, forms an island in the middle of the river. The neighbouring country, from its appearance, is possibly the line of the highest elevation of the fossil formation. Beds of the excellent compact limestone occur sometimes in the fossil formation. The surface stratum is either a mixture, principally of sand and carbonate of lime, the latter in a large proportion, or sand only. The mixed sand or carbonate of lime is very extensive: immense plains are wholly composed of it. On the banks of the Murray, from Lake Alexandria to the Great Bend, the surface of the fossil formation is covered with a thick brush of slender trees, shrubs, and bushes. On the north-western and northern limit of the great plains, there is evidently a great drainage to the E. by N. or N. N. E. It is not unreasonable to speculate, that this may, by an inconsiderable bend, produce by filteration, springs to supply Lake Victoria. As regards the province of South Australia, the valley of the Murray in its whole length, i. e. for about 200 miles, is a hollow cut through this great fossil formation to nearly the depth of the level of the sea; so that the hills and cliffs of either bank stand sometimes close to the margin of the river, sometimes at a distance of one or two miles from it, at elevations of about 300 feet. The long lines of hills and cliffs which bound the Murray valley, maintain throughout a rough parallelism to each other; but the river scarcely ever preserves an equal course between them. It sweeps continually in magnificent reaches from side to side, forming perpendicular cliffs wherever it strikes the hills, and encircling never-ceasing flats of from half a mile to four or five miles in length. The great Murray fossil formation is this province; is bounded to the westward by the great dividing range, which, commencing from the southward at Currency Creek, Encounter Bay, Yaukalilla, and Mount Terrible, unites into a general ridge to the north-eastward of Willunga, passes by Mount

Barker, divides at Mount Torren (nine miles north of Mount Barker), the sources of the Torrens, the Onkaparinga, and the Bremer, soon afterwards assumes a northerly course, parallel to the Murray, at about thirty miles miles of distance from it; inclines to the westward of north when nearly west of the great south bend; and terminates its northerly course abruptly in about 30° 20′, 65 miles N. W. by W. of the great bend at Mount Bryan (a mountain probably 2,400 feet in elevation.) From Mount Bryan, the great dividing range takes a sudden turn to the westward, and appears to join Flinder's range near the shores of Spencer's Gulf, in about latitude 33° 18′. From near this last point, it throws out a range, of which most of the peaks must be at least 2,000 feet in elevation, which, running to the E. by N. and E. N. E. passes to the northward of Mount Bryan, and continuing the same course to the limit of sight from Mount Bryan, forms, as far as it extends, a northern boundary to the immense plains of the Murray fossil formation. These ranges are, or appear to be, everywhere composed principally of slate.

Mr. Binney then proceeded to direct attention to the fossil shells on the table.

These (he said), were found at the town of Adelaide, immediately behind the South Australian Arms Inn. There, on sinking a well for water, they were met with at a depth of 160 feet from the surface. The mass appears to consist of a vast number of shells, cemented together with carbonate of lime and sand, containing a considerable amount of per-oxide of iron. It bears a great resemblance in its appearance to our crag formation, though the organic remains which it contains have not been yet identified with those of any European formation. The fossils which it contains, and for the most part of which it consists, are a large *ostrea*, a *pecten*, fragments of large bivalves, two specimens of *cidaris* (the spines of an *echinus*,) one having a cancellated structure and the other plain, a parasitical coral, several bones of fishes (chiefly ribs), a very minute bivalve shell, and a small univalve, resembling in external appearance a nautilus. These last-named minute fossils I found in the sand, deposited in the interior of the larger bivalves. The small bivalve is about one-third of a line in length, and a line in breadth. From the imperfect condition of the open valve, nothing can be determined by its hinge, so as to decide to what genus it belongs. The small univalve is the most remarkable shell, and it is to it that I shall direct my attention. It is scarce half of a line in diameter, is of a nearly lenticular shape, and has its outside marked with fine wavy lines of growth, forming minute ribs across its surface. In the furrows between these ribs are numerous fine oval punctures. The number of chambers in the specimens vary; but in one case they are 42 in number. The transverse plates are convex outwards, like those of the genus *ammonites*; and the projecting collars, which supported the siphuncle, extend outwards and not inwards, as in the *nautilus*. The orifices for the passage of the siphuncle are in the centre of the transverse plates, like those of the *nautilus*, and not in the side, like those of the *ammonites*. As yet, I have not been able to discover any part of the siphuncle itself, although there can be no doubt but that one existed; as the collars are seen projecting outwards, in one of my specimens. The outside of the shell is much thicker, in proportion to the transverse plates, than in the *nautilus*. The shell appears to me to be a new genus, partly resembling a *nautilus*, and partly an *ammonite*, but differing in some respects from both. There are at least three species of this shell. From the shells, and the description of the deposit, there is no doubt but that the strata at Adelaide, where the specimens were procured from, was the lower portion of the great fossil formation, mentioned by Governor Gawler.

GEOLOGICAL SOCIETY OF LONDON.

January 5th. 1842.—R. J. Murchison, Esq., President, in the chair; the following communications were read:—

1.—*On the fossil bones, found on the surface of a raised beach, at the Hoe, near Plymouth, by Dr. Moore.*

The author proves in this paper, that these bones are of remote origin, and that no human agency could have placed them in their present position. 2nd. That their situation, being on a *modern* beach, could not be confounded with a diluvial, or drift accumulation. 3rd. That as no evidences of glacial action existed in the neighbouring district, the beach could not have been formed by this agency; and lastly, he concludes, that the beach was raised above the level of the sea, most probably at a period more recent, than the time of the disappearance of the animals, whose bones are found upon it.

2.—*An account of the contortions and faults produced in the strata underneath and adjacent to the great embankment, across the valley of the Brent, on the line of the Great Western Railway, by Mr. Coulthurst.*

This paper related to the displacement of a sub-soil, consisting of a stratum of brown alluvial clay, four feet thick, and a bed of gravel from ten to thirteen feet thick, resting upon the London clay, and covered by vegetable soil, from the construction of an embankment, fifty-four feet in height, which had subsided to a considerable extent. The effect observed in the strata, was a contortion of the beds parallel to the undulated outline of the surface. This paper contained an elaborate account of the progress of the subsidence, and the developement of the effects.

3.—*Notice on the occurrence of fossil plants, in the plastic clay, at Bournemonth in Hants, by the Rev. P. B. Brodie.*

These beds of clay appear beneath the white and yellow sands of the plastic clay, at the higher parts of the cliffs, to the east of Bournemouth. Impressions of ferns appear in a bed of white sand, near the middle of the cliff, and a layer of sandy clay is full of small leaves. Somewhat further are beds of sand, and sandy clay, abounding with beautiful vegetable remains, so perfectly preserved that the epidermis peels off, when the specimen is exposed, and which are evidently of tropical origin.

4.—*On the mouths of Ammonites, and on other fossils found in the Oxford clay, near Christian Malford, on the line of the Great Western Railway, by Mr. C. Pearce.*

The section exhibited at the point, whence the specimens were obtained is as follows:

1.—Alluvial soil	2 feet.
2.—Gravel	8 feet.
3.—Beds of laminated clay, alternating with layers of sandy clay, composed of broken shells	6 feet.

The fossils described, were procured from No. 3, and consisted of crustaceans, which probably inhabited the dead shells of the Ammonite, and to which he applies the generic name *Ammoni-colox,* and an allied genus, for which he proposes the name of *Belemnoteuthis.* Mr. Pearce is of opinion that the lip, or perfect termination, assumes a different shape in almost every species, and that it has a simpler form in the adult, or full grown shell, than in immature individuals. He considers that the lateral prolongations, were successively absorbed and reproduced, but were never added to the final lip, and that they were for the support of the animal, which extended beyond the last chamber, contrary to the presumed conditions of the mature individual.

February 2nd.—The President in the chair. *A Paper on the South of Westmoreland, by Mr. D. Sharpe, was read.*

These remarks extended to the Coniston Lime-stone, Blue Flagstone rocks, Windermere rocks, and Ludlow rocks of the Silurian group; and to the Old Red Sandstone, bearing principally upon the observations of Prof. Sedgwick, as described at p. 25.

February 18th.—This being the ANNIVERSARY MEETING, the election of officers took place, when Mr. Murchison was re-elected *President*—Dr. Buckland, Dr. Daubeny, Dr. Fitton and Mr. Lyell, *Vice Presidents*—Mr. E. H. Bunbury and Mr. Hamilton, *Secretaries*—Mr. de la Bèche, *Foreign Secretary*—and Mr. John Taylor, *Treasurer*. The Wollaston medal was awarded to M. von Buch, for "his eminent services rendered to Geology," and the proceeds of the Wollaston Fund to Mr. Morris, to assist "in preparing for publication, a table of British Organic Remains."

February, 19th. 1842.—R. J. Murchison, Esq., President in the chair; *a paper was read, on the recession of the falls of Niagara, by Mr. Charles Lyell.*

Mr. Lyell recapitulates in this paper, the various opinions which have been made public, with reference to the positions of the falls, and the geological characters of the environs; and then states, that the strata between Lakes Erie and Ontario, are considered to belong to the middle lower portions of the English Silurian system, and are divisible into five principal formations, viz:—

1.—The Helderberg limestone, representing the Wenlock rocks of Mr. Murchison's system, and attaining at Scholarie a thickness of three hundred feet.

2.—The Onondaga salt group, consisting of red and green marls, with gypseous beds, and non-fossiliferous, differing from any member of the British group. The thickness is from eight hundred, to one thousand feet.

3.—The Niagara group, consisting of limestone, and shells, both containing fossils identical with those of the Wenlock series.

4.—The protean group, which crops out at the base of the falls, and composed of hard limestones, with *Graptolites, Pentamerus oblongus, P. lævis:*

5.—The Ontario group, rises from beneath the Protean, about a mile below the falls, and is from two hundred to three hundred and fifty feet in thickness. The two latter groups Mr. Lyell considers to correspond with the lower Silurian rocks of great Britain. Mr. Lyell then enters upon the consideration of the various circumstances with respect to the position of these rocks, and the probable changes in the course of the river, and consequently of the falls.

February 23rd.—R. J. Murchison, Esq., President, in the chair; *a paper was read by Professor Owen, on the mammalian remains exhibiting at the Egyptian Hall.*

We have elsewhere reported the conclusion at which Prof. Owen arrived in this paper, which contained an account of the most remarkable of the specimens in Mr. A. Koch's collection; from which he deduced his arguments, and which he substantiated, by reference to other recent and extinct animals. We will only recapitulate that Prof. Owen is of opinion, that with the exception of a few bones of the Mammoth, all the remains in Mr. Koch's collection may be referred to the *Mastodon giganteum* of Cuvier.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.

Wolverhampton.—The first meeting of this branch Society, was held in February 11th. last, at the Assembly rooms, and was most numerously attended. Henry Hill, Esq., President, in the chair.

Various remarks were made with reference to the establishment of this society, its utility in promoting the success of the parent Institution, and congratulatory on both these points; after which Mr. Jukes delivered the opening address, in which, after apologizing for his humble efforts, as compared with those of Mr. Murchison, who had delivered a similar discourse on the foundation of the Dudley Society, he traced the peculiar features of the mineral district of the neighbourhood, and pointed out the advantage which the parent Society possessed, with regard to its situation; Dudley being, as he expressed it, "the key of their geological position." The address contained many excellent remarks on the value of geology, and pointed out as the object of the Society, the examination of the *solid geometry* of the district, the formation of accurate charts, and the establishment of a central museum of the geological productions and peculiarities of the neighbourhood.

The thanks of the Society were presented to Mr. Jukes, on the motion of Mr. A. H. Browne, who in a short speech, called attention to the most valuable considerations in the address, and the meeting separated in a manner which would predict a continued activity in the management and conduct of the society.

SCIENTIFIC SOCIETY OF LONDON.

The first meeting of this Society, at their apartments in Gray's Inn Square, was held on February 16th. last, when a paper was submitted from Mr. James Buckman, (corresponding member of the Society at Cheltenham,) on the oolite formation of that district; but having been kindly favoured with a copy of the entire communication, which we shall present to our readers at no very distant date, we will at present merely remark, that the lucid arrangement of the details gave great satisfaction to the members. A long discussion subsequently ensued, as to the lithological character of the oolites of that district and of the West of England generally.

PARIS ACADEMY OF SCIENCES.

February 1*st*. 1842.—Mr. Ebelmen submitted a memoir on the nature of the various vapours developed in smelting, as observed at different altitudes in the furnaces. The following results were stated:

1.—The gaseous vapours, on coming out of a furnace heated by charcoal or wood, contain watery vapour, carbonic acid, and oxides of hydrogen and azote, but no carbureted hydrogen. At six, or eight feet below the mouth of the furnace, the watery vapour is not found, and the proportion of oxide of carbon increases, while those of hydrogen and carbonic acid diminish, according as the observations are made lower and lower down in the furnace.

2.—When coal is used jointly with wood, in heating the furnace, the carbonization of the vapours takes place in an internal zone, and the water is expelled from the metal at a very low altitude. He found that the proportion of gas which traverses a certain zone of the furnace per minute, is greater according as it is further from the bottom of the furnace.

A communication was read from M. Russiger, a German geologist, on certain geometrical observations, made in order to ascertain the relative altitudes of the Dead Sea, in Palestine, and in the Mediterranean. It appeared that not only was the Dead Sea 1,314 feet lower than that of the Mediterranean; but also from the geological phenomena observed on its shores, that the formation of the basin in which it lies, was antecedent to all historic epochs. Hence the supposition that the sea was formed by the sinking of the plain of Pentapolis, is incorrect.

REVIEWS.

Cours Elémentaire d'Histoire Naturelle. Minéralogie et Géologie, par F. S. Beudant, 12*mo. Paris, Langlois et Cie. Fortin, Masson et Cie.* 1841.

This work is one of a series published under the sanction of the Paris University, and edited by MM. Beudant, de Jussieu and Milne Edwards, and is consequently drawn up in conformity with the regulations observed at that Institution, of which a copy is prefixed to the work.

Like every introduction to the science of Mineralogy, a great portion of the work is devoted to an examination of the characters of mineral substances, their physical properties and crystallization, which latter department is certainly treated in the most ample and satisfactory manner, but the ground being already well trodden and the plan of this portion presenting nothing new, we do not consider it essential to include a lengthened notice.

The most interesting portion relates to a classification of minerals on a chemical system, which, although not completely novel, presents the subject under a very different aspect to that advocated by any other author, and to follow up in this instance the plan which we have adopted with regard to Reviews generally, we will give a tabular view of the arrangement in its proper place. We cannot say that we enter completely into the author's views on this subject, because we have always entertained an opinion, that the *predominant constituent* should contribute to the arrangement in most cases, the exceptions being confined to those minerals only, the peculiar characters of which are attributable to some *qualifying component part,* detracting from the power which would otherwise be exercised by the predominant component. The peculiar aptitude which substantives in the French language offer for conversion into adjectives, and the simplicity of expression which these terms convey, has recommended the insertion of this outline synoptical view in the original phraseology.

Palladium.	Plomb	Melaconise.
Platine.	Massicot.	
Or.		
Argent.	Minium.	Oxide cobaltique.
Mercure.	Cuivre.	Oxide cobaltique et manganique.
Amalgame.	Zigueline.	

CLASSES.

Sidérides, Manganides, Chromides, Aluminides, Tantalides, Tungstides, Molybdides, Uranides, Titanides, Stannides.

Antimonides.	*Arsenides.*	*Phosphorides.*
Antimoniure.	Arséniure.	Phosphures arseniures dans les composés artificiels.
Oxydes.	Oxydes.	
	Arseniates.	
	Arsénites.	Phosphates.
Tellurides.	*Sélénides.*	*Sulfurides.*
Telluriures.	Seleniures.	Sulfures.
Do. doubles.	Do. doubles.	Do. doubles.
		Acides du Soufre.
		Sulfatées.

Chlorides, Bromides, Iodides, Fluorides, Hydrogénides, Azotides.

Carbonides.

Carbone. Carbures.

Sels Organiques.

Carbonates.

Anhydres rhomboédriques, Anhydres prismatiques.

Hydratés, Hydratifères,

Sulfatifères.

Borides.

Borates. Borosilicates.

Silicides.

Silicates simples alumineux.

Anhydres, Hydrates, Hydratifères.

Silicates doubles alumineux.

Anhydres.

Anhydres calcaires, &c. Anhydres alcalins, Hydratés.

Silicates Chlorites, &c.

Alumino-silicates.

Silicates non alumineux.

Simples.	Doubles, Anhydres, &c.
Anhydres, Hydratés, Hydratifères.	

The evident principle of this system, is *the classification of minerals*, not from a consideration of the substance which may be termed the qualificative component, but *according to the agents which acted upon the original base, and from the action of which the present forms originated.* Thus the associations of chrome, alumina, tungsten, molybdenum, &c., with any particular base, detract from the individual arrangement of these metals, but contribute to the number of ores of the base upon which they have acted according to the laws of nature. Now so long as we are to recognize the existence of any of these metals as undecomposed bases, so long must we accord to them their proper position in the arrangement of mineral substances, when their presence in any ore produces a character which is solely attributable to them. In every system of mineralogy founded upon chemical composition, a place is granted to those minerals, in which a particular effect is produced by the admixture of an acid of any kind, under the class of the base upon which the action has taken place; but in the system before us, it appears that the several positions are accorded on the proof of the existence of the agent and nòt according to the base. Thus under the family of *Aluminides*, we have spinel and graphite associated. In the family of *sidérites*, we have oligistic iron and franklimite; and under the term *Arséniures*, we find the various associations of that agent with undecomposed mineral bases, as silver, antimony, lead, nickel and so forth. Nor do we deny that this is a very concise arrangement; but one argument is deduced from the conviction that, (as we have stated before) so long as the qualificative components themselves are recognised as undecomposed elements, so long must they be considered the qualificative constituents, and the ore or mineral rank accordingly in the arrangement, else any person studying the productions of nature, so far as regards the mineral kingdom, would, without minute study, leave with a false impression that the rarer metals did not exist in a state of nature, but were only the results of chemical research; upon these grounds then many of the metals, the most general in their occurrence, would yield their rank to others with which they are almost always found in connection. We quote this as the broad argument, at the same time that we record our estimation of the spirit of enquiry displayed in M. Beudant's work, and the very concise manner in which the information is conveyed to the student.

MONTHLY NOTICE.

1st. May, 1842.

We have been forcibly struck, on perusing a recently published work on Geology, at the similarity of ideas expressed therein with the sentiments we have long since entertained, and which we find increasing amongst all classes of Geologists; we refer, of course, to the question of "*nomenclature.*" The recent establishment of the Silurian system, and the existence of similar strata being proved in many other quarters, has naturally produced the reflection, that the term, although perfectly *à propos* with reference to British Geology, is inadmissible beyond this boundary; that, to speak of the Silurian system of Russia, of France, or of any other locality, is, in a degree, invidious and incorrect; for it appears to us, that if a series of strata, containing peculiar fossils, be set apart as a particular system, however exact the several relations may be of identical strata in other and remote districts, or however accurate their lithological character may be proved, the non-accordance of the fossil contents, which are, at present, the only index, would be the test of their right to admission under the system, or their rejection. If it was a question in which general statements are concerned, why should it not have borne a general name? and why, as the evidence of identity is derived from the examination of a district in our own country, should Geologists endeavour to classify rocks of the same lithological character, occurring in remote situations, under the British title? approving or discarding their admission, on the accordance or non-accordance of their fossil contents. We have sufficient data to prove that other formations, existing in districts far removed from each other, although perfectly agreeing as to construction and comparative situation, but differing, both numerically and specifically, in fossil contents, are the result of one common agency—the extraordinary difference being derived from local causes only—and yet they are considered members of one system, classified under one appellation, and considered as typical of one age; and to these a title of general import has been applied, without reference to country or language. In what a degree does this contrast with the *establishment of a system, upon the examination of a single district of country.*

A transatlantic Geologist, in speaking of this same subject, and after stating that particular rocks of his district range with Mr. Murchison's Silurian group, continues: "We do not, however, see any propriety in applying a local term to a class of strata abundant in every quarter of the globe; *we have the same right to our Nerepsis, Mispeck, and Quaco rocks, as our contemporaries across the Atlantic have to their Ludlow, Wenlock, and Caradoc rocks. It is high time a better nomenclature was introduced into the science.*"

Whilst noticing this subject, the evil of which is not confined to the appellation which we have quoted above (on the ground of its novelty, and the recent establishment of the system), it occurs to us, that although this fault originated with an institution, which, from its position and influence, should rank as the tribunal before which all geological questions should be maturely weighed and decided upon, its members have not all been parties to the like innovations. On the occasion of Professor Sedgwick submitting his elaborate paper on the stratified rocks of the English series, inferior to the old red sandstone, in which he described the *Cumbrian* rocks of the neighbourhood of Kendal and Kirby Lonsdale, he admitted, amongst other statements in his recapitulation of the constituents of the district, that "a second band existed (among the Cumbrian rocks), of calcareous slates, with lower Silurian fossils;" and an interesting and highly valuable discussion ensued, on the comparative merits of the terms *Cumbrian, Cambrian,* and *Silurian.* If we recollect aright, Mr. Greenough contended that a *Cumbrian rock with Silurian fossils, was an anomaly,* and judged from the author's paper, that the Cambrian strata, and the so called Cumbrian rocks, were quite or nearly identical; he could not, therefore, assent to the application of another term to those strata, which Geologists already understood by the appellation of "Cambrian rocks." The "pro's" and "con's" were not, however, equally sustained, and we were much pleased with the learned Professor's brief acknowledgment, after long addresses from Messrs. Greenough, Fitton, Murchison, and others, that his communication was only to be considered the outline of one much more elaborate and explicit in its details, and "for what it concerned him, they *might call the rocks what they pleased.*" We contend, that with such an opinion expressed by the learned Professor himself, the Society should have hesitated to record the title of "Cumbrian rocks," in their published abstract of the proceedings of that evening (3rd of November 1841); or had they considered it indelicate to alter the phraseology of the author, it was but justice that some remark should have been appended to the effect stated, which might caution Geologists against the reception of the title. We do not observe any notice in the published proceedings (which has, of late, been so usually appended to those of Societies generally), to the effect, that "as a body, this Society cannot be responsible for the opinions expressed in the various memoirs;" but against such innovations no plea can be urged with any propriety. A Society, when it offers an opinion, to which there is no opposition, even on the part of the author of the statement under consideration, is in duty bound to make it public. Our portfolio has teemed of late with letters from our German correspondents, concerning these local appellations; and we must say, that we agree as to the justice of their remarks; and as to the non-adoption of the terms in question.

We should much regret to find that Geology, which ought to be amongst the most simple and explanative of natural sciences, should rank with its sister study, Mineralogy, in verboseness, and confusion of details; and we have introduced the subject in order to lend our share of timely aid for the prevention of *fresh* innovations, and to urge, if possible, the introduction of a new system of nomenclature, which shall at once obviate all the difficulties which have obtruded themselves through the want of proper caution, as to the recognition of new titles and characters.

We are happy to notice that the Scientific Society of London has this month offered a premium, to induce Field Naturalists to communicate their researches, always valuable, if not altogether new.

There is nothing beyond this general intimation which requires particular comment from us, and we shall, therefore, conclude our customary notice without further remark.

THE EDITOR.

ORIGINAL COMMUNICATIONS.

Zoological and Geological considerations on the family of Rudista, by A. d'Orbigny.

(Read at the Académie Royale des Sciences, Janvier, 1842.)

M. d'Orbigny states, that having been engaged on the study of Rudista since 1822, he has arrived at the conclusion, from the examination of a great number of facts, that they are not allied to the Lamello-branchiæ, as MM. Lamarck and

Deshayes stated, but are, as M. Goldfuss observes, members of the class Brachiopoda. From a minute examination of the characters, the class *Brachiopoda* may be divided into two orders, *B. réguliers* and *B. irréguliers*, or Rudista; the former including those with loose shells, the latter those with fixed shells. The second order is divisible into two families, *Hippurites* and *Caprinidæ;* in the first of which he places the genera *Hippurites*, *Radiolites*, and *Crania*, and in the second the genera *Caprina* and *Caprotina*.

It is worthy of remark, as one of the prominent Geological considerations, that the Rudistidæ are not disposed generally throughout all formations, (*v. Geologist, p*. 92), but are disposed in bands, forming geological horizons, which are so much the more remarkable, as they may be traced through a large extent of Europe; and that these bands, as in the district of Corbières, have suffered no disturbance, but that the Rudista are in the same situations as those in which they existed previous to their destruction.

The Rudista first appear in the strata of the néocomien period; this band, to which M. Elie de Beaumont long since called attention, under the title of "*calcaire à dicérates*," forms a thick zone, which may be traced through the basin of the Mediterranean, from Martigues to Chambéry, and includes four distinct species. Leaving the boundary of this zone, not a single specimen is to be found throughout the Gault, whilst, in the chlorite-chalk, of the south-west of France, another band of Rudista is found, forming *the second zone of M. d'Orbigny;* this contains fourteen species, all of which differ from those occurring in the first zone. After ascending in the series, and passing several very extensive beds, *a third zone of Rudista* is found, which extends throughout the basins of the Pyrenees, and the Mediterranean, and may be traced into Egypt, through Moravia, Bosnia, and

Austria. This zone includes twenty-five species, differing from those in the two former.

Having again passed over several beds in the ascending order, *a fourth zone of Rudista* is found in the basin of the Pyrenees. It occupies the right bank of the mouth of the Gironde, and the environs of Bergerac (Dordogne); this again includes eight species, distinct from any contained in the three preceding.

A fifth zone of Rudista is met with in the white chalk of the Paris basin, and in Belgium and Sweden, containing nine species entirely distinct from those of the other zones, and, in addition, these belong to the genus *Crania*, which is unknown in the rest of the cretaceous system. Having reviewed these facts, and considered the geological basins in their different relations to each other, and the species of Rudista therein contained, M. d'Orbigny draws the following inferences, which he considers very important, in their zoological relation, as well as being the means of detecting and classifying the several geological epochs.

1.—The Rudista, from not being disseminated throughout the mass, but, on the contrary, forming successive and limited deposits, are the best means of determining the limits of the beds.

2.—These distinct zones, included within the limits of the same basin, and in a succession of beds, which have suffered no dislocation, prove that no great commotions were required to affect the assemblage of different fauna into one locality, but that, doubtless, there was a regular succession of forms, one fauna being successively replaced by another.

3.—The Rudista having appeared on the earth at five distinct times during the cretaceous period, each time under different forms, without any zoological blending of species, or transport of individuals from one geological zone to the other, therefore, the respective fauna of the five different zones of Rudista, whether in the beds of one epoch, or of distinct periods, having been destroyed, and subsequently replaced by others entirely different in their characters, prove that in this series of beings, there was no merging of specific forms, much less of the beds in which they are contained.

4.—The Rudista, being situated in clearly defined limits, in the cretaceous system, form horizons more or less extended, and which always bear the same relative position to other fossils.

Thus M. d'Orbigny proves, that the assignment of genera and species to particular formations is not by any means a chance, but that as proved in the instance of the Cephalopoda also, (Paléontologie Française), it is invariable in order, the several fauna being more or less numerous in contents, and is one of the readiest identifications of the chronological history of the Zoology of the globe.

Ammonites Zoologically and Geologically considered.

(Continued from p. 111.)

III. *Affinities between the external and internal characters.*

When I search for the affinities which exist between these two series of forms, I can easily prove that there is frequently a perfect concordance, and that the one would serve to guide our judgment as to the others, and to form groups perfectly natural. In addition to what I have already stated respecting the size of the whorls of the spire when compared with the number of the lobes, I shall offer some examples of species having common internal and external characters.

I.—Among the Ammonites having the lobes formed of equal parts, I have observed a series characterized by having the whorls simply in contact, cylindrical, smooth, or marked at intervals by points of interruption; and always having two lobes on each side (*Am. subfimbriatus, Honnoratianus, quadrisulcatus, striatisulcatus, strangularis, Juilleti.* All these Ammonites have, otherwise, the same external *facies.*

2.—Still, amongst the Ammonites having the lobes formed of equal parts, there exists a series where the whorls, more or less enveloped, are furnished, on the back, with several ranges of tubercules, one of which is central; the number of equal lobes and saddles is always above two (*A. Rhotomagensis, Fleuriansianus, Woolgari, Verneuilianus, &c*). All have likewise the same external appearance.

3.—Amongst the Ammonites having the lobes formed of unequal parts, but whose saddles are equal, there is a series which has the dorsal lobe longest and very wide, belonging to the species having the whorls compressed, provided with a salient dorsal keel, and having the mouth entirely pointed (*A. Roissyanus, Bouchardianus, inflatus, Delarnei, &c*).

4.—There exists still another series amongst the Ammonites, having both the lobes and saddles formed of unequal parts, whose dorsal lobe is very narrow and exceedingly short, belonging to the species having their whorls compressed or angular, furnished, on the dorsal line, with a very deep furrow, in which the dorsal lobe is placed (*A. tuberculatus, lautus, auritus*).

These four examples, taken from species having the lobes and form entirely different, are, I think, sufficient to prove that there is evidently an affinity between the external and internal forms, and that, therefore, the form of the lobes acquires so much the greater importance in the classification of the species into groups, as it is found to coincide with the external ornaments with which Ammonites are covered, and especially with the form of the back. The intimate union of these two series of characters, will enable us to form very distinct groups in the grand genus of the Ammonites.

DIVISION OF THE AMMONITES INTO GROUPS.

I shall now occupy myself with the classification of Ammonites into natural groups; and shall develope the ingenious classification of Leopold von Buch, by applying it to the Ammonites of the Cretaceous Period. The following are the results with which the combination of the characters of the lobes and saddles with the external form of the back and other appendages, have furnished me. I am obliged to include the whole of the Ammonites, to enable me to class those of the Cretaceous period.

SPECIES HAVING AN ENTIRE DORSAL KEEL.

1st Group. ARIETES, Buch.—*Shell* ornamented, on the sides, by ribs always simple, radiating, salient. *Back* square, provided with a mesial keel *Syphon* salient, placed in the dorsal keel. *Mouth* elongated into a beak. *Septa* formed of unequal lobes and saddles.* Dorsal lobe deep as wide, longer than the superior lateral lobe. The lateral saddle mounts rather higher than the rest; the dorsal saddle is very short. The species of this group are all confined to the lower beds of the lias (*A. Bucklandi, obtusus, rotiformis, &c*).

2nd Group. FALCIFERI, Buch.—*Shell* compressed, furnished laterally with folds, inflected forwards, frequently forming an angle about the centre of their length, without tubercules. *Back* sharp, salient, keel narrow, containing the *syphon*. *Mouth* complete, provided, on the middle of each side, with salient points. *Septa* formed of unequal lobes, and saddles almost equal. The dorsal saddle is of immense width, and its auxiliary lobe might be mistaken for the superior lateral one. The latter is always much longer than the dorsal lobe. This group is peculiar to the upper beds of the Lias (*A. Serpentinus, Schl. Murchisonæ, falcifer, Bifrons*, &c).

3rd Group. CHRISTATI, d'Orb.—*Shell* compressed, ornamented on the sides, with bifurcating ribs, inflected anteriorly, without forming an

* These characters of the *equal* and *unequal* lobes and saddles have been introduced by myself in characterizing groups. As also those of the entire mouths.

angle, either provided or not with salient tubercles. *Back* salient, keeled, and containing the *syphon.* *Mouth* in the perfect state prolonged into a salient beak, on the mesial line of the back. *Septa* formed of lobes generally divided into unequal parts, saddles equal. Dorsal lobe longer than the superior lateral one. Lateral saddle less elevated than the others. Dorsal saddle very high. This group differs from the *Arietes* by the ribs bifurcating, or being ornamented about the middle with points, instead of being simple, by the lateral saddle being lower than the dorsal, and not more elevated than the latter, and by its very long dorsal saddle. It differs from the *Falciferi* in its elevated ribs, ornamented with points and without angles, by the dorsal lobe being very long, instead of short, and by the dorsal saddle, which is of immoderate length. This group is composed entirely of species peculiar to the Cretaceous formation (*A. Helius, Ixion, cultratus,* of the lower stage of the Néocomien; *A. Roissynus, cristatus. Bouchardianus, Delarnei, inflatus, varicosus, Senequieri, Hugardianus,* of the Gault, and Lower green sand; *A. Bravaisianus, tricarinatus,* and *varians,** of the chloritic Chalk, or Upper green sand.)

SPECIES HAVING THE BACK CANICULATED.

4th Group. TUBERCULATI, d'Orb.—*Shell* ornamented laterally, with ribs and tubercles, these alternating on the sides of the back. *Back* furnished, on the mesial line, with a deep and distinct canal. *Mouth* complete presenting an elongated beak, corresponding to the dorsal canal. *Septa* formed of lobes and saddles divided into unequal parts. Dorsal lobe shorter than the superior lateral lobe, and so narrow, that it only occupies the width of the dorsal canal. All the species of this group which is very limited, belong to the middle Cretaceous rocks (*Am. tuberculatus, lautus, auritus,* of the Gault, or Lower green sand, *A. falcatus* of the Chloritic chalk).

SPECIES HAVING A SHARP BACK, BUT NOT KEELED.

5th Group. The CLYPEIFORMI, d'Orb.—*Shell* compressed, generally smooth, or slightly wrinkled. *Back* sharp, without a keel. *Spire* having the whorls large, generally embracing.

* This last species has the dorsal lobe very short, without having any of the other characters of the *Falciferi*; it may perhaps belong to a small group peculiar to the Upper green sand.

Mouth? *Septa* divided into a great number of lobes, formed of unequal parts; the saddles formed of equal or almost equal parts. Dorsal lobe, shorter than the superior lateral lobe. The saddles and lobes wide and short. The species belonging to this group are found in the Cretaceous rocks; *A. clypeiformis, Georilianus, Nisus, difficilis,* from the lower Néocomien; *bicurvatus,* from the Gault; *Requienianus* and *Goupilianus,* from the Chloritic chalk, or Upper green sand).

SPECIES HAVING A SALIENT BACK, CRENULATED ON THE MESIAL LINE.

6th Group. The AMALTHEI, Buch.—*Shell* provided, on the sides, with very slight ribs, inflected anteriorly, the back sharp, divided into salient, transverse folds, causing a crenulated surface. *Mouth* provided, anteriorly, with a beak, on the mesial line, of which the crenulations are the ancient traces. *Septa* formed of lobes and saddles, divided into unequal parts. Dorsal lobe shorter than the superior lateral lobe. All the species belong to the Jurassic, or Oolite Formations (*A. Amaltheus, cordatus, serratus, &c.*)

7th Group. The PULCHELLI, d'Orb.—*Shell* equally divided, on the sides, by straight, salient ribs, having no inflection, which pass from side to side, leaving, on the back, a compressed tubercle, representing a series of crests. *Mouth?* *Septa* formed of lobes, divided into unequal parts, and of saddles, divided into equal parts. Dorsal lobe nearly equal in length to the inferior lateral lobe. All the species are from the lower Cretaceous rocks (*A. Pulchellus,* from the Néocomien; *A. Brottianus* and *Itieranus,* from the Gault, or Lower green sand).

8th Group. The RHOTOMAGENSES, d'Orb.—*Shell* with the whorls turned, square or oval, ornamented with salient ribs, more or less supplied with tubercles, in four or five lines, one of which ranges on the mesial line of the back, which renders it more or less angular. *Septa* formed of lobes and saddle divided into equal parts. The dorsal lobe is longer than the superior lateral lobe. This group differs from the *Armati* by its back, which is provided with several ranges of tubercles, one of which is median, by its equal lobes and by its dorsal lobe, which is always the longest. All the species belong to the middle Cretaceous rocks (*A. Rhotomagensis, Woolgari, Carolinus, Verneuilianus, Pailleteanus, Fleuriansianus, Mantelli,** *Papalis, vertebralis, Deverianus, rusticus, Renauxianus,* from the Chloritic chalk, or Upper green sand, and *A. Lyelli,*† from the Gault).

SPECIES HAVING THE BACK EXCAVATED, PROVIDED WITH TUBERCULES ON THE SIDES.

9th Group. The DENTATI, Buch.—*Shell* more or less tumid, ornamented with ribs, often bifurcating around the umbilicus, where they generally form a tubercle. The extremities of the ribs rise in a salient manner on each side of the back, which is excavated in the middle. *Septa* formed of lobes divided into unequal parts, and of saddles, generally formed of equal parts. Dorsal lobe, equal or shorter than the superior lateral lobe. All the species belong to the lower Cretaceous rocks. *First division*; species having the tubercules unequal on the sides of the back (*A. verrucosus,* from the Néocomien ; *A. Interruptus* (*dentatus,* Sow.) *denarius, splen-*

* The *A. Mantelli,* without having the dorsal tubercle, is provided with the same disposition of lobes, and ranges of lateral tubercles.

† *A. Lyelli* is the only species of the Gault, and, at the same time, the only Ammonite of this group which, having all the tubercles and equal lobes of the other species, has, nevertheless, the dorsal lobe shorter. It is one of those beautiful exceptions which prove the difference of forms according to the Formation. Looking at its unsymmetrical Septa, we ought, perhaps, to form a separate group for it.

dens, Fittoni, Guersanti, Mosensis, Raulinianus, Cammatteanus, from the Gault, or Lower green sand). *Second division;* species having the tubercules even on the sides of the back (*A. Dufrenoyi, pretiosus, Neocomiensis, sinuosus, asperrimus,* from the Néocomien; *A. Michelinianus, Archiacianus, regularis, tardefurcatus, mammillaris,* from the Gault, or Lower green sand).

10th Group. The ORNATI, Buch.—*Shell* rather tumid, back narrow, bordered with tubercules; another range of tubercules about the middle of the sides. *Septa* formed of lobes and saddles, composed of unequal parts. The dorsal lobe always considerably shorter than the superior lateral one. All the species are from the Oxford Clay (*A. Duncani, Callowiensis, Castor, Pollux*).

SPECIES WITH THE BACK MORE OR LESS SQUARE.

11th Group. The FLEXUOSI, Buch.—*Shell* provided, laterally or around the umbilicus, with a range of tubercules, and also with one on each side of the back, the centre of the back slightly salient. Between the two ranges of tubercules on the sides, there are generally ribs, inflected anteriorly. *Septa* formed of lobes, divided into unequal parts, and the saddles, divided into equal parts. The dorsal lobe shorter than the superior lateral one; the superior lateral lobe very large. All the species are from the Lower Néocomien (*A. Leopoldinus, Cryptoceras, radiatus, Heliacus, Castellanensis.*)

12th Group. The COMPRESSI, d'Orb.—*Shell* generally much compressed, whorls large, embracing, furnished with ribs or striæ on the side, all slightly curved, forming tubercules on the back. *Back* narrow, and truncated or squared. *Septa* composed of a large number of lobes, formed of unequal parts, saddles often formed of equal parts. Dorsal lobe very large, considerably longer than the superior lateral one. All the species are peculiar to the Cretaceous rocks (*A compressissimus, Didayanus,* from the Néocomien; *A. Quercifolius,* from the Gault; *A. Largilliertianus, Beaumontianus, Sartousianus, Vibrouyeanus**, *Ferandianus, Lafresnaiganus, Catillus* from the Chloritic Chalk, and Upper Green Sand).

13th Group. The Armati, Buch.—*Shell* with the whorls square, furnished, on the sides of the back, with a range of salient tubercules, and, on the sides, with one or two others. *Back* wide, square, joining the sides at an acute angle. *Septa* composed of lobes formed of unequal parts, the saddles formed of equal parts. Dorsal lobe longer or equal to the superior lateral lobe, the latter placed in the middle of the sides, and always narrower than the dorsal saddle. All the species are from the Jurassic formation, and principally from the upper beds (*A. perarmatus, Bakeriæ, longispinus,* &c.)

14th Group. The Angulicostati, d'Orb.—*Shell* thick, whorls almost round, but marked, on each side of the back, with slightly salient parts, which render the latter almost square. *Back* much narrower than the sides. The elevated, alternate ribs, pass over the back. *Septa* composed of lobes, formed of unequal parts, and saddles generally equal. The dorsal lobe shorter than the superior lateral one; the auxiliary lobes oblique towards the umbilicus. They belong to the lower Cretaceous rocks (*A. anglicostatus, Martinii, crassicostatus, Gargarsensis, Cornaelianus, Deshayesi,* from the Néocomien; *A. Milletianus, Puzosianus, fissicostatus,* from the Gault, or Lower Green Sand). This group only differs from the *Planulati* from being characterized by the square back.

* This species is only placed here on account of its external characters. It is quite abnormal, on account of the singular form of its undivided lobes.

15th Group. The CAPRICORNI, Buch.—*Shell* with very convex whorls, ornamented with prominent, simple, straight ribs, without tubercules or spines. *Back* wide, often presenting a wider surface than the sides. *Septa* composed of lobes, formed of unequal parts,* and of saddles, formed of equal parts. Dorsal lobe the longest; the lobes of the sides wide. All the species are from the Jurassic formation (*A. Capricornus*, *angulatus*, &c.)

SPECIES WITH A ROUND CONVEX BACK.

16th Group. The HETEROPHYLLI, d'Orb.—*Shell* compressed, whorls almost always embracing, rarely visible in the umbilicus. The sides are smooth, slightly striated or grooved. *Back* small, very convex. *Septa* symmetrical, divided into a great number of highly foliated lobes, formed of unequal parts, and saddles, generally formed of equal parts. Dorsal lobe almost always shorter than the superior lateral one. The numerous branches of the lobes have the saddles between them, ornamented at the superior part with large foliations or rounded masses, more or less divided, and peculiar in appearance. They may be placed in two divisions:—1st, the species having the saddles formed of unequal parts, comprising *A. Heterophyllus* of the Jurassic rocks; 2nd, the species with the saddles divided into equal parts, all peculiar to the lower Cretaceous rocks (*A incertus*, *infundibulum*, *semistriatus*, *tortisulcatus*, *Calypso*, *Guettandi*, *semisulcatus*, *Tethys*, *Morelianus*, *picturatus*, *Terverii*, *diphillus*, *Rouyanus*, of the lower Néocomien, and *A. Velledæ* and *alpinus*, from the Gault or Lower Green Sand). We thus perceive that the species from the Cretaceous rocks are clearly distin-

* I have not seen the lobes of this group; the description is taken from the figure given by Von Buch. It is the only group which I have not personally examined.

guishable from those of the Jurassic rocks, by the form of the saddle.

This Group, which was not formed by Von Buch, as he was only acquainted with a single species, was nevertheless, clearly foreseen by him.* It is at present as numerous as many others.

17th Group. The LIGATI, d'Orb.—*Shell* compressed, generally smooth or slightly undulating, frequently marked at certain distances, with grooves or ribs, indicating the position of former successive margins. *Back* convex, sometimes slightly compressed. *Septa* composed of lobes formed of unequal parts, and saddles generally equal. The dorsal lobe shorter than the superior lateral one; the last auxiliary lobes often oblique posteriorly, towards the umbilicus; the saddles, much divided, without foliations. All the species are from the Cretaceous rocks (*A. ligatus, intermedius, cassida, dispar, flexisulcatus. Emerici, Belus, Rogerianus, impressus, inornatus, Carteroni, Grasianus, Cesticulatus, raresulcatus,* from the Néocomien; *A. Beaudanti, latidorsatus, Parandieri, Clementinus Mayorianus, Dupinianus, versicostatus,* from the Gault or Lower Green Sand; *A. Lewesensis, peramplus, Prosperianus,* from the Upper Green Sand, or Chloritic Chalk.

18th Group. The PLANULATI, Buch.—*Shell* discoidal, compressed, whorls more or less cylindrical, ornamented with serrated striæ or ribs separating, about the middle or two-thirds of the sides, into several branches, without any tubercule at the point of junction. *Back* round. *Septa* formed of lobes, always divided into unequal parts, and of saddles generally formed of equal parts. The dorsal lobe either longer or shorter than the superior lateral lobe; the auxiliary lobes very oblique posteriorly, towards the umbilicus. This group is peculiar to the Jurassic or Oolitic formations (*A. communis, polyplocus, plicatilis, annulatus*).

* Annales des Sciences Naturelles, 1830, tome xxix. p 27.

I have placed in it provisionally three species from the lower Cretaceous rocks (*A. macilentus, Seranonis,* and *Consobrinus,* with the lobes of which I am only partially acquainted). This group is therefore confined to the lowest beds of the Cretaceous formation, if the three species which are cited should eventually prove to have the characters of the lobes peculiar to this division.

19th Group. The CORONARII, Buch.—This group, bearing the characters of the *Planulati,* is only distinguished from it by the presence of a tubercule or knob, at the point of junction of the bifurcations of the ribs or striæ, which separate in groups. Whorls elevated. *Septa* composed of lobes of unequal parts, and of saddles formed of equal parts. The dorsal lobe shorter than the superior lateral one; the auxiliary lobes oblique; the superior lateral lobe is above, and the inferior lateral one below the tubercules. This group is chiefly characteristic of the lower Oolite (*A. Blagdoni, Bechei, contractus,* &c.

20th Group. The MACROCEPHALI, Buch.—*Shell* analogous in form, and in the ribs ors triæ, to the group of the *Coronarii,* with this difference, that it is frequently more tumid, and the turbercule, instead of being placed towards the centre of the whorl, is nearer the umbilicus; hence the superior lateral and inferior lobes are both above the tubercule, instead of one beneath and the other above, as in the *Coronarii.* The most tumid species are peculiar to the Jurassic formation (*A. Lallierii, Brochii, Banksii*), the former belong to the lower Néocomien (*A. Asterianus, fascicularis, Jeannomti, otobidichus.*)

21st Group. The FIMBRIATI, d'Orb.—*Shell* discoidal; spire formed of cylindric whorls, generally contiguous, without being in the least enveloped, smooth or ornamented transversely, at certain distances, with salient ribs or furrows, marking the ancient position of successive mouths. *Mouth* circular. *Septa* symmetrical, formed of lobes and saddles di vided into equal parts, always enlarged at their extremity, and narrowest at the base. Dorsal lobe generally the longest. This group, which is one of the best characterized, is found in the lower Jurassic formations, and the lower Cretaceous rocks (*A. fimbriatus* and *Jurensis* from the Lias, and *A. inæqualicostatus*, *subfimbriatus*, *Ophinurus*, *Honnoratianus*, *recticostatus*, *lepidus*, *quadrisulcatus*, *striatisulcatus*, *strangularis*, *Duvalianus*, *Juilleti*, *Matheroni*, from the Néocomien). We find that the greater number of the species belong to the Néocomien, which is characterized by them.

[*To be continued.*]

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY OF LONDON.

March 9th, 1842.—R. J. MURCHISON, Esq., President, in the chair. The following papers were read, viz.:—

1.—*On the Salt Steppe, south of Orenburg, and on a remarkable Freezing Cavern, by the President.*

This salt steppe differs from those between the Uralsk and the Volga, or on the Siberian side of the Urals, in consisting, not of a dead flat, but of wide undulations, and low ridges; it is nevertheless a true steppe, being devoid of trees, and slightly irrigated. The surface is composed of gypseous sands and marls, considered by Mr. Murchison to be of the age of the Zeckstein, through which protrude the small pyramidal passes of rock salt, that led to the discovery of the subjacent deposit. The salt is quarried to the south of the village of Illatzkaya Zatcheta, and the excavations extend about 300 paces in length, and 200 in breadth, the exposed thickness of the mass being about 40 feet. The salt is extremely pure, the only extraneous matter being a few minute filaments of gypsum. At first sight the mass appears to be horizontally stratified, but this, Mr. Murchison says, is owing to the mineral being excavated in large parallellopipedal blocks, twelve feet long, three deep, and three wide, which are separated vertically from the great body of salt by grooves, with a hatchet, and then detached horizontally by means of a heavy beam of wood suspended from triangles, and driven against the face of the block. The upper surface of the rock is irregular in outline, penetrating, in some places, through the overlying sands and marls; the base of the exposed mass is worn on the side first excavated into a cavern, by the action of dissolved snow and other causes, the roof of the cavern being adorned by pendant saline crystallizations. The entire range of this great deposit has not been ascertained, but Mr. Murchison is of opinion that it forms the subsoil of a considerable area. Its entire thickness has also not been determined, but it greatly exceeds 100 feet. In consequence of the salt occurring so near the surface, every part supplied with springs from below is affected by it.

The freezing cave is situated on the base of a little hillock of gypsum, at the eastern end of the village of Illetzkaya Zatcheta, and is distinguished from other adjacent caves, either natural or artificial, by abounding with ice in summer, and containing no ice in winter. The roof is covered with icicles, as well as the floor with snow and ice—all which disappear in winter. This paper was concluded with various conjectural reasonings respecting these phenomena; after which those of Sir John Herschel were submitted, of which we give the summary. After referring to some instances of great cold in caverns or excavations during summer, Sir John Herschel observes, it is clear that the cause cannot be ascribed to the evaporation or condensation of vapour. The temperature of Orenburg not being known to Sir John Herschel, he is induced to reason from that of Ekaterinburgh; and he states, that if anything similar occurs at Orenburg, he sees no difficulty in explaining the phenomena of the ice cave. Rejecting diurnal fluctuations, and considering the summer heat as a single wave propagated downwards, alternately with a single winter wave of cold, every point in the interior of an insulated hill, rising above the level plain, will be invaded by these waves in succession, converging towards the centre in the form of shells, similar to the external surface at times, which will deviate farther from midwinter and midsummer the deeper the point is in the interior; so that, at certain depths, the cold wave will arrive in midsummer, and the heat wave in midwinter. A cave, if not very wide-mouthed and airy, penetrating to such a point, will have its temperature determined by that of the solid rock which forms its walls, and will be so alternately heated and cooled. The analogy of waves, adds Sir John Herschel, is not strictly that of the progress of heat in solids, but nearly enough so for the purposes of the argument.

2.—*On some phenomena observed on Glaciers, and on the internal temperature of large masses of ice or snow; with some remarks on the natural ice caves which occur below the limits of perpetual snow. By Sir John Herschel, Bart.*—(Written in 1829.)

The glacial phenomena first described are the blocks of granite which rest on pedestals of ice of less diameter than the blocks, and rising above the general surface of the glacier; and the occurrence of smaller fragments sunk into the ice, the depth of the hollow being, within certain limits, increased proportionably to the smallness of the fragments. In both cases the heating and cooling influences are considered to be equal. These apparently opposite phenomena afford, Sir John Herschel says, a very pretty illustration of the laws of the propagation of heat through bad conductors, and the steps by which an average temperature is attained in large masses from a varying source. The sinking of the smaller fragments into the ice, the author shows, is dependent upon the greater power of absorbing solar heat possessed by snow than ice; and as the stone gives out this heat to the ice below nearly as fast as it is received, a greater depth of ice is melted in a given time beneath the stone than in the surrounding part of the glacier *(vide p.* 9.) The existence of the large blocks on the pedestals of ice, is due to the same cause. The example is thus afforded of the successive effects of heat and cold upon a block of stone in such a situation, during each twenty-four hours—evidencing that the heat imparted diminishes with much greater rapidity as it penetrates deeper, as it is imparted to the portions above on their becoming cold during night, as well as those below, and beyond the point where the two waves of heat and cold are reduced to a mean quantity, the temperature of the stone is constantly at or about 32^0, as the heat perforates feebly and uniformly. The surrounding portions of the glacier, however, being undefended by the stone, experiencing during the day the direct radiation of the sun, melt and run off. At night the surface cools by radiation, the cold being propagated downwards; but, on the return of day, the melting process is renewed, and the degradation of the general surface of the glacier is thus effected, the amount of ice dissolved being in proportion to the direct intensity of the sun's rays, and the time they shine; while the surface of the ice beneath the stone will be dissolved only in proportion to the excess of the mean temperature of day and night, above 32^0, diminished by the effect of the thickness of the stone. One curious circumstance, observes Sir John Herschel, seems to follow from this reasoning; namely, that the ice of a glacier, or other great accumulation of the kind, may, at some depth beneath the surface, have a permanent temperature much below freezing, though in a situation whose mean amount of temperature is sensibly above that point. In fact, there is no reason why waves of cold of any intensity below 32° may not be propagated downwards into the interior of the ice; but waves of heat above that point, of course, never can. Thus the cold of winter, and the frost produced by radiation in the clear nights of summer, will enter the mass, and lower its internal temperature; while the heat of the summer air, and that imparted by solar radiation, will mainly be employed in melting the surface, and will run off with the water produced.

In the concluding part of the paper, Sir John Herschel applies the same mode of reasoning to explain the existence of ice caves below the limits of perpetual snow. If, he says, the surface, during the whole or the greater part of the year, be covered with ice, the mean annual temperature of the interior will be materially less than that due to elevation, and which it would have, were it not covered.

The paper is concluded by an example, exhibiting the propagation of periodical as well as diurnal waves of heat and cold, throughout a mass; proving, that, in the case of diurnal fluctuations, the effect would cease to be sensible at a depth 300 or 400 times greater than that at which the diurnal effects are neutralized; and thus that the winter waves of cold (consisting of many diurnal waves of greater or less intensity) may not travel down to a cavern till the hottest period of next summer, or of many summers.

MANCHESTER GEOLOGICAL SOCIETY.

March 31*st*.—Dr. Black, F.G.S., in the chair.—Amongst the donations announced at this meeting, those presented by J. Heywood, Esq. and R. Thicknesse, Junr., Esq., were the most considerable, the former consisting of several thousand specimens of British fossils.

A paper was read "on the salt of Cheshire," by Mr. Ormerod.

The paper was divided into two parts: the first treated of the nature of the Cheshire brine, and its analytical contents; the second, on the origin of the Cheshire rock salt. Before proceeding to the subject matter of the paper, the strata in which salt had been found were shortly mentioned, and it was shown that the position of the Cheshire salt was in the upper beds of the new red sandstone. In treating of the nature of brine, Mr. Ormerod quoted the opinions of Dr. Holland, Messrs. Lyell, and Murchison, and Dr. Daubeny; all agreeing that brine was caused by water melting the upper surface of the highest bed of salt. He then showed, that the water could not be impregnated by percolating through the overlying strata, as these beds are scarcely permeable for water; and, even if they were so, the quantity of muriate of soda derived from them would be too small to supply the brine springs. The tables of analysis were compiled from "Holland's Agricultural Survey of Cheshire," and from a paper of Dr. Daubeny's in the "Philosophical Transactions for 1830." The last showed, that the Cheshire brines of Northwich, Middlewich, Nantwich, and Winsford, contained iodine, bromine, chloride of calcium, magnesium and sodium, sulphate of lime, and also a portion of insoluble matter. It appeared that no series of analysis which might be considered as really comparative, had as yet been made; but that, making a slight allowance for a temporary variation in the strength of the brines, the similarity in the proportions of their component parts was very great. After mentioning the existence of red colour in salt lakes of the present day, which was caused in some cases by the presence of an infusorial animalcule, the *Monas Dunalii*, which animalcule is also found in the salt at Cardona, Mr. Ormerod stated that he had examined the Northwich rock salt to discover the cause of the red colour: he had not, however, as yet examined more than a single specimen; the colouring matter on the salt being dissolved, subsided to the bottom of the tube, and consisted of red globules about one-sixteen thousand part of an inch in diameter in clusters, and apparently not crystalline; but he could not absolutely state that they were monads. The other matters detected were a small portion of rhomboidal crystals, small clear crystals apparently of quartz, the largest about one thousandth part of an inch in diameter, and a fibrous substance, which, after along examination, was considered not gypsum, but vegetable fibre. The second part commenced with a statement of Mr. Lyell's opinion, that the source of salt might be as deep-seated as that of lava, and that the theory which had obtained most favour with geologists, attributed the formation of salt in various parts, not to precipitation from an aqueous menstruum, but to sublimation from volcanic exhalations rising from below, which insinuated themselves into rents and cavities. The opinion of Dr. Daubeny and others was given, that mineral springs were most abundant in volcanic regions, but that when remote from their site usually coincided with some great derangement in the strata, as a fault or fissure, indicating that a channel of communication has been opened with the interior of the earth at some former period. The second part was subdivided into three heads:— The first treated on the traces of volcanic action in the vicinity of the salt; the second, on the question whether the salt had been injected by volcanic action, or precipitated from an aqueous menstruum; the third, on the nature of the aqueous menstruum. With respect to the first subdivision, traces of violent volcanic action were shown by extensive faults bounding the eastern side of the Cheshire salt field, and by the existence of beds of toadstone bordering on those faults, as at Buxton, Matlock, &c. The action of the same power was shown by two lines of elevation, mentioned by Mr. Murchison, reaching from Shrewsbury to Staffordshire;

in which, at places, trap had been discovered. The existence of traces of former volcanic action was also to be found not remote from Droitwich. With respect to the second subdivision, it was argued that it was impossible that beds of salt, one 75 and another averaging 105 feet in thickness, could be injected without breaking up the overlying strata, and sending veins of salt into the fissures so caused; but that, at Northwich, the strata overlying the salt were perfectly regular and not dislocated, and no veins of salt were found in any stratum above the 75 feet or highest salt; and further, that the fractures which were found in the strata lying between the salt were gentle, such as would be caused in the settlement and gradual hardening of the same. This was shown in some specimens, in one of which a diagonal crack had taken place; the edges of the laminæ were slightly bent, and a vein of salt had run in. This slight displacement was covered over again by horizontal layers, thus showing that the infiltration of the salt was contemporaneous with the deposit of the stratum. This contemporaneous deposit was also well shown in other specimens. At this place an account was given of certain strata of rock and salt, which had been bored through at Mr. Newman's pit at Marston, near Northwich. These particulars, it was stated, had not as yet been made generally known. Till within a few years, the thick or second bed had not been sunk through, though worked into, at some places, 117 feet. At Mr. Newman's pit, the thickness of the lower bed was 96 feet. The new shaft was sunk to a depth of 150 feet below the second or thick salt, and passed through four beds of salt of various degrees of purity, of the respective thicknesses of 6 feet 7 inches, 3 feet 4 inches, 6 feet, and 11 feet 6 inches. The appearance of these and of the beds long worked, taken both individually and collectively, was such as would be caused by evaporation or precipitation from an aqueous menstruum. On the contrary there was no appearance of any violent action or disturbance, such as would arise if an injection had taken place. From these reasons it was inferred, that the salt had been formed by precipitation. With respect to the third subdivision, it was shown that salt is now formed both by evaporation in salt marshes and shallow lagoons, by the sea, and by volcanic action.

After mentioning that, as yet, the cause of the saltness of the sea was not accounted for, Dr. Marcet's observations on the analysis of the sea were mentioned. Amongst these the most important were, that there was no satisfactory evidence that the sea was more salt at great depths than at the surface; and that sea water contained no muriate of lime. This substance is found, on the contrary, invariably in all the Cheshire brines. A comparison was then drawn between the deposits of Cheshire (where six beds of salt are seen in one section, varying in thickness from 3 feet 4 inches to more than 115 feet, and occupying, with the accompanying strictly saliferous beds, a depth of 350 feet) and the salt lakes of the present day, where rarely more than one thin bed is found formed by evaporation in summer, and disappearing in the winter, or on irruptions of water. The change of seasons would cause the latter, but successive subsidences must have taken place to cause the deposit of beds such as seen at Northwich. In answer to any opinion that might arise that the sea might have filled hollows made by subsidence, it was stated that no remains had been found in the salt, unless the supposed monads and vegetable fibre were such; and that, if such an irruption had taken place, such would, in all probability, have been found. From the example of the salt at Weiliczka, it was shown that wood and salt will be preserved in the salt. The discharge of small fish at volcanic eruptions was mentioned, showing that the presence of animal remains being embedded would not be inconsistent with the result of volcanic action.

The next point considered was the probable origin of the salt being attributable to volcanic action. Quoting from Mr. Lyell's Principles of Geology, it was stated, that, in many volcanic regions, jets of steam, which are often mixed with other gases, issue from fissures; and that, if such jets come into contact with strata filled with water, they may give rise to thermal and mineral springs. It was before mentioned in the paper, that chloride of sodium was one of the emanations of volcanic districts. A summary of some of the principal mineral springs on the Continent was then given, showing their rise in volcanic districts. In England, salt springs were shown to rise in deep coal pits near large faults, as at Patricroft and Pendleton. The same was shown to be the case in the Durham and Newcastle coal-field; in which district the salt was found rising from a vein of trap. The saline springs were shown to rise from a fault in the coal measures near Rowley; and from the Silurian, altered by trap, at Builth and in Radnorshire.

The paper concluded with the following observations:—In most, and probably in all these cases, their origin may be distinctly traced to volcanic rocks. Had such springs flowed into shallow hollows or lagoons, and from evaporation or other cause, deposits taken place: had subsidencies from time to time occurred, succeeded by fresh deposits of mineral and other matter, a series of beds would be formed, such as are now seen at Northwich; had the beds of salt been deposited from a salt lake or the sea, in consequence of supersaturation, the alternations of strata would, most probably, have been comparatively regular in their thickness: such, however, is not the case. Again, as relates to the salt of the new red sandstone, it is only found in insulated beds of the upper marls, and thus both temporary and local action is shown. Perhaps, therefore, a theory that the Cheshire fields of salt were the result of volcanic action, pouring the aqueous menstruum from which those beds were formed, into depressions on the surface of the higher strata of the upper new red sandstone; and that the alternation of the strata of rock and salt has arisen from periodical subsidencies, followed or accompanied by fresh discharges of the same aqueous menstruum,—a theory embracing the most important points in each of those to which allusion has been made, may be thought to account for the position, in Cheshire, of the salt, and its accompanying beds of rock and clay, and the lithological character of the same, in a more simple manner than can be done by reference to either of them alone.

SCIENTIFIC SOCIETY OF LONDON.

March 2nd and 16*th*, 1842.—These meetings were both occupied with considerations on a paper, proposing "The triune system of classification of Science;" with especial reference, on these occasions, to zoology and botany. Although these subjects are foreign to our work, we notice them on account of their forming a portion of a series, in which mineralogy is to hold an important place, with a view to searching for a method of classification of mineral substances more in accordance with the natural arrangement of other subjects. At the close of the former of the papers in question, Mr. Denton remarked, that he was greatly pleased to find that this Society entertained the desire of simplifying the arrangement of facts already investigated, and proved through the medium of scientific inquiry, and that if this "triune" arrangement, was traceable *throughout nature*, (for it has been clearly proved by Swainson, with reference to zoology, and hinted at by Lindley, with reference to botany, needing only its application to mineralogy), an easy alphabet of analogies would be established for facilitating the study of the different branches separately, or in connection; in which opinion Mr. Mudie afterwards expressed his entire concurrence. We shall notice the paper which relates to mineralogy, and which was to be brought forward on the 6th of April last, in its proper place, next month.

At the meeting on the 16th of March, the chairman announced that, on the occasion of the anniversary meeting of the Society, in November next, the council would proceed to award two silver medals, respectively for the best essays on electrotype, and general or specific phytography; the latter subject having been selected in order to encourage greater care in the arrangement of the details of such an essay, and the insertion of concise summaries, as the premium will be awarded to that which excels in these most desirable particulars.

REVIEWS.

Model Mapping, suggestive of a General System of Drainage and Irrigation. By J. Bailey Denton, Surveyor, &c. 8vo. *London, J. Weale,* 1842.

The importance of Geology in its practical applications, is, as we have contended from the beginning of our editorial duties, the main reason which should suggest its general study, at least by members of those professions in which Civil Engineering or Surveying are the prominent qualifications, and, on this account, we need offer no further explanation of the introduction of a review of the above pamphlet into the pages of the present work; the utility of its objects and the practicability of the plan therein proposed, are, however, additional recommendations of no small weight.

Since the first appearance of Mr. Denton's pamphlet, we have had several opportunities of inspecting the beautiful models which he has prepared to illustrate his views, and have to acknowledge the subsequent receipt of other papers relative to the same subject, with reference to agricultural improvements, dependent solely upon the benefits which a general system of drainage would introduce. We will, however, drop the subject in its relation to agriculture, solely, and consider our author's suggestions with reference to model mapping, adapted to the joint purposes of the Geologist and Agriculturalist.

In the intimate relation which also exists between these pursuits, we have another proof of the practical value of Geology; and Mr. Denton, fully aware of this being the case, has taken the necessary means for preserving, in his model maps, such records of the subsoil, as he considers essentially useful for the proper completion of the drainage system.

A *model map*, which, for all the usual purposes of reference, is far more valuable than an ordinary survey, presents the following advantages over the latter system, viz.—In the actual representation of the elevations, therefore, offering the readiest means of distinguishing the natural lines of drainage, and, secondly, in enabling the surveyor to represent the subsoil, either by sectional divisions, on the sides of which the strata may be coloured, or, as Mr. Denton has suggested, by the insertion of a number of pegs, of about a quarter or half inch diameter, along certain lines on the principal elevations, upon which the respective thicknesses of the strata would be represented by different colours, in accordance with those of the surface.

The landed proprietor who possesses such a model map of his property, (the cost of which would not be more than double that of an ordinary survey), would be enabled to tell the dip of the strata, or the direction of the beds in any one hill (when he requires to sink a well for instance), by reference to two pegs on any line in it.

Mr. Denton recommends this latter system in preference to any other, as he advocates the practical demonstration of the best means of drainage by the submersion of the model in water, and by gradually removing it the subsidence will take place in the same way as in nature; thus showing the portions which require an improved system, and those to which the surplus of water in other parts might be conveyed with great advantage.

This is the principle of the model maps, and is well worthy attention. Mr. Denton has included in his work, notices of several new instruments of his invention; constructed for the purpose of affording a ready index of the respective heights of any two elevations or pieces of ground ; and for the measurement of embankments, cuttings, &c; but as these do not relate to our subject, we are compelled to refer to them thus briefly. We cannot close our short notice without inviting attention to Mr. Denton's beautiful models, which we are sure he will feel much pleasure in exhibiting to any of our readers who may feel an interest in the system of model mapping in its various applications.

Annales des sciences géologiques, ou archives de Géologie, Minéralogie et Paléontologie, &c. &c. Publiées par M. A. Rivière, 8vo. in monthly parts. Paris, J. B. Baillière.

The first monthly part of this work appeared on the 31st of January last, and, together with the February number, has been forwarded to us. We are glad to find a contemporary established abroad for the same purposes as our own work, and shall feel pleasure in communicating to our readers such novelties as its pages may afford, and our own will permit.

The first two numbers are occupied with translations principally of German works, lengthened proceedings of French and other societies, Miscellanea, and Bibliographies, in which much interest will be found.

The Editor has contributed an interesting paper, entitled "A Review of Geological Maps," with a comparison between those already published of France and England; in which the subject is carefully considered, and which offers an excellent example of the nature of the critical notices in the work.

In the preface attached to both numbers, we observe, amongst other objects of the publication, that it is proposed to insert Reviews of such works on Geology, &c., as may appear from time to time; but of these, as yet, no example has been given; judging from the comparative number of those published in England, France, and Germany, which come under our own observation, we may justly attach some considerable degree of interest to this portion, as of the three countries, the French press issues, at this present time, by far the larger number of works on the sciences in question. We close our present notice with our best wishes for the success of our contemporary, and the maintenance of a friendly relation between our publications.

We beg leave to congratulate Sir Henry De la Beche, (Director of the Ordnance Geological Survey), on the honour so recently conferred upon him.

We have received notices of two beautiful specimens of "*Ichthyosauri*" having been found and arranged by our friends, Messrs. Buckman and Dudfield.

MONTHLY NOTICE.

1st. June, 1842.

SINCE we closed our comment on the reports of the proceedings of the Geological Society of London, last month, other facts have come under our observation which suggest a renewal of the remarks we then made, more especially relative to the publication of the Reports, under the sanction of the Society, without any notice being appended as to the opinions expressed on occasions when the merits of the communications were severally discussed.

We will refer our readers to those Reports which we insert this month, amongst which will be found that of a paper read at the above Society, on the "Tetracaulodon," in which Mr. Koch apparently establishes the identity of that genus; nothing to the contrary being stated in the publication which the Society has since issued.*

Our readers will have observed that great interest has recently been attached to the identification of the fossil remains now exhibiting in Mr. Koch's collection, and the Geological Society has considered them worthy of that critical examination which Mr. Owen is alone competent to undertake. We have briefly reported his statements in a preceding number of our work, to which no comment was appended by the Geological Society; and we considered, at the time, that, in the opinion of the Society, the subject had received ample attention at their hands, and the question was fully decided.

How comes it then that Mr. Koch submits a communication to that Society, *which they publish*, and which, disagreeing in some measure from the results of Professor Owen's examination, nevertheless *goes forth virtually under their*

* From a paragraph in Richardson's "Geology for Beginners," we learn that Prof. Grant considers the genus "Tetracaulodon" well founded.

sanction, whereas we learn that the sentiments of the meeting were decidedly in favour of Professor Owen's decision.

We contend again in this instance, that if the Society proposes to *encourage* Geology, and discriminate upon subjects brought under its notice, it should not virtually sanction the publication of communications, to the merits of which they do not give their entire assent, by presenting them to the public without comment. This is not an error to which we are alone opposed, but can say, at the same time, that many of our friends, really first-rate geologists, will not enter amongst the lists of that Society, upon the ground which we have made public in our last and this present notice.

The Geological Society was founded for the express purpose of encouraging the science of geology; not for the mere purpose of meeting together to talk over matters without any import; not for founding a museum, which is not visited by a dozen students in the twelvemonth; not for forming a library of books which are unthumbed by any but the ten or dozen active members of the Society; it was, we repeat, for the purpose of advancing our knowledge of the science of geology: and yet we see two or more communications, opposed in their statements, published virtually under the sanction of the same Society.

Our friends, many very near to the council of that Society, will not add their names to its list of members, although frequently solicited, upon these very grounds,—and we therefore hope, by a timely notice, to direct the attention of the executive to this erroneous proceeding. For the present, we can state that *we had hoped better things than these.*

We have hinted, in the course of our arguments, that there is but little said at the meetings except by the members of the council; yet we could never discover whence this apathy arose; for lack of attendance certainly not, for although only fifteen members on some occasions add their quota to the ballot box, we have known cases in which many of these have introduced half a dozen friends, and the apartment has thus been filled; also not from incompetency, as many men then present, to our own knowledge, have gained high honours in the science of geology, both abroad and at home; and hence, we must conclude, it was from *fear*—not being willing to be allowed a hearing, on the ground of politeness only. A confidential friend, who has attended the meetings of this Society for the last eighteen years, states to us distinctly, that the difference between the meetings held during the "youth" and "maturity" of the Society, is striking—that meetings which attracted in former times, on their individual merits, have long since fallen off, except casually, when the *bon-hommie* of a Sedgwick enlivens the audience, or the novelties of a Murchison astound the ear—and that now it is a great difficulty to find any assemblage beyond the President, Curator, Secretary, Messrs. Fitton, De la Beche, and one or two others and their friends. * * * * We were ourselves forcibly struck when a worthy *chevalier* uttered a few words—on condescension, of course—on the occasion of Mr. Logan's communication being submitted to the Society; and we must say candidly that this exception to the rule perfectly astonished us, and we left, ere half the *business* of the meeting was finished, convinced that we had spent an unprofitable evening in the company of the Geological Society of London. How different is the spirit of friendly contention observed at the meetings of the Manchester Geological Society, where, as our reports will have already indicated, there is a real spirit of inquiry, and a profitable result. We repeat again, *we had hoped better things of the patriarchal Society.*

It is with feelings of deep regret that we have to record this month the death of our much respected friend, Mr.

Robert Mudie, better known as the author of several first-rate scientific works. It is only three or four weeks since we had the pleasure of a lengthened converse with him on the science of geology; and although he was far into the vale of years, gladly did we listen to the opinions which the versatility of his genius suggested; and, had we the power of his pen, energetically would we use it for the exposure of those abuses in modern science of which he then complained. We have given but a faint reiteration of his ideas; and it is but our duty, now that he is gone, to give him that meed of praise to which his talents were fairly entitled. Although no professed geologist, he possessed powers of scrutiny much to be envied by many of the leading members of that profession, and which, although seldom displayed, when so used, were extremely powerful and beneficially employed. We are afraid to name the number of his works—popular or abstruse—but they were as talented as numerous, and numerous as well known; and in his loss, both old and young will share the same regret as ourselves.

THE EDITOR.

ORIGINAL COMMUNICATIONS.

Table of Tests of the various simple Earths and Metals before the Blowpipe with Borax, as established by Plattner, in his "Probierkunst."

In the annexed table will be found a list of the colours imparted by the various substances named in the first column to the bead formed of borax, according as they are subjected to the agency of the reducing or oxidating flames.

SIMPLE EARTHS.

Substances.	In reducing flame.	In oxidating flame.
Alumina	Colourless	Opaque.
Barytes	Ditto	Colourless.
Glucina	Ditto	Ditto.
Lime	Ditto	Ditto.
Magnesia	Ditto	Ditto.
Strontian	Ditto	Ditto.
Silica	Ditto	Opaque.
Yttrium	Ditto	Colourless.
Zirconia	Ditto	Ditto.

SIMPLE METALS.

Antimony	Grey	Opaque.
Bismuth	Ditto	Ditto.
Cadmium	Colourless	Colourless.
Cerium	Ditto	Red.
Chrome	Green	Green.
Copper	Reddish brown	Ditto.
Cobalt	Blue	Blue.
Iron	Green	Red.†
Lead	Reduced	Yellow.
Manganese	Colourless	Violet.
Molybdena	Brown	Opaque.
Nickel	Grey	Red.
Silver	Ditto	Colourless.
Tantalium	Colourless	Ditto.
Thoria	Ditto	Opaque.
Tellurium	Grey	Ditto.
Tin	Colourless	Ditto.
Titanium	Grey	Colourless.
Uranium	Green	Yellow.
Vanadium	Ditto	Ditto.
Wolfram	Yellow	Opaque.
Zinc	Colourless	Ditto.

• With the addition of tin, it is reduced to the protoxide, which is red and opaque.

† When only a small quantity, the head is yellow when warm, and when cold becomes colourless: with an excess it is red when warm, and yellow when cold.

MISCELLANEA.

FERRIC ACID.—The constituents of the ferric acid are Fe. O^3, whence it is evident that this acid takes place by the side of the chromic, manganic, sulphuric, and other acids; furthermore, the ferrates obtained either by the moist or dry process have precisely the same composition.—*M. Frémy.*

METEORIC STONE.—On the 22d of March, 1841, at half-past nine P.M., the inhabitants of Heinrichau, who were abroad in the fields, heard three heavy reports, like thunder claps, in the air, and soon after a whizzing noise, which ended in a sound like that of a heavy body falling to the ground. The sky, at the time, was almost wholly clear. Some persons went in the direction from which the sound came, and found, at the bottom of a fresh hole in the earth, a stone, a portion of one much larger, and weighing two pounds four ounces, three sides of which were broken, and the fourth encrusted with a thin black covering peculiar to meteorites.—*Poggendorff's Annalen.*

NATIVE AMALGAM OF ARQUEROS (CHILI.)—This mineral is composed of six atoms of silver and one atom of mercury; its constituents are constant, and it occurs dendritic and in small octahedral crystals. It is white as silver, extends under the hammer, and may be cut with a knife.—*Memoir by M. Domeyko, read at the Academy of Sciences.*

COAL FORMATION IN CALABRIA.—This coal field is represented as being of considerable extent, and the out-crop of the coal measures is about four miles from the sea, dipping S.E., at an angle of 20^0 to 25^0.—*Mining Journal,* No. 349.

THE MAGNESITE FORMATION OF INDIA. This formation is principally developed in the neighbourhood of Salem, where it is found in considerable quantities, occupying an area of eight square miles, and distant about four miles from the town, towards the N.E. The surrounding formation is composed of a series of gneiss, mica, hornblende, and talcose schists, associated with granite and a rock analogous to serpentine, penetrated by dykes of basaltic greenstone. The magnesite is chiefly found in the hornblende, in veins varying in thickness from a yard to a few lines. Its general character in the mass is that of a hard white travertine; its colour varies from white to buff; its fracture is conchoidal, and although softer than quartz, it is sometimes hard enough to strike fire with steel.—*Lieut. T. J. Newbold.*

On the Mines of Chromate of Iron in Southern India.—These are situated in the neighbourhood of Salem, where it is associated with magnesite, forming with it a complete net work. The chromate sometimes runs in veins, varying in width from nearly four feet to less than an inch, but suddenly and irregularly contracting and expanding. In other cases it is found in nodules inclosed in the magnesite, the nodule in one instance weighing two tons. The veins run more frequently along the sides than down the middle of the veins of magnesite, though frequently they penetrate and intersect them,—a fact indicative of their posterior origin. A specimen yielded about 49 per cent. of chromic acid upon analysis.—*Lieut. T. J. Newbold.*

Earthquake in Cornwall.—It has been ascertained that the effects of this earthquake were greatest near the edge of the granite mass, which extends from the N.E. to the S.W., from Carn Marth to south of Penryn. Although it was felt at Falmouth, Helston, and other places, which are on the clay slate, yet all inquiries show that it diminished in force rapidly as the distance from the granite increased.—*Proc. Polytechnic Society of Cornwall.*

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY OF LONDON.

(Continued from page 150.)

March 9th, 1842. 3. *On the Rock Basins in the Bed of Toombuddra, Southern India, (lat.* 15° *to* 16° *N.) By Lieut. Newbold.*

The rock basins occur principally below the ancient stone embankments thrown across the Toombuddra, for the purpose of irrigation, near the island of Desauur. They are generally of a circular or oval form, the diameter of the interior being usually greater than that of the mouth, with a projection at the bottom in many cases. They abound where cascades occur, and are never found in places where the current is not strong. Lieut. Newbold also alludes to similar cavities in rocks above the surface drainage of the country, which he ascribes to the agency of temporary torrents produced by rain.

4.—*Notices of a great Cavern, of the Remains of Elephants, and of a Well sunk in Pumice, &c., in Mexico. By Mr. J. Phillips.*

The cavern known by the name of the Cave of Cuernavaca, occurs in a limestone hill, near the village of Cacaguamilpas, 32 leagues south-south-west of Mexico; it is composed of two branches, of great height. Other caverns occur in Mexico. The only fossil found by Mr. Phillips in the limestone, which is abundant in Mexico, is a species of *Astrea.* The remains of the elephant were found near the Hacienda of Chapingo, in making a canal to communicate with the lake of Mexico. At twelve feet below the surface, an ancient causeway was discovered, and two or three feet lower the remains of the elephant. Mr. Phillips alludes to Humboldt's notice of similar bones found in cutting the great drainage canal of Mexico. The well sunk in pumiceous obsidean, was undertaken to procure better water than that which the district afforded. The locality is the new inn between Perote and Santa Gertrudes. In sinking the well to the depth of sixty varas, ten were through sand and the debris of pumice, and the remainder in pumice and scoriæ, mixed with obsidian. The volcanic rock then assumed a more compact character.

March 23*d*, 1842.—R. J. Murchison, Esq., President, in the chair:—

1.—*The Coal-fields of Pennsylvania and Nova Scotia. By W. E. Logan, Esq., F.G.S.*

The observations detailed in this paper were made during the autumn of last year. The great carboniferous district of Pennsylvania, which is only part of the vast area occupied by similar deposits, and extending into the state of Maryland, Virginia, and Ohio, consists of numerous alternations of grits, sandstones, argillaceous and carboniferous shales, valuable bands of limestone and seams of coal, in some districts bituminous, and in others anthracitic. Beneath this series occurs a very hard, coarse, quartzose conglomerate, which, in the south-western portions of the coal district, is from 800 to 1200 hundred feet thick; but which in the north-west thins out considerably. Under this conglomerate is a red shale, also of variable importance, being 3000 feet thick in the south-east portions of the state, less than 100 in the western, and disappearing in the north-west. In its lower part it contains a partial bed of fossiliferous limestone. To the red shale succeeds a formation composed of white, grey, and buff-coloured sandstones and conglomerates, occasionally interstratified with beds of shale, and it is, apparently of uniform thickness. The whole of these deposits are conformable to each other, and are considered as belonging to the carboniferous series, containing coal-measure plants, but no workable seams of coal occur under the uppermost group. Beneath the sandstone formation a distinct series of strata commences, though the inclination of the beds is conformable to that of the carboniferous deposits. It has been termed by Professor Rogers, the Appalachian system, and consists of nine formations, arranged in the following descending order :—

1. Red and buff-coloured shales and argillaceous sandstones.
2. Olivaceous shales.
3. Fossiliferous sandstones.
4. Argillaceous blue limestone.
5. Variegated calcareous shales.
6. White and yellowish fucoidal sandstones.
7. Red argillaceous shales and soft red sandstones, with hard, greenish, and dark grey sandstones.
8. Dark blue, drab, and yellow slates.
9. A thick blue limestone.

The entire thickness of these formations is estimated to be at least 10,000 feet. The lowest limestone (No. 9) has a great range, extending through Pennsylvania and New York to lake Champlain and the banks of St. Lawrence, and it is considered, on account of its organic remains, assignable to the lower Silurian rocks of Mr. Murchison. The whole of the foregoing series, including the carboniferous deposits, are contained within a gigantic trough, which ranges from north-east to south-west, and is traversed, to a greater or less extent, by seven remarkable parallel ridges, ten to twelve miles distant from each other, and presenting the appearance of a series of concentric segments of circles, with the convex sides towards the north-west. These ridges are also parallel to the great range of the Alleghany and Appalachian mountains, increasing in sharpness and importance as they approach those chains. The first or most north-western ridge, has not been traced far into the north-eastern limits of the coal-field; the second is known to extend 125 miles from the northern boundary of the state to a considerable distance within the coal area, where it flattens down; the third and fourth have been ascertained to range 160 and 200 miles respectively, penetrating still further into the carboniferous regions, and there disappearing. The fifth and sixth have been traced 250 miles each from the county of Susquehanna, quite through the coal area to the confines of Virginia; but the seventh has been found to range only sixty miles within the district described in the paper, or from the southern boundary of the state to the Alleghany Mountains, one of the ridges of which is conjectured, however, to be a continuation of it. In the southern limits of Pennsylvania these ridges are said to produce anticlinal hills and synclinal valleys; but at the northern extremity anticlinal valleys and synclinal hills, instances of each occurring in the intervening or midway districts. Where the inclinal lines constitute hills, they always consist of the hard quartzose conglomerate; but where they occur in valleys they are always connected with the soft members of the coal measures, or the softer beds of the inferior red shales.

Confining his observations to the anthracitic regions, east of Susquehanna River, Mr. Logan next describes their geological and physical structures; but it is impossible to render this portion of the memoir intelligible without the assistance of very detailed maps. We can merely state, that the district is divided into three troughs—called the southern, middle, and northern anthracitic coal regions—by ridges of the hard conglomerate, and that numerous minor lines of disturbance, parallel to each other and to the separating ridges, traverse the troughs. In the southern region, the minor anticlinal ridges, five in number, present a more abrupt acclivity on the north than on the southern side; and this feature becomes more prominent in each succeeding escarpment; so that in the most southern the strata have been elevated beyond the perpendicular, and turned over, exposing beds many thousand feet below the coal measures. Pottsville and Mount Carbon are mentioned as good localities for studying these inversions. Beneath every seam of anthracite Mr. Logan detected a bed of fire-clay, containing stigmaria identical in mineral character, and in the mode of occurrence of the fossil plants, with the beds of underclay described by him on a former occasion as occurring under every seam of coal in South Wales. The number of the workable seams in the southern region, Mr. Logan is of opinion, ought to be reduced to one-fifth the amount given by the resident miners, as he allows for repetitions by faults; but he estimates their aggregate thickness at one hundred feet. The celebrated summit mines, worked in open day, in the neighbourhood of Mauchchunk, presents a nearly solid mass of coal, fifty feet thick. Standing on the edge of the excavation and looking down into the black abyss below, cut out into dark-sided lanes and streets, surrounded by sable precipices, it is impossible (says Mr. Logan) not to be amazed at the store of mineral wealth contained in this one seam, and equal to between 40,000 and 50,000 tons of fuel per acre.

In an appendix to the paper, Mr. Logan gives long and valuable sectional lists; and, he states, it will be evident from them that he personally examined nearly the whole of the anthracite coal seams noticed in the memoir.

Nova Scotia.—After his visit to Pennsylvania, Mr. Logan proceeded to Nova Scotia, and investigated the coal-bearing strata in the neighbourhood of Pictou, on the northern side of the province (lat. 45° 48′ long., 62° 48′ W.) Pictou stands on a carboniferous series, and a bed of coal passes under the town; but the principal locality for workable seams is at the Albion Mines, ten miles to the south.

In Judge Haliburton's statistical account of Nova Scotia, ten beds are stated to occur there, and the aggregate thickness is stated to be sixty feet; but only one seam, containing twenty-four feet in vertical dimensions of clean coal, is at present worked; and its daily produce is about 240 tons. In Frazer's Mount, near New Glasgow, two miles to the eastward of the Albion Mines, are other workable beds, resting, with the interposition of a stratum of stigmaria fire-clay, on limestone. Judge Haliburton has given a section of the Albion Mines, including 600 feet; and in the appendix to Mr. Logan's memoir is an elaborate list of beds, commencing 238 feet below the Judge's section, and extending in the descending series for upwards of 2500 feet. The whole of these series Mr. Logan divides into the following groups:—

1. Red and drab-coloured sandstones with red and grey shales, a few coal seams, occurring chiefly towards the bottom, associated with limestone, and resting on a very coarse conglomerate of considerable thickness.

2. Soft dark shales, with a few beds of sandstone, and richly stored, particularly in the lower half, with workable seams of coal and ironstone—5000 feet. Beds of fire-clay, with stigmariæ, were found by Mr. Logan under every seam of coal which he examined; and he states that they are reported to occur in the same position in the carboniferous series of Cape Breton.

3. Limestone with marine fossils—ten feet.

4. Coal measures, probably unproductive, consisting, in the upper half, chiefly of red and dark-coloured shales and sandstones, also of carboniferous shales, resting on fire-clay, with stigmariæ; and in the lower half, of strong red and other sandstones, divided by a few bands of red shale—1900 feet.

5. Limestone—ten feet. All the above rocks contain carbonised vegetable remains; but in the beds next to be noticed they are very rare.

6. Soft bright red and pale green shales, alternating in the lower part with red sandstones—650 feet.

7. Limestone—twenty feet.

The limits of the coal deposits of Nova Scotia have not been defined, and great care would be necessary in attempting to ascertain them, on account of the overlying strata. Mr. Logan is of opinion that the Pictou deposit probably extends westward across Colchester county, to the north side of the Basin of Mines, including the seams of Kemptown and Onslow; and he believes that a parallel trough exists to the southward, ranging from Hawkesbury on the western side of Cape Breton Island to Windsor on the south side of the Basin of Mines (lat. 44° 49′, long. 64° 19′ W.), three miles south of which Mr. Logan discovered coal measures. He states that they are also found at Middle Stewick, on the line of strike between Hawkesbury and Windsor; and they are reported to occur at Beaver Lake, which is situated on the same bearing.

With respect to the gypsiferous marls and limestones of Nova Scotia, Mr. Logan is of opinion that they are newer than the coal measures, because in a section near Windsor the former rise out unconformably at an angle of 45° from beneath the latter, and because the fossils collected by him have been ascertained not to belong to any of the deposits more ancient than the coal measures, but to agree generally with those characteristic of the magnesian limestone and triassic series.

2.—*On the Tchornoi Zem, or Black earth, of the Central Regions of Russia. By Mr. Murchison.*

This earth constitutes a superficial deposit, the northernmost limits of which may be defined by a curved line drawn from a little south of Lichwin (54° N. lat., 33° 44′ E. long.) and the left bank of the Volga, in lat. 57°; it occurs also near Casan, and at Crasnoi Glasnova, on the Asiatic side of the

Urals. Of its southern limits no precise lines were given, but it was said to occur at intervals on the eastern flanks of the Southern Urals, in the steppes of the Kirghise. It is found at all levels, to the height of 400 feet, and varies in thickness from two to twenty feet. It consists of fine black particles, mixed with grains of sand; and when wet forms a terraceous mass, but becomes an impalpable powder when dry. The following is the analysis:—silica 69·8; alumina 13·5; lime 1·6; oxide of iron 7; vegetable matter 6·4; traces of prussic acid, sulphuric acid, chlorine, and loss, 1·7. Mr. Murchison states that he thinks this deposit is of the same age as the Loess of the Rhine, though it contains no fluviatile or terrestrial testacea, and because it occurs in plateaux; this is not the case with the latter. He also believes it to be a submarine accumulation, deposited under quiet circumstances.

April 6th and 20th, 1842.—R. J. Murchison, Esq., President, in the chair.

A notice was first read "On the Tetracaulodon," by Mr. Koch.

The object of this communication is to support the opinion that the tetracaulodon is generically distinct from the mastodon, and consequently that the tusks in the lower jaw are not merely sexual characteristics. Mr. Koch states, that during his residence in the United States, he examined nearly all the inferior jaws of the mastodon which had been preserved in public and private collections, but in no one instance did he ever observe any traces of a tusk; and Dr. Hays, of Philadelphia, is reported to have arrived at a similar conclusion respecting at least forty specimens of lower jaws. Mr. Koch refers particularly to the mastodon in the Philadelphia Museum, and that preserved at Baltimore, both of which, he says, must have belonged to males. He then alludes to the impossibility of the mastodon, with long upper tusks, making use of inferior tusks such as those forming the subject of the present discussion, and never exceeding twelve inches in length; but these tusks nevertheless bear, Mr. Koch says, evident signs of having been employed in rooting and grubbing; and hence, he infers, that the animal to which they belonged must have had equally short upper tusks. For the purpose of illustrating his views, the author proceeds to offer some remarks on three species of tetracaulodon, to which have been applied the names of *T. Godmani*, *T. Kochii*, and *T. tapiroides*. The first has been described by Dr. Godman, its discoverer, and by Dr. Hays; but Dr. Koch calls attention to the characters presented by the maxillary and nasal bones, as well as to the additional foramen near the molar bone, and which is wanting in the mastodon and elephant. Of the *T. Kochii* the author possesses an entire upper jaw, with six molars and two tusks, found resting on the lower jaw, which contained a tusk undisturbed in its alveolus. The upper tusks indicate, Mr. Koch says, that they were designed to be used in harmony with the lower tusk for rooting and grubbing. They are nineteen inches long, more than one-third of the entire length being concealed in the skull; and their greatest circumference, which is nine inches and a half, occurs at the apex, and not on the base. The enamel on the root is very thin, but at the opposite extremity it is uncommonly thick, and this part bears indisputable proof of having been much used during the life of the animal. Mr. Koch admits that the left tusk disappears in the adult animal, but he says that both in the old and young individual the tusks have the same peculiarity of being equal in circumference at the root and farther extremity, and that the "bulb for the reception of the nerve and nourishment of the tusks resembles that of the upper tusks minutely both in the old and young animals, which peculiarity would almost give rise to a suspicion of not merely a different variety of the tetracaulodon, but even of a new genus." The *tetracaulodon tapiroides* has received its specific name from the resemblance of its first grinder to the molar of the tapir. An upper jaw in Mr. Koch's collection contains two tusks, bent downwards like those of the morse, and thickly covered with enamel; and they plainly indicate, he says, that the animal fed on water-plants. In conclusion, the author calls attention to some peculiar vertebræ which were found associated with the skull and lower jaws of the tetracaulodon, and he is of opinion that they exhibit characters in accordance with the supposed aquatic habits of that animal.

"*On the Flat Regions of Central and Southern Russia, in Europe. By Mr. Murchison, M. de Verneuil, and Count Keyserling.*

This paper, which occupied the greater part of the first, and the whole of the second evening, included in our notice, described the flat regions of Russia traversed by the authors during the summer of 1841; the second, devoted by them to the examination of that empire; and the account of Ural, or mountainous districts, is reserved for subsequent meetings. The formations which occupy this vast territory belong to the Silurian, Devonian, and carboniferous systems; to a great series of deposits equivalent in geological position with the magnesian limestone of England and the zechstein of Germany, and to certain portions of the oolitic, cretaceous, and tertiary systems, the whole being overlaid by far-spreading masses of northern drift and other detritus. It is impossible, in a notice suited to our Journal, to grapple with the details of a paper, describing, for the first time, the true order of position of strata extending over twelve degrees of latitude and thirty degrees of longitude; but we will endeavour to give an analysis of the conclusions arrived at by the authors. The centre of Russia, between the parallels of 52 degrees and 54 degrees north latitude, is occupied by a dome of Devonian rocks, which divides the empire into a northern and southern basin, each characterised by marked geological features, but most especially by all the good or workable coal being confined to the southern basin. Over the whole area of European Russia, however, whether it be traversed from Archangel to the Black Sea, from its western confines to the foot of the Ural Mountains, or from St. Petersburgh to the sea of Azof, the strata present a conformable succession and nearly horizontal position, except in the coal regions north of the sea of Azof, where the carboniferous beds are dislocated and highly inclined, and overlaid unconformably by newer deposits. The Silurian rocks do not occur within the flat, central, and southern regions of Russia, but they exist extensively in the Ural Mountains, and will be fully described in future memoirs. The Devonian rocks forming the central dome, before alluded to, differ lithologically from the equivalent strata in other parts of Russia, but they contain the distinguishing ichthyolites of the system, and the same testacea which occur in the Devonian rocks of the south-west of England, the Boulonnais, and the Eifel. They are, moreover, surmounted along their northern frontier by the lowest strata of the mountain limestone. The author's knowledge of the carboniferous system of Russia was greatly extended during their last expedition. In the northern region or basin, and ranging from near Moscow to Archangel, it exhibits great uniformity of character, consisting principally of a white limestone, which often resembles the calcaire grossier of Paris, and it contains only one thin bed of very impure coal; but, in consequence of their extended researches, the authors show that the system may be separated into three divisions, the lowest being characterised by the great *Productus hemisphericus*, the middle one by the *Spirifer mosquensis*, and many well-known carboniferous shells, and the upper division by the great abundance of a foraminifera, to which Fischer de Waldheim has applied the name of *Fusulina*. The establishment of this triple subdivision has enabled the authors to correct some important errors in previous classifications of Russian deposits. But the most interesting feature in this system, south of the central dome, occurs between the Don and the Dnieper, and consists of a vast interlacement of limestones, containing the same fossils as near Moscow, with sandstonės, shales, and numerous seams of bituminous as well as anthracite coal. This series, the authors state, is distinguished from the coal measures of western Europe by the absence of all beds containing fluviatile or lacustrine remains. Along the western flank of the Ural Mountains, the carboniferous limestone is overlaid with grits, conglomerates, shales, and flaggy limestones, containing new species of goniatites and plants common to the whole carboniferous series. These beds are considered by the authors to be the equivalents of the British coal-fields, and the lower newer red sandstone, or the rothe-todt-liegende of Germany, and reasons are given for separating the latter with its English representative from the newer red sandstone series, and making it the upper, but an integral part of the coal measures.

The next system of deposits, in ascending order, claimed the particular attention of the authors, on account of the difference of opinion which had been expressed respecting its true geological position, and the most competent observers having begged them to make it an object of careful research. The series consists of inosculating deposits of limestones, marls, and gypsum, with grits, sandstones, and conglomerates containing copper,—of saliferous marls, sandstones, and rock salt, and of bituminous grits; and it is characterised by a peculiar fauna, but it contains also the typical shells of the magnesian limestone of England, and of the zechstein of

Germany, as well as the distinct saurians of these formations. Nevertheless, if it had not been for the vast development of this series in Russia, for its possessing an independent flora and fauna, and for the want of a term to express a complex series of deposits, occupying a geological situation intermediate between the carboniferous and triassic systems, the authors would have hesitated to have erected these important rocks into a system. They feel, however, that they are fully justified in doing so, and they propose to designate the system by the appellation Permian, on account of its extensive distribution in the Government of Perm, and because more of the names applied to subordinate members of the system in other parts of Europe express the aggregate characters of the Russian deposits. The system has been long mineralogically known along the western base of the Ural Mountains, where it abounds in copper ores, which are not distributed in veins, but are disseminated through the sandstone and grits, especially in those parts in which vegetables occur, the original plant being often replaced or charged by carbonates and other ores of copper. In the north of Russia the system is feebly exhibited, consisting of only a bed of inconsiderable thickness. Overlying these strata occurs a deposit of green and red marl and sands, destitute apparently of organic remains, but occupying a vast region. Whether these marls are the representatives of the triassic system, or belong to the Permian, the authors decline to offer any opinion, not being provided with that evidence which they consider sufficient. The regular sequence in the ascending order, between the Permian, or the beds last noticed, and the cretaceous series, is partially represented in Russia, many of the deposits constituting marked features in the English secondary formations being totally wanting, and others but imperfectly represented. The authors, however, show that the beds between the red and green marls and the cretaceous series are separable into two divisions, the lowest consisting of dark shales and ferruginous sands, being the equivalent of the middle and inferior oolitic deposits of England, and the upper composed of earthy and sandy limestones, being on a parallel with the coral rag and Portland oolite; and the correctness of the classification is proved by lists of fossils, including well-known British species. This attenuation of a great European series of rocks, was due, the authors conceive, to changes of level between sea and land, whereby large areas were, for a time, raised above the ocean, and again depressed beneath it; and they adduce, in support of this opinion, instances of erosion or denudation in the red and green marls, before the deposition of the bottom bed of the oolitic series. Though these strata occupy comparatively small areas, especially near Moscow, and on the Volga and Okka, they are extensively distributed in the Government of Simbusk and Saratof; also on the south-west flanks of the Ural, and in the steppes of the Kirghiss; but the superior division is only known on the Upper Donetz. The cretaceous system of Russia is, in many respects, identical with that of western Europe, and it contains several of the long-known characteristic fossils: it occasionally, however, presents discrepancies in composition, passing in the highest part into arenaceous strata, so that the fine white chalk is enveloped in masses of marlstone, sands, and ferruginous grit, analogous to the upper and lower green sand series of England. The tertiary strata of Russia are shown by the authors to agree most strikingly with those of England, the lowest bed being lithologically undistinguishable from the Bognor rock, and containing fossils, stated, on the authority of Mr. J. Sowerby, to be identical with Bognor species; and other beds are exact counterparts of the grey-weathers of England, or the paving stones of Paris. The next strata, in ascending order, are shown to be of the age of the Vienna basin or Miocene epoch, and the shelly lime stones of the steppes are stated to exhibit the finest examples of a transition from the pleiocene to the post pleiocene series, the organic remains in the uppermost beds being undistinguishable from the shells of the Caspian. Of this most recent deposit, Russia, as the authors observe, possesses peculiarly two distinct accumulations, one characterised by an arctic fauna, now living in the North Seas, and the other by a fauna of temperate zones, or that of the Caspian. In reviewing the phenomena presented by the vast territory which passed under their survey, the authors dwell on the uninterrupted succession of conformable marine deposits throughout nearly the whole of the flat regions of European Russia, or the non-intercalation of terrestrial, freshwater, and estuary formations, connecting the absence of such strata with the total want of intrusive or other igneous rocks, as well as all evidence of violent disturbance and inconformability, except in the coal-field north of the sea of Azof. The cause of these peculiarities, or the absence of plutonic rocks, is considered by the authors to have also influenced the lithological structure of the formation, some of the oldest of the Silurian strata having quite as recent an aspect as the cretaceous or tertiary beds.

Another point of great zoological, as well as geological interest, connected with the singular structure of Russia, is insisted upon in the memoir. Each formation is clearly marked by its distinct suit of organic remains, even in those cases where there is no unconformability or abrupt transitions between one series of rocks and the next in succession; and therefore, Mr. Murchison observes, that this distinction, especially in the Silurian, Devonian, carboniferous, and Permian systems, cannot be due to violent operations, which destroyed one race of animals to make way for another; and, consequently, that the theory founded on such a supposition, and deduced from the investigation of countries which present numerous instances of violent commotion and unconformability, must be greatly modified before it can be admitted.

In conclusion, the authors recapitulate the evidences of the marine origin of all the regular formations to the newest tertiaries inclusive, alluding, nevertheless, to the proofs of the interruption in the sequence of the secondary strata, and the probable influence which the elevation of the central dome of Devonian rocks had, in the marked difference of the characters of the formations north and south of the dividing region, and they show that the submarine condition of the surface did not terminate with the post pliocene epoch, but extended throughout the period when the superficial detritus was accumulated, and, in part, to within the pistoric era.

Lastly, they allude to the effect produced by the operations of man on the waters of the lakes and rivers, proving incontestibly that their diminished volume is due to the felling of the forests, and the cultivation of the soil.

MANCHESTER GEOLOGICAL SOCIETY.

At the meeting of the members of this society, held on Thursday the 28th of *April*, EATON HODGKINSON, Esq. F.R.S. in the chair, Mr. Binney read a communication, by Robert Harkness, Esq. of Ormskirk, entitled "*On the Influence of Temperature on the Waters of the Ocean*," of which the following is an abstract:—

The former existence of glaciers in localities where at the present time the climate is mild, is inferred by Agassiz, Buckland, and Lyell, from the occurrence of moraines similar to those which are now found to be produced by the glaciers of Switzerland, as well as from the dispersion of erratic boulders over surfaces which no cause at present existing, with the exception of ice, would have been able to effect. Besides these circumstances, there is another which affords strong proof of the former occurrence of a frigid climate in the temperate zone; viz. that the shells found by Captain Bayfield, in a modern deposit near Quebec, belong to arctic genera and species resembling those collected by Mr. Lyell, at Uddevalla, in Sweden. Those also found by Mr. Smith in the valley of the Clyde possess an arctic appearance. Although the discovery of arctic remains is *at present* confined to temperate regions, there can be no doubt that the distribution of boulders in the torrid zone was caused by the same means as in the temperate one.

The observations of these geologists appear to me to furnish considerable data towards explaining the occurrence of sea beaches at an elevation above the present sea level. Although this, at first sight, may appear improbable, yet when we connect the general distribution of glaciers with other circumstances, the inference will in a great measure be borne out.

The general distribution of ice over the surface of the earth would cause a great decrease in the temperature of the waters of the ocean. These, deriving their heat from the land, are affected by the changes which the temperature of the earth undergoes; in different latitudes partaking, at the surface, of a temperature similar to that of the neighbouring land: but the temperature of the sea, under the same latitude, varies considerably with the depth; in the tropical and temperate regions, decreasing with an increase of depth; while, in high latitudes, the reverse is the case; viz. an increase of temperature without an increase of depth. Captain Labine, in latitude 0° 33′ N. found the temperature at 653 fathoms to be 43; that of the surface being 78¾. Also Scoresby, in latitude 78° 2′ N. found the temperature at the depth of 761 fathoms to be 38; the surface being only 32.*

* Some authors have stated, that the waters of the ocean are influenced by heat in a similar manner with matter generally. But the above experiments show, that salt water, as well as fresh, offers an anomaly to the laws of cooling, so far, at least, as density is concerned.

From these observations it is evident, that, at a depth comparatively small, there exists a very large portion of water having a temperature of about 40° Farenheit, at which temperature water is more dense than at any other.

The mean depth of the Pacific Ocean is supposed to be about four miles, and the Atlantic about three; the mean of which would make the depth of the ocean about 3000 fathoms, in round numbers. At the depth of about 800 fathoms, there is every reason to believe that the temperature of the sea is about 40° Farenheit; and also, that the remaining 2,200 fathoms is of the same heat, may be inferred from its then being at its greatest density; for, if the water at a greater depth were either colder or hotter, then it would ascend in consequence of its being specifically lighter.

If this inference of the great density of so large a portion be correct, it necessarily follows, than any alteration in its temperature must cause a corresponding alteration in the mean sea level. By a decrease in heat, an increase in depth would be the consequent result.

Water, according to Dalton, in assuming a solid state, increases 0·05 in volume; so that, were all the waters of the ocean to be converted into ice, there would be a great increase in volume; the depth being dependent entirely on the area of surface.

Although the supposition of the ocean having been converted into ice be entirely gratuitous, yet it in no way affects the conclusion, that a decrease in temperature would cause a corresponding increase in the volume of the waters of the ocean. It is while in the act of freezing that waters expand 0·05; so that, during the time of cooling from the temperature of its greatest density, a gradual increase in volume would follow.

The former occurrence of the sea above its present level does not depend merely on the supposed former existence of glaciers. Another cause—viz. the relative distribution of land and water having great influence on the temperature of the earth — would, for the reason before mentioned, also exercise peculiar influence on the temperature of the ocean. As the temperature of the surface of the globe depends upon solar heat, that land most immediately under the equator absorbing most solar rays must have the greatest influence upon the general temperature of the earth: consequently the smaller the quantity of land within the tropics, the lower would be the temperature of the waters of the ocean. This paucity of land within the equatorial regions is confirmed by the observations of Darwin, who is of opinion that a large portion of South America is of very recent geological origin. So late as the year 1822, no less than 100,000 square miles was raised several feet. Also, in 1819, across the delta of the Indus, a portion of land, 50 miles in length by 16 feet broad, was raised 10 feet; showing that, even up to the present time, the same causes continue to operate which have elevated a large portion of the tropical regions.

Although elevating causes are at present confined to equatorial regions, there is no reason to doubt that they also formerly operated in higher latitudes.

That, by this cause, considerable masses have been raised to their present position is undeniable; yet the universal diffusion of traces of the ancient ocean having been above its present level *about the same geological epoch*, as well as the *horizontality* of elevated sea beaches, and the probability of the temperature of the earth having been at an epoch slightly antecedent to the historical period considerably less than its present average temperature, appear strongly presumptive in favour of a general depression of the surface of the waters of the ocean.

Mr. E. W. Binney said, the hypothesis started by the author of the paper which had just been read, with respect to the alterations in the temperature of the ocean, was not only original, but one which would account for many of those geological phenomena of which no satisfactory explanation had hitherto been given.

Dr. Black thought the Society was much indebted to the author of the paper just read; but he could not help remarking, that there were many objectionable points in it. There was something said in it about boulders in the torrid zone: now he was not aware that boulders had ever been discovered in that part of the globe. Again, it appeared from the reasoning adopted by the writer, that he assumed the law affecting the specific gravity of sea water to be the same as that of fresh water; a point which was by no means well ascertained. If all the waters of the ocean had been fresh, then the data with which he set out, viz. that the greatest specific gravity of water is at a temperature of 39° to 40°, would have been perfectly correct; but as it so happens that the greatest specific gravity of sea water is at a much lower temperature than that of fresh, this affected the whole of the theory.

The Chairman understood that it was very doubtful whether the law by which the specific gravity of salt water is determined, was the same as that relating to fresh. He was inclined to think, that the greatest specific gravity of salt water was at a temperature of 20°.

Dr. Black agreed with Mr. Binney, that if the hypothesis were well founded, it would go far to explain many things in geology.

Mr. Binney, in relation to what had fallen from Dr. Black about the existence of boulders in the torrid zone, said he had never heard of any having been found there; but they all knew that Professor Agassiz was of opinion that the entire continent of Europe had formerly been one vast glacier. Now, if that was the case, might they not find in it a corroboration of the views laid down in the paper which had been read?

Dr. Black was quite familiar with Agassiz's notions on that head, but he could not see that they warranted the speculations of Mr. Harkness as to the alterations in the temperature of the ocean. For his part, he thought they could not speak with any confidence on the question, till they had ascertained at what point the specific gravity of sea water was greatest.

Professor Wallace was of opinion that the density of sea water was governed by the same law as that of fresh water. The mean point of specific gravity was different; but its decrease, as the temperature rose or fell, would, no doubt, be after the same rate. He thought the hypothesis now propounded would, in connection with the glacial theory of Professor Agassiz, account for most of those fluctuations in the surface of the ocean which have taken place at various periods.

The chairman said there was one point on which he would like to have some explanation. They were aware, that, from recent experiments, it had been ascertained that the temperature of the earth increased in proportion to the depth penetrated. At a depth of two miles, it had been calculated that the temperature would be equal to that of boiling water. Now, were there no means of determining whether land and sea were alike in this respect? Another question was with regard to the condensation of water at great depths. They all knew that water was compressible to a considerable extent; and it might therefore be taken for granted, that in the deepest parts of the ocean the lower strata would thus be much more dense than those near the surface. After a few remarks from other members, the thanks of the society were given to Mr. Harkness for his contribution, and to the chairman; after which the meeting terminated.

SCIENTIFIC SOCIETY OF LONDON.

April 6th and 20th. 1842.—Donations of several thousand plants; fossil productions, &c. announced. The subject which occupied the attention of the members on both these occasions related to the "*truine system of classification of science" applied to Mineralogy.*—By CHARLES MOXON.

The paper was prefaced by an extract from a work by J. H. Kyan, "on the elements of light, and their identity with those of matter, radiant and fixed," in which the author's words are applied with direct reference to mineral substances and in which, after detailing the reduction of all the constituents of animal and vegetable substances to three elements, he concludes by remarking, that "on turning to those of the mineral kingdom, we are indeed astonished at the discordance that appears in their accepted system of conformation, imputing the existence of *fifty four* original or undecompounded bodies for such purpose.

1. That these are original elements, he contends is doubtful, in as much as the experiments by which these results have been obtained, were in many instances inaccurate, and in most cases incomplete, no allowance having been made for the particles which passed off in a radiant form or were dissipated in the process.

2. He contends, that so long as any body assumes a crystalline form, so long must it be of a compound nature, as no homogenous body can present such a diversity of atomical arrangement.

3. That all bodies being compounds formed of the same constituents, their peculiar properties and qualities are not to be considered innate, but are to be attributed in addition to variation in proportion; and to a modification of arrangement inducing a polar influence, by which their passage to other

stages of fixity is facilitated or impeded, and they are rendered applicable to further appropriate changes.

The paper next contained a statement of the reasonings and experiments proving the following analogies, between simple elements and simple rays of light. viz :—

The Red Ray	.	Oxygen.
The Yellow Ray	.	Nitrogen.
The Blue Ray	.	Hydrogen.

each of which primary rays possesses peculiarly distinct and countervailing qualities.

It was next proved that *colourless* surfaces of nearly homogenous construction, after being subjected to the rays of light, become coloured according to the absorption of the separate or combined rays; evidencing the agency of these rays of light and the heat engendered by them in producing and imparting colours. This was done by instancing in particular, the effect of light upon glass, upon the corolla of plants, and the variable colours observed in one and the same flower during different periods of the day, according to the degree of light to which it is subjected.

Having thus traced the affinity between these two constituents of all matter, the author next proceeded to illustrate his views with reference to mineral substances, evidencing their relation to the foregoing combinations, notwithstanding the impurity (or multiplicity of parts) of their components.

1. Nearly all the natural combinations of oxygen with an earthy or metallic base, are of a reddish colour.

2. Natural combinations of nitrogen with the same, are yellow.

3. Natural combinations of hydrogen with the same, are blue or bluish white.

Thus, even with a present doubtful knowledge of elementary substances, there is an apparent law of colour in mineral productions, which is further evinced by the ordinary compounds, as follows—

Iodides	allied to oxygen, are red.
Muriates	allied to hydrogen, are blue.
Nitrates	allied to nitrogen, are greenish.
Chlorides	allied to chlorine, are greenish blue.
Sulphurets	allied to ?, are yellow.
Sulphates	allied to oxygen and hydrogen, are dark blue approaching purple.

And many of these are materially affected on their being subjected to extraordinary influences.

This system of colours would, therefore, assign to minerals an arrangement according to their composition; the simple forms, or, in other words, the most pure substances, occupying the respective positions of equi-distant radii of a circle, between which numerous other radii, determined by the colours presented, would be subsequently placed. This, however, is merely an illustration of the arrangement; but as it has long ago been determined that to define such distinct line of demarcation is impossible, on account of the gradations throughout nature, so, in all probability, will these colours range in circles, one within the other, according to the equivalents of their composition, and hence their colour. Again, as it is clear that all colours are reducible to three, so it is, also, that as no one law of nature can nullify another, the system must reduce itself into one, composed of three grand families, of which oxygen, hydrogen, and nitrogen (?) are the probable types.

The author concluded the second paper by expressing a hope, that having called attention to this beautiful series of analogies, chemists as well as mineralogists might contribute to the identification of some rule, founded upon this or other equally broad basis; and that he hoped, at some future time, to lay before the Society a much more elaborate communication on the constituents of *qualifying agents*, and their analogies, both in respect of composition and colour.

After the conclusion of the paper, an interesting discussion occurred between Messrs. Croft, Taylor, Mudie, Fordham, and Moxon, founded mainly on a critical examination of the equivalents and colours of artificial substances, in which it appeared that the system alluded to was not so generally prevalent. Mr. Moxon resumed the argument in support of the system, by referring to the influences engendered by the natural process of formation, namely, the origin of electrical, galvanic, and magnetic forces, from the separation of the individual original constituents of light, which were less perfectly developed in the artificial or chemical process of formation.

Mr. Taylor stated that his objection to concur at once in the original principles of the system, was derived from his doubts as to the effect of polarization of the rays of light, and their subsequent alleged influences. Mr. Moxon contended, in opposition, that the polarity was caused by circumstances acting when the rays were near the surface of the earth, and, consequently, that having previously assumed their respective associations with the elements of the atmosphere during their previous passage through them, the fact of their becoming polarized would not affect the combination already assumed.

The usual vote of thanks having been passed to the author of the paper, and the Chairman having stated the pleasure which he had felt in this Society being the first to entertain the subject, the meeting separated.

REVIEWS.

Etudes sur les Glaciers. Par L. Agassiz. Neuchâtel, 1840. 8vo. *(Gent et Gassman.)*

We did not intend to withhold our notice of this work for so long a period, but having borrowed largely from its pages in the compilation of our periodical summary on Glaciers in January last, we feared that we should have seemed to introduce the subject too much upon the public attention at that time. We had, moreover, interspersed the prevailing opinions of the day as to the merits of Professor Agassiz's glacial theory; and on that account the summary in question might have seemed to serve both as a notice of the subject generally, and a specific review of the work, which, as we have said, added so extensively to its compilation.

But this work of M. Agassiz needs further comment, and the record of opinions which we could not express in the article to which we refer. The volume itself, although presenting margins and type sufficiently large to incur condemnation on the score of "book-making," contains the detail of many laborious researches and careful observations; but the principal merit rests in the beautiful atlas of plates accompanying it, presenting us with views of glaciers under their different aspects, and the prominent effects by which their courses are marked.

The lithography is first-rate, and the style unexceptionable, and the whole series have rather the impress of works of art, than records of mere research; they seem more adapted to the portfolio of the collector than the library of a man of pure science.

We do not know of any method better calculated to disseminate the author's particular views on the subject, than allowing him to speak in a measure for himself; and we shall, therefore, borrow somewhat from the preface to his work.

M. Agassiz says, "That of all natural phenomena, glaciers are the most worthy of the attention, and are best calculated to excite the curiosity of the naturalist." We agree with the author in this last opinion; and we find him complaining, in the next succeeding paragraph, that they have almost exclusively fixed the curiosity; but they are worthy of the attention, he says, on account of their important history, as forming the sources whence the waters of many of the largest rivers flow, and the reciprocal influence which they bear upon climate, and climate upon them.

There is scarcely a Swiss traveller who has not admired the glaciers of the Alps, and been inspired with a degree of curiosity; but, with regret be it said, there are few who have allowed their curiosity to lead them into an examination of the phenomena, to which our author directs attention. The truth is, there are few who will encounter the difficulties of a "glacial tour," and follow M. Agassiz in his perilous ascents, —who are prepared to surmount the barriers which surround the voyager in his travels, with the apparently trifling reward of a few facts. Yet, we must say with him, that much remains to be seen which will repay the troubles of a journey, and that, in proportion as this field of research is better explored, so will the number and value of the facts increase.

The main object of the work appears to be the introduction of a theory of glacial action of very general application, and hence of a very important nature. We have elsewhere stated that to accord with this theory, based more especially upon observations in the western portion of the continent of Europe, would be to give our fullest assent to M. Agassiz's views; and we hesitate so to do, from the startling nature of the admissions we must make to give the argument its proper weight. We still think with him, that glaciers and diluvio-glacial agency have effected many of the most important changes on the surface of the globe, and that to them we may attribute the distribution of erratic blocks, of gravel beds, and boulders.

MONTHLY NOTICE.

1st. July, 1842.

On the suggestion of many of our correspondents, we have communicated, during the past month, with the Council of the Geological Society of London, remonstrating with them on the subject of their publications, the errors of which we pointed out in our editorial notices of May and June last; and it is but justice to them that we should here insert a copy of the document referred to, which we accordingly perform.

To the Council of the
Geological Society of London.

Gentlemen.—Many correspondents of the "Geologist" have repeatedly called our attention to the statements which are published in the proceedings of your Society, and which, in their opinion, cast rather obliquity than perspicuity upon the subjects reported. The recent cases noticed in the Monthly Editorial comments of the "Geologist" of May and June, to which they have referred more directly, will illustrate the nature of the complaints which have been so generally made, and our object in communicating with your Hon. Society in this instance, is to represent, if possible, the grievance under which geologists labour, from the uncertainty which your publications convey, both in themselves, and the transcripts which naturally take place into the scientific periodicals.

If it were not presumptuous on the part of an individual to offer an opinion, I would suggest the adoption of the method practised amongst many societies abroad, of printing, appended to the papers read, a summary of the discussions which ensued, with the further addition of wood-cuts of those sections, etc. which were submitted at the meetings, in illustration of the author's views.

The cursory reports contained in the "proceedings" of your Society, and the total absence of any more lengthened notice of many articles in the "Transactions," are a very sinecure publication of observations and discoveries for the benefit of geological science, and it is a source of much regret, that so many observations should be lost to the world. Gladly would we ourselves, as the only periodical devoted to the science of geology, give immediate insertion to the abstract of the *proceedings in full*, and furnish, for the benefit of the geological public, with your assistance, sections and diagrams illustrative of the communications, *in lieu of the present method* of inserting regrets at the incompleteness of the reports. Your answer would oblige, etc. etc.

We will leave our friends to judge, whether we have expressed their sentiments or not.

Geology is a science in a degree independent of natural history in general, although it cannot be denied that its objects are the same *in the end*, and the means by which the general object should be accomplished are of the same nature; it is not for the aggrandisement of the naturalist himself, but for the praise of the creator and governor of the universe. All persons must be convinced of this latter argument, and with us, will naturally regret to find the progress of discovery impeded by party-spirited dissensions as to the merits of particular discoveries. We are glad to find an active spirit of friendly endeavour to promote the general good, and the origin of fresh questions for the display of talents, perseverance, and research; and on no one occasion have we been more gratified than on finding the revival of a subject so generally interesting as the agency of glaciers in geological transformations. We read and recorded with pleasure the facts discovered by Agassiz, Charpentier, Venetz, etc. as so many data added to the then existing number, and it was not in any degree with reference to the merit of the respective observers. We were, therefore, the more surprised at receiving a communication from M. Agassiz, founded upon a dispute between himself and Professor Forbes, of Edinburgh, as to the merit of *discovery* of the lamellar structure of glaciers.

There is a dispute, in the first place, arising from various assertions as to the dates of the discovery, which are, virtually, the answer to the question; but each seems to deny the statements of the other, and the arguments of both, as to these particulars, are equally futile, for that reason. But we cannot pass over a paragraph in M. Agassiz's letter to Professor Forbes (published for distribution), in which the former claims for himself, under any circumstances, the *merit* of the discovery, on the ground that Professor Forbes had enlisted as a "student under him," without any intention of proceeding further than deriving instruction from M. Agassiz's experience; in fact, claiming the merit of the student (so to speak), he being the teacher!

What motive could dictate such a claim, we are at a loss to conceive, if it is not that to which we have referred?—and, whilst we also remonstrate with Professor Forbes on his claiming the merit for himself with that pertinacity which pervades his letter, we cannot but say that, on a fair and impartial review of the circumstances, we are inclined to give him the greater share of the merit of the discovery.

THE EDITOR.

ORIGINAL COMMUNICATIONS.

On the occurrence of the bones of the Mammoth in Blue Marl (above the weald clay), in the valley of the Medway; being an extract from a letter received from W. J. West, Esq. M.R.C.S.

Mr. Barlow has handed me your note to him, and requested me to reply to it. The only portions of the remains of the mammoth which Mr. Barlow preserved, are two teeth, a portion of the ilium, tibia, and a very small fragment of the tusk. I have one of the teeth in my collection, and it has all the characteristic marks of the true fossil species; the laminæ of these molar teeth are narrower and more numerous than those of the Indian elephant, and the lines of the enamel, which separate the divisions of the laminæ, more slender and less festooned in the fossil tooth. I have carefully compared it with a recent tooth and a fossil tooth from the Norfolk-crag, with the latter of which it corresponds; the size is also greater than the recent; it weighs 6lbs. 11oz., and not mineralized, or as it is called petrified. The next bone of interest is the ilium, from the size of the acetabulum, which is eight inches in its largest diameter, and six in its shortest.

The tibia had its head, or upper articulating surface, perfect, being eight inches in diameter, and the shaft of the base twenty inches long, although the lower articulating surface is broken off.

The small portion of the tusk was six inches in diameter.

Judging from comparison, I should think the above was a full grown animal; indeed it could not have been a young one, from the appearance of the teeth and of the bones.

These remains were not found imbedded in weald clay, as has been stated, but in blue marl, under a bed of gravel, about twenty feet thick, which are only the diluvial deposits above the weald clay.

We have every evidence that the great valley of the Medway, which runs parallel with, or indeed, forms a part of that zone called weald clay, till it cuts the lower green sand, gault, chalk, near Maidstone, was an estuary;—if so, why may not the mammoth have sported and lived on its shores in this part of England, since it is generally along the shores of large rivers that these remain, recent as well as fossil, are generally found.

As soon as I saw the above bones, I sent to Mardon to purchase all those that could be found, and have been waiting, in hopes of being able to give you a fuller description; should, however, any thing more come to light, you may rely on my giving you the earliest account of it.

Sketch of the Oolite formation of the Cotteswold Range of Hills, near Cheltenham, by James Buckman, Esq.

The situation of the oolite formation of this district, as before intimated, is immediately upon a bed of yellow clay, forming the upper member of the lias formation.

The high range of hills, called the Cotteswolds, are partly composed of different beds of the freestones and grits peculiar to the oolite formation. Some of these beds are of great thickness, and to those who look minutely into their structure will afford sufficient data for sub-division into the following groups.

1st. The Inferior Oolite, consisting of the following subordinate rocks.

I. Pisolite, or Pea-grit.

II. Roestone, or true oolite.
III. Freestone.
IV. Oolite marl.
V. Gryphite grit.
VI. Cidaris sand.

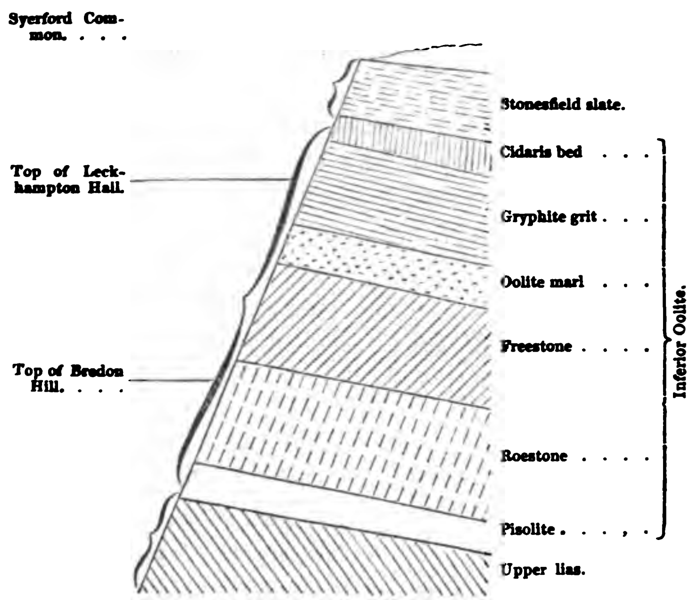
2nd. Stonesfield slate.

In studying these beds the more conveniently, and with the greatest success, we shall, of course, commence our research with an attentive examination of the escarpments which are presented to our view on their western side, as from the fact of their strata dipping from the west to the east, we are enabled to do so with the greatest facility; and when we have indubitably ascertained the position of the pisolite, we shall find little difficulty in tracing up the overlying beds in the order before noted. But it is frequently a difficult matter to determine the situation of the pisolite, on account of the debris with which the escarpment is covered, as well as from the displacement of large masses of the pisolite itself from its normal position; and these two causes frequently lead the geologist, when examining this district, to the conclusion that the Cotteswold hills are composed entirely of oolite, when this rock only forms about one-third of their height. In order, then, to satisfy ourselves upon this point, it is necessary to examine, 1st, the direction of the dip, and 2ndly, the position of this bed with respect to the underlying one. If the dip be from west to east, at an angle of about 120°, and it is found superimposed upon the yellow clay of the upper lias, we have then the right starting-point from which to commence the study of the oolite.

It is the more necessary to attend to these circumstances, as at one hill in this neighbourhood we have the pea-grit occurring at the bottom of a quarry (near the base), and again in the same position in a quarry about 100 feet higher up the hill; and as may be expected, the upper position is the correct one.

Now, to understand the causes of this displacement, it will only be necessary to bear in mind that the pisolite is a very hard compact rock, of the general thickness of about ten feet, and this solid mass rests immediately upon beds of soft clay (lias clay); it will hence result that the diluvial action subsequent to the upraising of this portion of our island would of necessity carry away the soft underlying clays, whilst the harder and more compact rock would fall down the acclivities, and thus lead the inexperienced geologist into the belief that the oolite beds commenced much lower than is actually the case, or that the pisolite was of greater thickness than it is really found to be.

I have been particular with this part of my subject, for this reason, that on accompanying strangers to our hills, they uniformly err in determining the proper commencement of the oolite beds; and even Mr. Conybeare, in the Geology of England and Wales, fell into the same error with regard to Bredon, an oolitic outlier, which stands out in bold relief, dividing the vale of Evesham from the vale of Gloucester. With reference to this hill, he says: "Bredon Hill is so lofty, that it may be expected (for we are not aware that it has been attentively examined) to exhibit *a cap of the great oolite.*" Now, the truth is, that this hill is capped with roestone, the second bed of the inferior oolite formation, and its relative heights may be seen by referring to the section.



We shall now proceed with a description of the beds in the ascending order, upon the same plan as that which was adopted in describing the beds of the lias formation.

The first bed, then, which occurs, is the pisolite, or pea-grit, composed of small concretionary masses, of a light ochreous colour, having a kind of nucleus within, of a somewhat darker tint, and more or less flattened, and many of them are so covered with a very minute coralline as to give them the appearance of organised structure; their chief chemical constituent is carbonate of lime, the colour being derived from peroxide of iron; these masses are plentifully mixed with fragments of small shells, portions of pentacrinites, portions of several small species of cidaris, and minute corallines of several species; these are all firmly cemented together, and present in the aggregate a rock varying in thickness from eight to ten feet; it is quarried for gate-posts, and other rough work, and provincially known by the name of pea-grit.

2. The next in order is the oolite, or roestone, about fifty feet in thickness, and rests immediately upon the pisolite, without any intermediate layer of clay, though it is somewhat coarser towards the bottom of the bed; this bed contains many small shells, but none very remarkable; the following is a rough list of those which I have found at Leckhampton Hill.

Univalves.	Patella rugosa.*
	Turitella 1.
	Cerithium 1.
	Trochus 1.
Bivalves.	Pecten 2.
	Gervellia 1.
	Ostrea plicatula.

And on the Cirencester road,

Pyrina myteloides.

3. Freestone. This bed occurs in immense blocks, is of a light colour and very fine grain, is soft when first taken out of the quarry, but hardens on exposure; the bed is from forty to fifty feet in thickness, and is well exposed in the numerous quarries of this neighbourhood, whence it is obtained for building purposes, some of our best edifices being built of it; but it is apt to shell off with hard frosts.

The lithological character of this stone is similar to the building stone of Bath; but it must be remembered that the Bath stone is a member of the great oolite formation,

* The Patella rugosa runs all through the oolite. I believe this is the first notice of its having been found inferior to the Stonesfield slate.

whilst our freestone belongs to the inferior oolite; and this may serve as an illustration of the oft-repeated fact, *that lithological structure is no proof of the comparative ages of different formations*, but it is to the fossils, and these alone, that we must look for accurate data upon which to found our arguments as to the relative ages of different rocks. One family of shells, in particular, will serve to distinguish the great from the inferior oolitic beds, which is the *Patella;* of these the great oolite contains about six species, whilst the inferior oolite contains but one.

Pecten vagaris, Trigonia clavellata, Cuculæa oblonga, together with several small species of univalve shells, amongst which are the Rostellaria and Melanea, also distinguish the great oolite. The fossils peculiar to the freestone of our oolite are the following:—

Plagiostoma punctata,
" cardiformis,
Terebratula fimbria (the most abundant shell),
" media,

and two beautiful species of corals, the names of which I cannot ascertain.

4. At the top of the last named bed of freestone, a stratum presents itself of a totally different character, as in it we lose all traces of oolitic structure, the masses of stone present more the appearance of chalk, being white and like compact marl; hence I have named it oolitic marl; its fracture is uneven and eccentric, and presents no appearance of cleavage; it is rich in fossil remains, although it contains no great variety of species; still, the fossils peculiar to it are abundant, and well mark the bed in which they are found. The following is a list of those at present in my collection:—

Plagiostoma Parkinsoni,
Pecten lens,
„ punctata,
Unio 2 species (undetermined),
Terebratula fimbria, plentifully continued
through this bed.

5. The next rock which occurs, has been named Gryphite grit, from its containing such a vast accumulation of the Gryphæa cymbium; it is a rough stone, somewhat oolitic, of a brownish-red colour, giving the soil, which is formed from it at the top of the hills, the appearance of the red marls of the new red-sandstone formation. The stone presents no regular cleavage, nor does it appear to be separable into distinct layers, still we find certain fossils attach themselves almost exclusively to different elevations in this stratum. Thus, the G. cymbium occupies the lower third of this mass of stone; the Terebratula dygona and Pholodomya ambigua the middle position; whilst the upper third is nearly composed of the remains of Trigonia costata. Besides these, this stratum contains a large variety of fossils which are more diffused through the whole of the rock than those just mentioned.

I have reason to believe that the following list is by no means complete, as every fresh search in these beds furnishes us with some new species. The undermentioned are already in my collection.

Fishes.	Palates of a species of Psmodus, and rarely found.
Multilocular shells.	Nautilus.
	Ammonites Parkisoni, and three others.
	Belemnites brevis.

Univalves.	Turritella 1.
	Melanea 1.
	Trochus 1.
	Cyrrus 1.
Bivalves.	Isocardia concentrica.
	„ costata.
	Plagiostoma gigantea, and two others.
	Lutraria lyrata.
	Unio 3.
	Pecten 3.
	Avicula inequivalvis.
	Pholodomya ambigua.
	Trigonia costata.
	Ostrea Marshii, and two others not plicated.
	Modiola plicata.
	„ gibbosa.
	Mya calciformis.
	Terebratula perovalis.
	„ dygona.
	„ globata and others.
	Gryphæa cymbium.

And in addition to these, about twenty species of corals.

6. Situated immediately upon the last named stratum, is a bed of about fifteen feet in thickness, composed, for the most part, of a loose brown earth, with occasional blocks of stone; the only remarkable circumstance appertaining to which is, that in this loose earth are imbedded hundreds of the clypeus sinuatus; indeed, so abundant are the remains of these animals, that wherever this particular bed forms the surface soil, bushels of the Clypei are turned up at each ploughing, and the Gloucestershire bumpkins (who have not studied in the school of geology), will tell us that,

"these stones grow so uncommon fast, that it is *impossible* ever to get *shut* on 'em."

2nd. The Stonesfield Slate.—The Stonesfield slate is the upper member of the oolite of this neighbourhood, and, as it occurs on the Cotteswolds, it is a thick bed, of a light coloured stone, inclining to grey; it is found in a conformable position in the quarry, in laminæ from half to an inch in thickness; these laminar beds observe the usual line of dip, except from local dislocation, when they may occasionally be seen dipping in all directions. "The lithological structure of our slate is similar to the Stonesfield, as found at Blenheim, near Oxford,"* but we have not yet succeeded in finding those varied animal remains in our stratum, which so decidedly characterize the Stonesfield at Blenheim; still we are not without that curious admixture of animal and vegetable remains which render this rock so remarkable. Wood of various kind is found with the slate on Syerford Common, and from a quarry near Bourton-on-the-Water, I have succeeded in obtaining some specimens of the seeds of a dycotelydenous plant.

Of animal remains, I have in my possession specimens of the long thin teeth of the Pterodactylus, and also some slender bones, evidently belonging to the wings of these singular animals, together with palates of several species of fishes; but no animal in a sufficient state of perfection to enable us to decide upon its specific character.

Of multilocular shells, one ammonite, which I think has never before been described; the following is its specific character.

Shell flat, acute round the margin, whorls from 7 to 8, outer whorl very much the largest, the inner ones more

* Murchison's Geology of Cheltenham.

than half involved in each other, ribs bifurcated towards the outer edge.

Small univalve shells of many species, amongst which is the Acteon; these are much varied, and particularly beautiful, though for the most part microscopic; several microscopic species of bivalves accompany the above; a small species of Trigonia; T. minima marks the Stonesfield slate, both in our neighbourhood and also in the Oxford strata.

PROCEEDINGS OF SOCIETIES.

MANCHESTER GEOLOGICAL SOCIETY.

May 26*th.* 1842.—The last meeting for the present session was held this evening, Capt. Thomas Brown, F.L.S. M.W.S. in the chair. After the usual routine of business, the Secretary announced donations from Mrs. Bowman, Messrs. Murchison, W. Meller, Ormerod, Moore, Hall, Whitehead, Dr. Clay, and the Manchester Natural History Society.

Mr. Binney, after reading the report of the discussion, which took place at the last meeting, upon the paper on the Temperature of the Ocean, by Robert Harkness, Esq. of Ormskirk, as given in the "Geologist" of June, read a further communication from that gentleman, of which the following is an abstract:—

During the short period which has elapsed since Agassiz first published his glacial theory, evidences of glacial action have been discovered, not only over a great part of Europe, but also in America. Maclaren, in the *Edinburgh New Philosophical Journal,* in reference to the traces of glaciers in that region, states that proofs of the former existence of glaciers are found, with a few local exceptions, over a breadth of 2,000 miles, extending from Canada to Florida. The soil of Persia is also said to contain gravel, consisting of flint and gypsum. The only positive notice that I am aware of, of the absence of boulders, is by Humboldt, in South America, which appears to favour the opinion of that region being of subsequent origin to the glacial epoch.

With regard to the *vexata quæstio*, the temperature of the greatest density of sea water, Scoresby remarks, page 238, of his Voyage to Greenland:—" I have invariably found it to be warmer below than at the surface. This exception, therefore, is remarkable, referring to an experiment before mentioned, in which he found the temperature at the surface to be 34^0 Fahrenheit, while within five fathoms of the bottom, the thermometer registered 29^0. " On my first trial," he says, " made in the summer of 1810, in lat. 76^0 16′; long. 9^0 east; the temperature, at the depth of 1,380 feet, was found to be 33° 3′ (by the water brought up), whilst at the surface it was 28^0 8′." This experiment is detailed in a tabular form, in the first volume of his account of the Arctic Region, page 187, as follows:

Lat.	Lon.	Depth in ft.	Tem.	S. grav.	Colour.	Tem. of air.	Time.	
76 16..	9..	Surface..	28 8..	1·0261*..	Blue.	12..	19th April, 1810	Ship beset in ice.
76 16..	9..	300	.31 8..	—	..Blue..	12..	19th April, 1810	
76 16..	9..	738	..33 8..	1·0270	..Blue..	12 .	19th April, 1810	
76 16..	9..	1,380	..33 3..	1·0269	..Blue..	12..	19th April, 1810	

The specific gravity of the sea in lat. 76^0 16′ strictly coincides with the conclusion, that the water of the ocean increases in density in a similar manner with fresh water. We find also, from the above table, that at the depth of 1,380 feet, the density of the water was less than at 642 feet

* There is a typographical error in the work, from whence the above is extracted, where it is stated that the specific gravity at the surface is 1·2061 instead of 1·0261.

above; *its temperature being also slightly lower*, showing that the density of the sea is comparatively little influenced by superincumbent pressure. Other experiments are recorded in the same work, but they are not of so conclusive a nature, although they in general confirm the above opinion as to the temperature of the greatest density of sea water; for the density is very much affected by the different quantities of saline matter held in solution, and also by the presence or absence of *medusæ* and marine animalcules.

The following table, composed from the same work, shows the quantity of saline contents, as well as the specific gravity and temperature of the sea at the surface:—

Lat.	Long.	Specific Grav.	Temp. at Surface.	Colour.	Sal. Mat. per cent.
64 26....	0 38....	1·0269....	43 5....	Ultra M. Blue....	3·54
66 45....	1 0 ...	1·0263....	43 5....	Ultra M. Blue....	3.79
69 14....	3 0....	1·0269....	38 0....	Ultra M. Blue....	3·75
71 10....	5 30....	1·0269....	39 0....	Ultra M. Blue....	3·75
74 34....	10 0....	1·0267....	32 0....	Blue	3·77
76 33....	10 20....	1·0267....	33 0....	Blue	3·60
77 30....	6 10....	1·0263....	28 5....	Olive Green	3·42
77 34....	8 0....	1·0267....	38 0....	Blue	3·70
78 25....	8 20....	1·0265....	31 0....	Olive Green	3·91
78 30....	6 30....	1·0265....	29 0....	Blue	3·88
78 35 ...	6 0....	1·0261....	29 0....	Olive Green	3·27

It may be remarked on the foregoing table, that the observations 1, 3, and 4, in which the temperature was near that of the greatest density of fresh water, the specific gravity was also greatest; whilst in the observations 9 and 10, in which are found the largest portion of saline contents, the temperature being considerably less, the specific gravity is the smallest recorded, with the exception of 7 and 11, which contain the smallest quantity of saline contents. The other observations generally favour the conclusion, that the sea is at its greatest density at or near to the temperature of

40^0 Fahrenheit, with the exception of the second, which, from its anomalous nature, probably contains some error.

In conclusion, I have to state, that I am aware of no reason that can satisfactorily account for the temperature of the sea decreasing with the depth in lower latitudes than 70^0, whilst in higher, the reverse is the case; except that the waters of the ocean are similarly influenced by heat with fresh water, and are also at their greatest density near to the temperature of 40^0 Fahrenheit.

On the conclusion of the paper, a long and interesting discussion took place; after which, the Rev. Robert Wallace moved, and Mr. Binney seconded a vote of thanks to Mr. Harkness, for his valuable communication.—A vote of thanks having been given to Captain Brown, for his services in the chair, the meeting terminated.

GEOLOGICAL SOCIETY OF LONDON.

May 4th.—Mr. Murchison, President, in the chair.—The following communications were read:

1. *A letter by Mr. Ick on some superficial deposits near Birmingham.*

In excavating a canal in the valley of the Rea, at Saltby, 1¼ mile N.E. of Birmingham, a peaty deposit, containing trunks and branches of trees and hazel nuts, was discovered under five feet of superficial detritus, and in the same bed were also found, stags' horns, apparently of the existing species (*Cervus elephas*), likewise the core of the horn of an ox, one foot in circumference at the base, and one foot eight inches in length. This carbonaceous deposit reposes on the usual marine drift of the district, and is overlaid by a bed of variable thickness, of fine, white, or mottled clay, above which occurs the superficial detritus.

2. *Postscript to the memoir on the Aust bone-bed, Tewkesbury, by Mr. Strickland.*

Since his former communication, the author has determined that the "bone-bed" has a further range northwards of at least ten miles, having ascertained that it occurs in some old salt works on Delford Common, in Worcestershire. The shaft of these works, 175 feet deep, was emptied of its brine a few months ago, and it was ascertained that it descends through the lias into the gray marl, which forms the top of the triassic series, but without reaching the red marl. The shaft, as the author observes, consequently intersects the horizon of the bone bed, and, among the rubbish thrown out, he found considerable quantities of the peculiar white sandstone with bivalves, which, in his former paper, he shows is the representative of the bone-bed; and he further noticed, that the sandstone is occasionally charged with the teeth, scales, &c. which are so numerous in the bone-bed at Coombe Hill.

3. "*On the high temperature of Well Water in the vicinity of Delhi,*" *by the Rev. R. Everest.*

If, says Mr. Everest, a line were drawn due west from the Jumna at Delhi to the Indus, a distance of 100 miles, it would intersect no river, brook or spring, water being obtained only from wells. In Delhi, the depth at which water is reached, is generally about 35 feet, 40 or 50 miles to the westward from 80 to 90 feet, and beyond that distance, as far as Hausi, 95 miles, it is found at 150 feet. The soil consists of a granitic alluvium, but the surface is covered in many places with saline efflorescences, such as the floods of Jumna now leave behind them. Mr. Everest gives various tables of the temperature of well water, both at Delhi and at points intermediate between that city and Hausi; but as the results, which vary considerably, are stated to be connected with the extent to which the water in some cases is used for irrigation, it is thought advisable to confine our extract to one set of observations, made in a well at Delhi, the depth being 42 feet:

		Temp. of water.	External air.
1833.	12th Nov.	79	76
	17th Dec.	76	62
1834.	25th Jan.	74.7	68
	2nd March	76.8	84
	29th Do.	77	67
	12th May	78.9	78
	17th June	80	86.5
	25th July	80.9	82.2
	2nd Sept.	81.3	92
	29th Do.	81.5	80
	Mean	78.61	77.57

4. "*On the Tertiary formations, and on their connexion with the Chalk in Virginia, and other parts of the United States,*" *by Mr. Lyell.*

Having examined the most important localities of the cretaceous strata in New Jersey, Mr. Lyell proceeded to investigate the tertiary deposits of Virginia, the Carolinas, and Georgia; and he states, as the general results of this extensive survey, that the tertiary formations which he saw agree well in zoological types with the eocene and miocene beds of England and France; that he found no secondary fossils in those rocks which have been called upper secondary, and supposed to constitute a link between the cretaceous and eocene series, but that all the organic remains of these assumed intermediate deposits are characteristic of lower tertiary beds, without any blending of the fossils, which in New Jersey, Alabama, and other states, occur in true equivalents of the cretaceous system. Mr. Lyell then details the evidence upon which these conclusions are founded.

Virginia.—Good descriptions of the strata bordering on James River have been given by Professors W. and H. Rogers, and by Mr. Conrad in his excellent work on the tertiary shells of the United States. At Richmond, a bed from twelve to twenty-five feet thick, consists of an impalpable siliceous powder derived from the cases of infusoriæ. It rests on eocene strata of greenish sand, and is overlaid by miocene clays containing *Artemis acetabulum*, &c.; and it has been referred by Professor W. Rogers to the former epoch. A similar tertiary green sand occurs at Petersburg, thirty miles south of Richmond, and contains a Venericardium and an Ostrea, undistinguishable from *V. planicosta* and *O. bellovicina*. It is there also covered by miocene marls, which yield a rich series of fossils distinct from those of the sub-adjacent sands, but bearing a great resemblance to series from the Suffolk crag and the faluns of Touraine, several species of Virginia testacea, crustacea, echinodermata, &c. being very analogous to crag and Touraine fossils; but the most important point is shown to be the correspondence which exists in the proportion of recent to extinct species of shells, sixteen out of eighty-two species being regarded by Mr. Conrad as identical with recent shells, the greater part inhabiting the coasts of the United States. This proportion of one-fifth agrees well, Mr. Lyell says, with the results obtained by him in 1840, in different localities of the faluns of Touraine. The total number of American miocene shells known to Mr. Conrad is 238, of which 38 are recent.

North Carolina.—Near South Washington, on a branch of Cape Fear River, the author found, in the dark bluish marls of the cretaceous series, previously noticed by Mr. Hodge in a paper on the Southern States, several fossils, characteristic of the cretaceous series of Europe, and he states that the marls very much resemble beds containing similar shells in New Jersey, about 360 miles to the northwards. The marls extend from South Washington to Rocky Point, fifteen miles from Wilmington, where they are covered by an eocene deposit, to which has been applied the name of Wilmington limestone and conglomerate. This formation has been considered to be an upper secondary rock, but Mr. Lyell says that he could find no organic remains in it which supported this opinion, and though the specimens he obtained at Wilmington were only casts, yet many of them belong to the genera Oliva, Cypræa, Conus, Calyptræa, and Siliquaria; and further, two of them appeared to agree with casts of *Pecten membranosus* and *Lucina pendata*, eocene fossils; and he afterwards found that a Pectunculus, a Vermetus, and a Lunulite, which he obtained at Rocky Point, occur also in the limestone of the Santee Canal, in South Carolina. The Wilmington limestone and conglomerate extend to the town after which they are named, and thence along the coast to the mouth of Cape Fear River, and they are almost everywhere overlaid by a miocene deposit.

South Carolina.—Charlestown stands on a bed of sand, beneath which, is a blue clay, containing shells of the neighbouring seas, also the *Gnathodon cyrenoides* which is not known as an existing species nearer than the Gulf of Mexico. Mr. Lyell could not ascertain whether this post-pliocene formation rises above high water mark, but thirty miles to the north, on the Cooper River, he found, beneath the superficial sand, a marsh or swamp deposit, from which Dr. Ravenel has procured remains of a cypress, the hiccory, and a cedar; and the author says, as those trees must have grown in that region, although the formation is six feet below high tide, and as the salt water of the Cooper River must now cover much of this swamp deposit, a very modern subsidence along the coast is implied. At the Grove, near the mouth of Cooper River, a soft pulverulent limestone, exposed only in artificial openings, contains fossils different from any known in other localities, but Mr. Lyell conceives it may be an eocene deposit. Between this place and Vances Ferry, on the Santee River, is a continuous formation of white limestone, at least 120 feet thick, in some places hard, in others soft, and composed of comminuted shells and corals; Mr. Lyell examined it in company with Dr. Ravenel. It so precisely resembles in aspect the upper cretaceous deposit at Timber Creek, in New Jersey, that it has been confounded with the cretaceous group, and Mr. Lyell at first felt no doubt that the limestone belonged to it. The testacea and corals, however, prove that it is truly a tertiary formation, and the author sought in vain, through a distance of forty miles, for an admixture of organic remains. In consequence of this and similar mistakes, many fossils have been considered to be both tertiary and secondary, and the beds containing them to be transitions from one order of deposits to another. The upper surface of the Santee limestone is very irregular in outline, and is usually covered with sand, in which no fossils have been found. At Stoudenmine or Stout Creek, a tributary of the Santee, the limestone is concealed by a newer tertiary deposit of considerable thickness, and composed of strata of slaty clays, quartzose sand, brick red loam, and burr stone. Mr. Lyell is not aware of any published account of this formation, but it occurs also on the Savannah River. The clays are soft when wet, yet when dry, they have a conchoidal flint-like fracture, and even pass into a substance resembling menilite. The fossils collected by Mr. Lyell were only casts, and he does not pretend to fix the age of the deposit, but he believes that it is of the same relative antiquity as that of the burr, or mill-stone series of Georgia. In the brief notice of the cretaceous and tertiary strata of the Southern

States, drawn up by Dr. Morton from the notes of Mr. Vanuxem (1828), the burr-stone, sand and clay are included in one group; but Mr. Lyell infers, from the observations which he made on the Savannah river, that the burr-stone is the uppermost of the two formations. In specimens of that rock obtained west of Orangeburg, twenty miles from Stoudenmine Creek, Mr. Lyell recognized *Ostra sellæformis*, a characteristic eocene shell. At Aikin, sixty miles west of Orangeburg, a cutting in an inclined plane on the railway has exposed a section, 160 feet thick, of earth and sand of a vermillion colour, mottled clays and white quartzose sand: and included in the sands as well as the clays, are remarkable masses of pure white kaolin. These strata are within ten miles of the junction of the tertiary series with the great hypogene region of the Alleghany or Appalachian range; and Mr. Lyell states, that they have evidently been derived from the decomposition of clay slate and various granitic rocks. They appear to be destitute of fossils, both at Aikin and at Augusta, where they are well developed, and must in some places be 200 feet thick. Three miles above Augusta, the rapids of the Savannah River are due to highly inclined clay and chlorite schists, surmounted unconformably by tertiary strata; and Mr. Lyell states, that on all the great rivers of the Atlantic border, from Maryland to Georgia, the first rapids occur where the granitic and hypogene rocks meet the tertiary, and a line uniting these points, ranges nearly parallel to the Atlantic coast, at the distance of 100 and sometimes 150 geographical miles. Maclure first mentioned this great feature in the geology of the United States. On Rae's Creek, near Augusta, the highly inclined clay slates and associated beds are decomposed to the depth of many yards from the surface, and the ferruginous clays and sands which have been thus produced, resemble so precisely a large portion of the horizontal tertiary strata, that the altered accumulations might be mistaken for them, if the quartz veins did not remain unaffected. These decomposed materials throw much light, Mr. Lyell says, on the origin of the beds of red and mottled clay, and of the sands usually devoid of fossils, spread extensively over the low lands, and constituting the higher portions of the tertiary series. The only point at which he has seen casts of shells in beds, associated with the red earth, is at Richmond, in Virginia, and they belonged to miocene species; but, as at Stoney Bluff, on the Savannah, similar red strata occur beneath the burr-stone, he is of opinion, that the same mineral character belongs to the upper division of the eocene group.

For the purpose of ascertaining the order of super-position of the masses of strata, Mr. Lyell descended the river from Augusta to Savannah, though the country is generally flat, and the structure is exposed only in the bluffs. After passing cliffs of horizontal strata of the brick red sand and loam, the first considerable exposure of new rocks was observed forty miles below Augusta, at Shell Bluff, 120 feet high. They consist, in the lower part, or for about eighty feet in altitude, of white calcareous sand, or comminuted shells, passing into solid limestone, containing a few quartz pebbles, numerous casts of testacea, and a bed of the huge *Ostrea Georgiana*. The upper forty feet of the cliff consists of the red loam, devoid of fossils, but considered by the author to belong to the burr-stone formation, and therefore to be an upper eocene deposit. Mr. Lyell concluded, from his first inspection of the organic remains at this Bluff, that the limestone belonged to the eocene series, but it was not till he had had the advantage of Mr. Conrad's assistance, that he was able to identify a considerable number of the species with characteristic fossils of the well known eocene beds of Claiborne in Alabama. A similar section is laid open at London Bluff, nine miles below Shell Bluff, and two miles further, the oyster bed is exposed, the shells standing out in relief. At Stoney Bluff, the calcareous strata have quite disappeared, and beds of siliceous burr-stone or mill-stone, containing casts of shells, rest on the red loam. The same rock is also exposed at Millhaven, eight miles from Stoney Bluff. It is evident, Mr. Lyell states, that the mill-stone is subordinate to the great formation of red loam; for at this point, there likewise occur masses of Kaolin. One mile west of Jacksonborough, is a limestone passing upwards into marl, the surface of which appears to have been denuded, as it undulates considerably, and upon it rests a bed of yellow and red sand and clay, belonging to the burr-stone formation. The fossils hitherto procured from the limestone, are new to American palæontologists, but Mr. Lyell has no doubt, from their general aspect, that they belong to the eocene period. The limestone and marl, the author is of opinion, constitute the fundamental formation of the region, as proved by the numerous hollows, or "lime-sinks," which occur over its surface. All the Bluffs examined by the author below Briar Creek, belong to the beds above the limestone, and are referable, for the greater part, to the burr-stone formation, or the red loam and yellow sand. In some white clays, a little below Tiger Leap, he found fragments of the teeth of Myliobates and Lamna, and impressions of bivalves; and in the sections at Sisters' Ferry, the clay, in places, passes into a kind of Menilite. In conclusion, Mr. Lyell observes, that the part of South Carolina and Georgia, between the mountains and the Atlantic, is known to have a foundation of cretaceous rocks containing Belemnites, Exogyræ, and other fossils, and that above them, with the occasional intervention of a lignite deposit, mentioned in the paper, on the authority of Mr. Vanuxem, rest, first, the eocene limestone and marls, and secondly, the burrstone formation. The remarkable dissimilarity in the eocene limestone, at different localities, may lead some observers to suspect that there exists a considerable succession of subdivisions of the eocene period; and Mr Lyell is willing to admit, that all the beds may not be precisely of the same age, but he is inclined to ascribe the chief difference, first, to the number of species procured at each place being small, and, therefore, only a fraction of the entire Fauna of the period, so that variations in each locality may have arisen from original geographical circumstances; and secondly, to there not having yet been formed any great eocene collection from any part of the United States. Some fossils are common to the limestone and the burr-stone formation, and he, therefore, considers it as an upper eocene division, bearing, perhaps, the relation to the calcareous beds, which the upper marine sands of the Paris basin bear to the *calcaire grossier*. With respect to beds of passage between the cretaceous and secondary series, Mr. Lyell repeats the remark given at the commencement of the paper; but he said it would require a far more extended investigation to enable a geologist to declare, whether there may exist in the Southern States any such intermediate strata. The generic affinity of the cretaceous fossils to those of Europe, is most striking, and the author observed in Mr. Conrad's collection of Alabama shells, a large Hippurite, an analogy previously unnoticed. The proportion of recent shells in the eocene strata of the United States, he says, appears to be as small as in Europe, and the distinctiveness of the eocene and miocene testacea, hitherto observed, to be as great. The author also states as worthy of remark, that the recent shells in the American miocene beds are not only in the same proportion to the extinct as in the Suffolk crag, or the faluns of Touraine, but that they also agree, in general, specifically with mollusca of the neighbouring sea, in the same manner as the recent miocene species of Touraine agree with species living on the western coast of France, or in the Mediterranean; or as those of the crag agree with shells inhabiting the British seas.

SCIENTIFIC SOCIETY OF LONDON.

Wednesday. May 18th, 1842.—George Alexander, Esq. F.S.A. in the chair. Communications were read on the following subjects.

1. *On the deposit of sand at Dersingham, in Western Norfolk, whence the most approved silex for the flint glass manufacture is obtained.*—By MR. J. E. MOXON.

This notice embraced descriptions of the various layers of sand, their respective thicknesses, siliceous constituents, and the general geological features of the neighbourhood.

2. *On vertical flint bands in Chalk.*—By MR. F. COLLIER.

These bands occur in the chalk on the line of the Thames and Medway Canal; they generally range from thirty to fifty feet in length, and are composed, not of separate flint nodules, but of thin bands, generally continuous for several feet, and rarely exceeding an inch in thickness; they intersect the horizontal layers of flint nodules at right angles, without giving rise to any displacement.

3. *On two ores of argentiferous galena, from Mount Barker district, South Australia.*—By Mr. H. B. Denton.

These specimens are samples of the first lead ore met with in Southern Australia. At the request of Mr. Croft, these ores were referred to that gentleman for analysis.

Wednesday, June 1st, 1842.—The annual general meeting was held this evening, George Alexander, Esq. F.S.A. in the chair. The minutes of the former annual general meeting, and of a subsequent special general meeting, having been read and confirmed, and the report of the Council, showing the increasing prosperity of the society, having been adopted, the election of council and officers for the ensuing year took place, the following proving the result:—*President*, John Stevens; *Vice-Presidents*, George Alexander, F.S.A., J. Bailey Denton, M. Just, C.E; *Council*,

W. Tierney Clark, F.R.S., F. Collier, A. Marshall, C. Moxon *(Treasurer)*, P. J. Bruff, M. Just. C.E., B. W. Croker; *Hon. Secretary*, George F. Fordham; *Hon. Curator*, H. Watkins.

The following amendment in the rules was adopted, viz: "Members resident in the country, at least ten miles from London, shall be exempted from payment of the entrance fee, and may compound for their annual subscription upon payment of £8. 8s."

The thanks of the society were then ordered to be presented to the Council for their services during the past year, to the Treasurer, to the donors to the museum and library, and to the authors of the several papers read at the meetings of the society during the past session.

Mention was made, during the course of the meeting, of the increased facilities which would be afforded by this society, on the completion of their museum (which already includes upwards of twelve thousand specimens), for the acquirement of scientific knowledge; and the chairman congratulated the members on the success of the meetings, the unostentatious nature of which, while affording the greatest pleasure to the members individually, proved that it is not so much from the number as from the qualifications and energy of those constituting a list of members, that science derives most benefit.

MISCELLANEA.

BÉRAUNITE, A NEW MINERAL.—This substance is found at Hobeck, near Béraun, in Bohemia, in the crevices of a rich ore of silicate of iron; it closely resembles the oxide of cobalt (cobalt-bloom), and Vivianite. When melted, it resembles glass in vitreous appearance; and on its cleavage in perfectly flat surfaces, these are nacreous in appearance. Its colour is analogous to that of the hyacinth (ferro-zirconite), or yellowish ochre passing into reddish brown; it is opaque; scratches gypsum, but is softer than mica. The primitive crystalline form is the rhomboid, and the specific gravity is 2·878. According to Plattner, it is composed of phosphoric acid, and hydrous oxide of iron.—*Breithaupt, in Journal f. Pract. Chimie,* No. XX, p. 66.

ON A HUMAN SKULL TRANSFORMED INTO LIMONITE AND LIGNITE.—This skull was in the collection of the late Mr. Teschen; and although transformed into a brownish earthy mass, preserves its form; it weighs about seven pounds, and when minutely examined, the substance presented none of the characters of the original bone; and, judging by its external characters, it is intermediate between lignite and an earthy oxide of iron, from which Mr. Kersten considers that it has been partially transformed into lignite and partially into limonite. He also concludes, that having by chance fallen into a deposit of the former, the change has taken place by degrees.—*Mr. C. Kersten, in l'Institut.* No. 423, p. 47.

THE GLYPTODON.—A valuable addition has been made to the museum of the College of Surgeons by the arrival, from the neighbourhood of Buenos Ayres, of a fossil wonder, to which the name of the *Glyptodon* has been assigned by Professor Owen. The Glyptodon was a giant armadillo, and some idea of its appearance may be formed, from the fact that when the Carapace was first seen, it was mistaken for a cask. This specimen is unique, and affords a gratifying illustration of the advanced state of comparative anatomy; for whilst Dr. Buckland supposed that the fragments of horny covering, sent to the College of Surgeons by Sir Woodbine Parish, belonged to the Megatharium, Professor Owen maintained that they belonged to some other animal, of which he gave a description, and the arrival of the complete Carapace fully establishes his views.—*Athenæum*, No. 752, p. 276.

REVIEWS.

Geology for Beginners. By G. F. Richardson, F.G.S., (*of the British Museum*). 12*mo. London, H. Baillière*, 1842.

Mr. Richardson states, in the preface appended to this volume, that, "during the course of some experience as a lecturer on Geology, he has constantly recommended the various works, already published on the science, and as constantly, has been requested to name some treatise more particularly intended for the tyro, and more expressly designed to convey that preliminary information, which the mere beginner is so anxious to acquire." It is true, that Bakewell is not simple enough—much less Lyell, (who is vastly too speculative).—De la Beche, (whose works, generally, are too tedious);—or Phillips and Conybeare, (whose memoirs are principally local). We agree, therefore, with the author of the work now under our consideration;—that, nothing detracting from the value of either of the above, an elementary introduction is required,—one which shall dispense with technicalities, and treat Geology as a science, with which the public ought to be as familiar, as general history—as it is only interchanging that of the natives of the earth, for that of the earth itself.

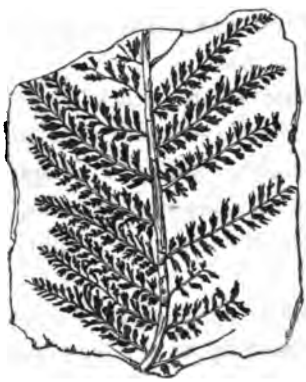
A few words will serve to convey a general idea of the plan of the work.—In its pages will be found, successively traced, the definition and connections of Geology, its history and historians—its harmony—the bibliography on the subject—mineralogy—physical geology—fossil conchology and botany—palæontology and sketches of the different groups of rocks—all of which are interspersed with numerous well finished wood-cuts.

In addition, there is a feature which struck us as exceedingly concise and well adapted;—namely, the insertion of "Exercises" for the student, after each chapter—which in no way detract from the absolute value of the work, whilst they essentially contribute to its utility, as a guide book and manual.

There is yet another marked peculiarity, which we should not omit to mention; referring to the best collections of fossils, and works relative to each group of rocks, as those which are best calculated to afford a complete study of the particular riches of each.

Having thus enumerated the points upon which rest the merits of Mr. Richardson's "Geology for Beginners," we will proceed to notice the scientific character of the work, and give such proofs of its qualities as we shall consider necessary. For this purpose we will pass over the introductory portions, and commence with that part which relates to the means of identifying the strata by their fossil contents.

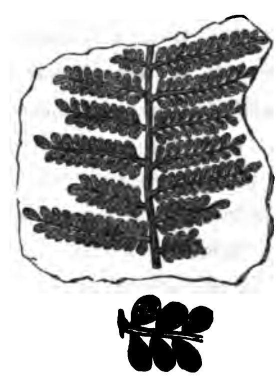
The lucid manner in which the comparative study of the vegetable kingdom is discussed, will be duly appreciated, we doubt not, both by the botanist and geologist. The description of the natural system of arrangement of exogenous and endogenous plants, their structure and differences, with reference to the more especial study of the fossil plants of the coal measures, is exceedingly clear and accurate, and the characters of the different groups are admirably represented in the wood-cuts by which they are accompanied, of which we present examples, without any lengthened notice of their peculiarities.



Sphenopteris Crenata.

Neuropteris Loshii, with a magnified leaflet.

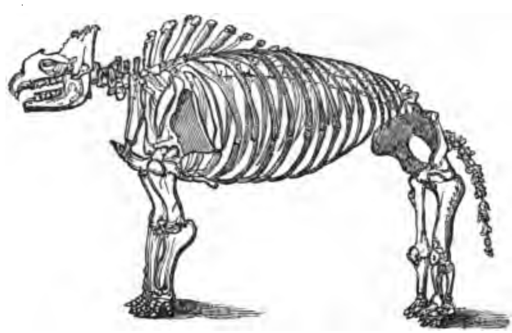
Odontopteris Minor.



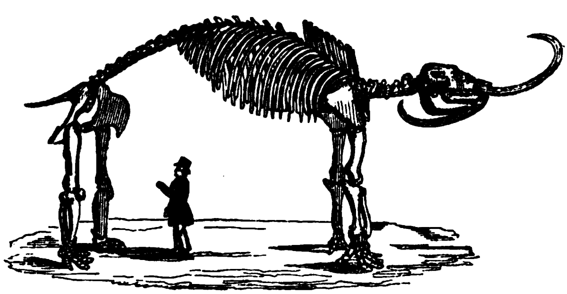
Precopteris Adiantoides, with a magnified leaflet.

To each of these the characters are appended, and thus by the joint assistance of a well executed figure, and a systematic description, the student will have no difficulty in pursuing his future studies.

Passing to the subject of Palæontology, we find an interesting notice of the Tetracaulodon, and the various opinions which have been expressed as to its peculiarities. He concludes by stating, that from its osteological structure and general characters, Professor Owen declared it to be no new animal, but a very fine specimen of a species of Mastodon, already known and figured by Cuvier, as the Mastodon Giganteum. As to the justice of these remarks the world seems to have been left—(as we have had occasion to remark elsewhere)—in a state of perplexity and doubt; we are, however, glad to be enabled to insert the figures of the two animals, from Mr. Richardson's work.



Mastodon Giganteum.



Mastodon Giganteum, as now exhibited in Piccadilly.

As examples of the figures of fossil mollusca, we cannot do better than select the following plate.

1. Lima rudis, 2. Pectan vagans. 3. Plagiostoma rigidum. 4. Avicula inequivalvis. 5. Trigonia-costata. 6. Terebratula globosa. 7. Modiola plicata. 8. Pinna lanceolata.

We have thus noticed the several points in this work, which deserve particular attention, and we think that Mr. Richardson has certainly gained the object which he proposed, and has produced a work, which can be safely recommended to the student of geology, both for general clearness in arrangement and completeness, embracing as it does the records of the most important facts in the science to this time. We only think that the author has been indiscriminate in his comments, and has eulogized, in particular, the researches of too great a number of geologists;—but he is an F.G.S., and we can excuse this error.

MONTHLY NOTICE.

August 1st. 1842.

We have to communicate this month the answer received from the Geological Society of London, in reply to the letter addressed to that body, on the representations of our correspondents, which we presented verbatim in our last number; in justice to them we now insert the transcript of the reply.

Apartments of the Geological Society,
Somerset House, June 16, 1842.

Sir,

I am directed by the Council of the Geological Society of London, to acknowledge the receipt of your letter, dated the—day of——, and to inform you that it is contrary to the long established and approved practice of the Geological Society, to permit or in any way sanction the publication of the discussions which take place at their evening meetings, or any comment thereupon; and the council have seen with extreme regret, in the numbers of "the Geologist," to which you have referred them, that you have allowed allusions to those discussions to be inserted in those publications.

I have the honour to be, Sir,
Your obedient servant,
(*signed*) WM. J. HAMILTON, SEC.

This reply, on the part of the Geological Society, leaves us however, in precisely the same situation as previously, and therefore calls for more than a mere insertion. We are informed, that the Society will not permit the publication of the discussions which take place at their evening meetings, or any comment thereon, and are *surprized* at the notices which we have already given. The results of the several meetings of the members of the Geological Society, (founded, as it is, for the common welfare of the interests of science) are, according to their view, to be only transcribed into the minute book, there to remain for ever undisturbed—there to be lost in forgetfulness, although in them, the outlines of discussions will hereafter be found, condemnatory of many a theory, and many a statement; all these *must* some day rise up in judgment against the Society, which has permitted the statements to go forth under their sanction, howsoever much they may have disapproved of the ideas.

It is clear, that it is useless for a number of persons to assemble, to hear a simple communication, or the record of one simple fact read at a meeting; such subjects could be better promulgated, through the medium of a periodical work, where everybody may read and judge for himself; but when any thing at all dubious is laid before the Society, the private interests of the author, if such there be, must sink into insignificance before the opinions of a body of men, constituting, as we have before said, *a Geological Tribunal.* The council of the Geological Society, express their extreme regret, that we should have allowed any allusions to their meetings to be inserted—*words said in public are public property*, is the justification which we *must* adopt, and as the Society has not endeavoured to refute one word of our comment, we feel assured that "they paused and the moral came home to their heart." That the Society will not *permit* such comments, is another question, in which they can have no voice, for the reasons we have already given; and in justice to Geologists, contemporaries, and scientific men generally, we shall, when occasion requires, continue to notice such extraordinary proceedings as those relating to the *Cambrian affair;* convinced that if the Society will not itself act in the spirit of fairness, we, being opposed to succumbing to their ideas, must do our duty in the matter.

We have devoted a considerable space this month, to the proceedings of the Geological section of the British Association for the advancement of science, at the meeting recently held in Manchester, arranged with as much conciseness as possible, for which we are indebted to many talented friends, and the statements in the "Manchester Guardian," "Athenæum," and other contemporaries.

THE EDITOR.

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY OF LONDON.

May 18.—R. I. Murchison, Esq., President, in the chair.

A Memoir on the Geological Structure of the Ural Mountains, by Mr. Murchison, M. de Verneuil, and Count Keyserling, was read.

After describing the physical features of the Ural Mountains, and the passes by which they may be traversed, the authors proceed to detail the structure of the formations, both sedimentary and igneous, dwelling on the facts produced by the latter, and on the fossil evidence whereby they have been enabled to place the former on a parallel with well known series of rocks in other parts of Russia and Western Europe. The axis, or central portion of the chain, consists to a great extent, of ancient sedimentary strata, for the most part in a highly metamorphic condition, in consequence of numerous syenitic and trap rocks; but referred by the authors, on account of the presence of certain organic remains, traceable at intervals in limestones, to the Silurian series. Along the eastern flank, the most accessible by reason of the mining establishments, the strata are also greatly altered by the prevalence of igneous rocks; and it was only along the western flank that the authors were enabled to establish a clear succession of carboniferous, Devonian, and Silurian deposits. The evidence on which these inferences rest, is given at length in a series of detailed sections obtained in river gorges and by other accessible lines; and, notwithstanding the greatly dislocated nature of the strata, a clear passage is shown to exist from the Permean beds, described in a former memoir, into the carboniferous system, and thence into the Devonian, and afterwards into the Silurian. Explanatory accounts of variations of lithological character from the ordinary types are likewise given, and a certain amount of specific difference in the organic remains is also enumerated; but it is shown that the suites of testacea and other fossils, agree with those of well determined carboniferous, Devonian, and Silurian regions, and are totally distinct from the organic forms of any other series of rocks. Full descriptions are given of the various igneous rocks, of their effects upon the sedimentary strata, and of the metallic veins connected with them. It may, however, be stated as an interesting fact, that true granite is of very rare occurrence along the axis of the chain. Another point of interest is connected with the periods of dislocation, the change of relative level of land and water, and of the protrusion of igneous rocks. The authors offer in detail their reasons for concluding that these phenomena were repeated at different geological epochs. From the occurrence of cupriferous minerals diffused throughout the Permean strata, they infer, that anterior to the deposition of those beds, metallic veins must have existed in the Ural Mountains; and, from the abundance of the remains of terrestrial plants in the same deposits, that the chain must have been raised to a certain extent above the level of the then existing ocean. Subsequent periods of disruption are proved by the lines of disturbance in the Permean series on the immediate flank of the Ural Mountains, and connected with dislocations which have affected them. The patches of Jurassic rocks at the northern and southern extremities of the range are considered by the authors to have been subsequently desiccated, and the absence of strata of that age throughout the great mass of the chain, or for 12° of latitude, to prove that it was constantly above the level of the sea during the Jurassic epoch. Between that period and the accumulation of the gold alluvia, there are no signs of any great changes in the physical structure of the Ural, and the only deposits assignable to that interval, are certain trachytic grits and beds of lignite, which, it is conceived, may have been formed in lakes.

The authors next proceed to describe the gold alluvia distributed along the eastern flank of the chain, and to point out, first, the connexion which subsists between this superficial detritus, and the adjacent rocks, and afterwards to deduce from the evidence afforded by the deposits, the true age of the accumulation. The authors are of opinion that the quartzose and other veins from which the gold detritus was derived, were produced by one of the last of the igneous intrusions which have affected the Ural Mountains, as the veins intersect, not only the schists and serpentines, but even the granitic and syenitic rocks. They also show that the gold alluvium belongs to the ordinary, coarse, local detritus of the country, and has been derived from the adjacent rocks. With respect to the relative age of the deposit, it is proved that the accumulation must have taken place subsequently to the period when the chain had received, to a great extent, its present modification of slopes and valleys, yet anterior to the existing conditions of the surface, because it occurs in considerable thickness at points beyond the reach of the streams which now traverse the country, and because it contains the remains of extinct mammalia.

Another question of interest dwelt upon in the paper, is the total absence, on both flanks of the Ural Mountains, of erratic blocks, and, as far as the author's observations extended, of any traces of those scratches, grooves, and polishings, which are considered, by the advocates of the glacial theory, to be proofs of the former existence of glaciers; and it is stated as an argument in support of the objections previously advanced by the authors against those views, that in the northern portion of the chain, between 60^0 and 65^0 of latitude, no glaciers are found on peaks constantly covered with snow, and attaining an altitude exceeding that of the highest mountains of the British Isles. This absence of all the phenomena of glacial action must, they contend, utterly exclude the possibility of the lower or flat regions of Russia having been once invested in a cerement of ice. The problem connected with the entombment of mammalian remains in the gold alluvia, as well as in alluvium generally, the authors state, is extremely difficult of solution, but that by whatever means the universal destruction of those great mammals, during one particular period, may be attempted to be explained, they conceive that it was owing, in the district under consideration, (including the low regions extending from each flank of the Ural,) to an elevation whereby a change to a colder climate was effected.

BRITISH ASSOCIATION.

The annual assemblage of the members of the association took place in Manchester, on June 22nd. 1842. The General Committee assembled on that day, under the presidency of Professor Whewell, when the report of the committee was read. The only paragraph of interest to the Geologist, refers to the publication of a report on the Radiata and Mollusca of the Ægean and Red Seas, which we therefore insert.

"1. The Council having learnt that it had been the intention of the Committee of the Geological Section, at the meeting at Plymouth, to have proposed to the Committee of Recommendations that Mr. Edward Forbes should be requested to draw up a Report on the Radiata and Mollusca of the Ægean and Red Seas, and that 60*l.* should be placed at his disposal for expenses connected therewith, but that from a circumstance purely accidental this proposition had not been submitted to the Committee of Recommendations: and being also informed that Mr. Edward Forbes was then in the localities referred to, and willing if requested, to prosecute the researches and furnish the Report in question, the Council passed the following resolution, viz:—

"That Mr. Edward Forbes be requested to draw up for the British Association a Report on the Radiata and Mollusca of the Ægean and Red Seas, with special reference to the relation of the recent genera and species to those which have hitherto been supposed to exist only in a fossil state."

With regard to the grant of 60*l.* which it had been the intention of the Sectional Committee to have recommended, the Council were of opinion that the exigency would be provided for in the least exceptionable manner, by requesting the Treasurer to place that sum at Mr. Forbes' disposal, on the guarantee of individual members of the Council that the amount should be made good by private subscription amongst themselves, in the event of a grant failing to pass the Committee of Recommendation or the General Committee, when it should be brought forth at Manchester."

We shall depart in this instance from the ordinary routine of inserting the dates of the several meetings of the different Sections, confining our notice simply to those relating to Geology and Mineralogy, and reporting those only, which are most interesting or novel; premising, however, a statement of the grants made by the Association at the General Meeting, as far as they relate to the sciences on which we are engaged:

For examining the gases evolved from iron furnaces, with a view to the economy of fuel, by Dr. Lyon Playfair and a committee . .	£50 0
For the further illustration, by engravings, of a report on British fossil reptiles, by Prof. Owen, under the direction of Sir H. T. de la Beche and other members (*additional*) . .	£40 0
For making coloured drawings of railway excavations	£200 0
For registering the shocks of earthquakes in the British Islands, under the direction of Dr. Buckland and a committee . . .	£100 0
For uncovering the lower new red sandstone, at Collyhurst, near Manchester, by Mr. Binney .	£10 0
For experiments on the temperature of mines in Ireland, by Major Portlock . . .	£10 0

The President (Lord Francis Egerton) alluded in his address to the benefits which this association had conferred upon science generally, by affording the means of the publication of reports, such as that now entrusted to Professor Owen, which would otherwise have been lost to the scientific world.

Comparing the grants made at the present meeting with those of the preceding year, we find that the former are in addition to the following amounts—viz:

For Railway Sections	£161 11s.	making in all	£361 11s.
For British Belemnites	£ 50 0s.	. . .	£ 50 0s.
For Fossil Reptiles	£210 0s.	. . .	£250 0s.

We may therefore ere long, anticipate the most complete publications on the above subjects. We will now recur to the Sectional Meetings on Geology and Mineralogy, under the auspices of the following gentlemen.

Geology and Physical Geography. President—Mr. R. I. Murchison. *Vice Presidents*—Sir H. T. de la Beche. Revd. W. Buckland. Revd. A. Sedgwick. Mr. R. Griffith. *Secretaries*—Mr. H. E. Strickland. G. Lloyd M. D. E. W. Binney and R. Hutton.

Chemistry, Mineralogy. President—Dr. J. Walton. *Vice Presidents*—Marquis of Northampton. Prof. T. Graham. Revd. W. V. Harcourt. Mr. M. Faraday. Dr. C. Henry. *Secretaries*—Dr. Lyon Playfair. Mr. R. Hunt, and Mr. J. Graham.

GEOLOGICAL SECTION.

The following are the most interesting communications submitted:

1. *On the Physical Structure of the Appalachian Chain, as exemplifying the laws which have regulated the elevation of great Mountain Chains generally, by Professors H. D. Rogers and W. B. Rogers.*

The Appalachian Chain of North America is described by the authors as consisting of a series of very numerous parallel ridges or anticlinal lines, forming a mountain belt generally 100 miles in breadth and nearly 1200 miles in length, stretching from the South-eastern angle of Lower Canada to Northern Alabama.

1. The strata which compose this chain are the American representatives of the Silurian, Devonian, and Carboniferous systems of Europe, united into one group of conformable deposits. The general direction of the chain being N.E. and S.W., there is a remarkable predominance of S.E. dips

throughout its entire length, especially in the south-eastern or most disturbed side of the belt. Proceeding north-westwards or away from the quarter of greatest disturbance, N.W. dips began to appear; at first few and very steep, afterwards frequent and gradually less inclined.

2. The authors consider the frequency of dips to the S.E. or *towards* the region of intrusive rocks, accounted for by the nature of the flexures, which are not symmetric, the strata being more inclined on the N.W. than on the S.E. of each anticlinal, amounting at length to a complete folding under and inversion, especially on the S.E. side of the chain, where the contortions are so closely packed as to present a uniform dip to the S.E. These folds gradually open out, the N.W. side or inverted portion of each flexure becomes vertical, or dips abruptly to the N.W.; proceeding further in this direction the dips gradually lessen, the anticlinals and troughs becoming rounder and flatter, and the intervals between the axes constantly increasing till they entirely subside at about 150 miles from the region of gneiss and intrusive rocks. The authors express their belief that a similar obliquity of the anticlinal axes will be found to obtain in *all* great mountain chains, their planes always dipping *towards* the region of chief disturbance. The inverted flexures are regarded by the authors as exhibiting simply a higher developement of the same general conditions. The passage of inverted flexure into faults is stated to occur frequently, and invariably along the N.W. side of the anticlinal or S.E. of the synclinal axes; these dislocations, like the axes, maintain a remarkable parallelism.

3. The axes of the Appalachian chain are distributed in natural groups, the members of each group agreeing approximately in length, curvature, amount of flexure, and distance apart. Nine principal groups are described, in five of which the axes are straight, whilst the four which *alter-*

nate with them are curved; in two of the curved divisions the line of strike is convex to the N.W., in the other two it is convex to the S.E. In every part of the chain the axes, whether curved or straight, maintain an approximate parallelism to those of their own division, and in the minor groups within the large divisions the parallelism is still more exact. The axes vary in length from insignificant flexures to lines frequently 100 and sometimes 150 miles in length, and they deviate very little from a rectilinear course, or, as the case may be, from a uniform rate of curvature. Some of the longer curved axes exhibit a difference of strike at their extremities of 50° in a distance of 90 miles, and the rectilinear axes of different divisions vary in their line of direction as much as 60°. As all the flexures were undoubtedly formed at one period, the authors consider these facts at variance with M. Beaumont's hypothesis, that dislocations of the same geological age are parallel to one and the same meridian.

4. The general declension in level of the Appalachian strata towards the N.W., or away from the quarter of greatest local disturbance, is considered important by the authors in its bearing upon the subject of the elevation of broad continental tracts. The authors next proceed to notice memoirs, describing what they consider similar phenomena in Europe.

Theory of Flexure and Elevation of Strata.—From the consideration of the preceding general facts the authors have arrived at a theory which they conceive applicable to the bending and elevation of strata generally. They state that the *oblique* form of all normal anticlinal and synclinal flexures "indicates that the force producing the dips was compounded of a wave-like oscillation and a tangential pressure;"—a purely vertical force exerted simultaneously or successively along parallel lines could only produce a series of symmetrical flexures, whilst tangential-pressure, unaccompanied by a vertical force, would result in irregular contortions dependent on local irregularities in the amount of resistance. The alternate upward and downward movements necessary to enable the tangential force to bend the strata into a series of flexures, are such "as would arise from a succession of *actual waves* rolling in a given direction beneath the earth's crust." The authors observe that it would be difficult to account for the formation of grand yet simple flexures, by a repetition of feeble tangential movevements, or by "a merely upward pressure, unaccompanied with pulsations on the surface of a fluid; and if this force be feeble and oft repeated, it is difficult to understand how it could return always to *the same* lines until they became conspicuous flexures." The authors suppose the strata of the region in question to have been subjected to excessive upward tension arising from the expansion of molten matter and gaseous vapours; the tension would at length be relieved by many parallel fissures formed in succession, through which much elastic vapour would escape, and, by thus removing the pressure adjacent to the lines of fracture, produce violent pulsations on the surface of the fluid below. This oscillatory movement would communicate a series of temporary flexures to the overlying crust, which would be rendered permanent by the intrusion of molten matter into the fractured strata originating the tangential force by which the flexures received their peculiar character before described. The authors do not deem it essential to this explanation that, in the production of axes of elevation, the strata should be permanently fractured to the surface. Fissures sufficient for the escape of vast bodies of elastic vapour, might open and close again superficially; and the strata may often be supported in their new position by subterranean injections not visible on the surface.

Identity of the Undulations which produced the Axes, with the wave-like motion of the Earth in Earthquakes.—The authors suppose all earthquakes to consist in oscillations of the earth's crust propagated with extreme rapidity; and they ascribe this movement to a sudden change of vertical pressure on the surface of an interior fluid mass, throwing it into wave-like undulations, such as would produce permanent flexures in the strata if more energetic, accompanied by the formation of dykes. The successive earthquakes of any region usually proceed from the same quarter, and this must also have been the case with the movements which gave rise to the parallelism of contiguous anticlinal lines. In illustration of the power of producing permanent lines of elevation which earthquakes have exhibited in modern times, the authors instance the Ullah Bund, an elevated mound extending 50 miles across the eastern arm of the Indus, which was the result of the great earthquake of Cutch in 1819; and another case recorded in 'Darwin's Journal of Travels in South America,' which a traveller described as a line of elevation of the strata, crossing a small rivulet, and shown in the fact that he found himself going down hill, while ascending the dry deserted channel.

Date of the Appalachian Axes.—The authors describe the elevation of this chain as simultaneous with the termination of the carboniferous deposits of the United States, and as the cause which probably arrested the further progress of the coal formation. With one local exception, on the Hudson, the whole series seem to have been deposited conformably, without any emergence of the land. That the elevation did not take place later, is shown by the undisturbed condition of the overlying beds, approximately of the age of the European new red sandstone. The elevation of the chief part of the great belt of metamorphic rocks on the S.E. side of the chain is referred to the same great movement. In conclusion, the authors remark that an incomparably greater change in the physical geography of North America, and perhaps of the globe, seems to have occurred at the close of the Carboniferous epoch than at any previous or subsequent period; and they consider these changes, and the effect produced by them on the organic world, as affording some of the highest subjects of geological investigation.

Mr. Murchison confirmed the views given by the authors of the paper, of the great break in the series of geological deposits which occurs between the Palæozoic rocks and later deposits; the coincidence in the direction of some great chains in Europe and America, belonging to the same geological period, was very striking. He was not prepared to give any opinion upon Professor Rogers' undulatory theory.

Sir H. T. De la Beche described the general character of anticlinal and synclinal lines, and stated, that whilst contortions of the strata sometimes assumed the character of mountain chains, at other times they occupied large tracts of low ground, as in the comparatively flat country of South Wales. He then made some observations on the space occupied by masses of rock over certain areas; the older rocks of England, if *flattened*, would occupy a much greater space than at present; and the area of the Alps and Jura would be greatly extended if all their contortions were spread out. The phenomena described in the Appalachian chain, so far as small differences in the direction of the anticlinals were concerned, did not at all affect the brilliant theory proposed by M. Elie de Beaumont; the object of the geologist was to trace the correspondence in the direction of the *great lines of elevation*, and in this broad view the

N.E. and S.W. direction of great part of the European rocks agreed remarkably with the direction of the Appalachian chain. He did not consider the pulsation of molten matter, as described by the authors of the paper, necessary to account for the flexures so very numerous in the strata of mountainous districts, but not confined to them, and in many instances unaccompanied by the intrusion of igneous rocks. The only force necessary for the production of such flexures and contortions was, the tangential or lateral pressure, in order to compress the strata into a smaller space. Contortions were formerly accounted for by a supposed secular diminution in the volume of the earth; the crust was compelled to accommodate itself to the diminished surface arising from the contraction of the mass. But it was to be remembered, that these contortions were not common to all the world: in Russia, the strata presented one even bend over a wide area. Our knowledge of America, and much of the rest of the world, was imperfect; and until we were much better acquainted with the distribution and character of contorted strata all over the globe, we should not be able to account very rationally for the figures they assumed.

Mr. Sedgwick pointed out those circumstances in the structure of the Appalachian chain which accorded with previous observations in Europe; the persistency of the strike of the strata, the parallelism of the anticlinal and synclinal lines, and the diminution in the amount of disturbance as the strata recede from the district where the greatest force was applied. He did not allow that the circumstance of curvilinear elevations was opposed to the theory of Mr. Beaumont, who had himself described curved elevations quite as striking. Most of the instances adduced by Prof. Rogers, in illustration of his view of the average inclination of the strata being greater on the side of each flexure *farthest* from the centre of the disturbing forces, did not, in his opinion, confirm the view the authors had taken of the origin of those contortions. Again, Mr. Sedgwick stated, the position of the successive strata in the British chains, was not generally such as that which characterized the chain so carefully described by the authors of the paper. The effects of disturbing forces, such as the intrusion of igneous rocks, was chiefly dependent on the nature of the rocks affected. In Cumberland the porphyritic rocks, which were evidently molten when introduced, had become hard by cooling, and had been fractured and dislocated along with the rocks among which they were intruded; but from the very nature of those rocks, they could not be thrown into many undulations. In North Wales, where the conditions differed, and the igneous rocks were less abundant, the alternating beds of solid porphyry and softer rocks were thrown into a series of anticlinal and synclinal lines; whilst in the Liege country the beds, when in a very soft and plastic state, had evidently been subjected to great lateral pressure, forcing them to assume enormous contortions, but never elevating them into mountains. The authors had, he thought, rather undervalued the power of tangential forces. These were well illustrated in the effects produced upon the soft slates of North Devon, by the intrusion of masses of granite many miles across, like that forming the forest of Dartmoor, between which and other granite masses, the strata were crumpled and thrown into innumerable undulations. He believed there was very little analogy between the phenomena produced by earthquakes, and those attributed to continental elevation; the oscillations of the earth's surface produced by earthquakes were like those of a cord struck when subjected to tension: from the very nature of these vibrations, they might be propagated rapidly over a great part of the globe. The impulses of elevation, as far as any thing was known of them, were slow, acting over wide areas, and disrupting and contorting mountain masses. Nothing was more certain than that continental masses had risen, and were rising, in our own time: Norway, for example, with curvations so slight as to be invisible. In the Southern and Pacific Ocean, Mr. Darwin had pointed out large areas, rising and subsiding, some of them 3,000 or 4,000 miles in diameter. He stated that he was not prepared to grapple with a theory which was so imperfectly explained, and without diagrams; he only wished phenomena not to be pressed into its service, which either bore not upon it at all, or were, perhaps, opposed to it—namely, the phenomena of the British chains. He lastly endeavoured to show how, in many cases, a reversed dip might be produced after the first protrusion of a central granitic axis. Professor Sedgwick concluded with a merited compliment to the American nation for the elaborate surveys they had published of which the present memoir was an example; the facts of which must, in the end, serve along with similar phenomena to form the base of a legitimate theory.

Report of Committee appointed at the Meeting of the British Association, held at Plymouth in* 1841, *for Registering Shocks of Earthquakes in Great Britain.

The Report commences with a list of shocks observed at Comrie, in Perthshire, since the date of that given in, last year, to the Association by the Committee. Sixty distinct shocks are recorded as having occurred on thirty-six different days, between July 23rd, 1841, and June 8th, 1842. Twelve of these are registered as having occurred on the 30th of July, 1841, being the greatest number hitherto noticed in the course of a single day.

The instruments employed to indicate the shocks were those described last year. The new instruments provided by the Committee have not with one exception, yet been affected, having been but a short time at their respective stations; and out of the sixty shocks above mentioned, there were but three occasions on which these instruments were moved.

1. On the 26th July, 1841, the inverted pendulum set in the steeple of Comrie parish church, was thrown about half an inch to the west, apparently indicating a horizontal movement of the ground eastward, to the same amount. An *upward* heave of the ground, to the extent of half an inch, was also indicated by two instruments, one of them being a horizontal bar, described in the course of the Report.

2. The next shock by which the instruments were affected occurred on the 30th July, 1841. The inverted pendulum in Mr. Macfarlane's house at Comrie, vibrated to the extent of half an inch, in a direction south and north; whilst at Tomperran (about 1½ mile east of Comrie), an instrument on the principle of the common pendulum vibrated east and west. The instruments for showing vertical movements were but slightly affected. Mr. Macfarlane describes this shock as very severe, though not so violent as that of October, 1839: estimating the former at 10, the intensity of this shock may be represented by 8. The shock was distinctly *double*, and the noise and vibrations accompanying it are described as very loud and violent, both as observed within houses and in the open air. Twelve shocks are said to have been felt in the course of the day; the weather was cold and inclined to stormy, at the time of this occurrence, and for a day or two before and after. The trees in the neighbourhood of Comrie are described as much agitated. The shock was felt eastward, at least as far as Newburgh, about

38 miles from Garrichrow; westward to Dalmally, about the same distance; as far north as Glenlion, 30 miles; and southward to Alloa and Stirling, 20 or 30 miles. All the shattered chimneys noticed near Duniva, were on walls, &c. running N. and S.; those on E. and W. walls being untouched. The injured buildings stood on a gravelly soil; but the distance from rocks below was unknown. There was nothing in the weather previous to the earthquake, to give any notice of its approach; indeed, after a course of some years' observation, no exact rule in this respect has been obtained; even a period of wet weather, which was formerly thought the constant forerunner of frequent and violent shocks, is not always succeeded by them; and, on the other hand, earthquakes have occurred when the sky was clear and open. The spot from which the earthquake shocks in Perthshire appear to originate, being situated about a mile to the north of Duniva, it is not difficult to understand why walls running N. and S. were affected; and those from E. to W. untouched.

3. On the 9th September, 1841, another pretty severe shock was felt at Comrie, about 10′ before midnight. The following morning the Association's instrument in the steeple was inclined ¾ of an inch to the south; that in the Comrie House ½ an inch to the north. This disagreement in the indications may perhaps be accounted for by the occurrence of two other shocks in the course of the night, and previously to the examination of the instruments: the weather during the two preceding days was remarkably wet and close.

4. On the 8th June, of the present year, two shocks were felt at Comrie, between 1 and 2, A.M. The horizontal pendulum recently sent to Mr. Macfarlane's house, indicated an upheave of the ground to the extent of a quarter of an inch. From the review of all the details, it seems probable

that the particular spot from which the earthquakes emanate, is situated about one mile N.E. of Duniva House, and one and a half or two miles N.W. of Comrie; and it is considered desirable to place additional instruments at Duniva, and in the neighbourhood, with the view of approximating still nearer to the exact spot of emanation.

The additional instruments for indicating earthquake shocks, lately sent out, are seven in number.

1. Four of these are on the principle of the watchmaker's noddy, explained in the last year's Report.

2. Another instrument consists of four horizontal glass tubes slightly turned up at each end, and filled with mercury. These tubes are laid down on the solid floor of a room, according to the points of the compass; and it is expected that when a shock takes place the mercury will flow out of one or more of these tubes. If there is no horizontal movement, but an inclination of the ground only, the mercury will flow out of the tube or tubes affected by the inclination. This instrument was made by Mr. Newman, of London, under the directions of Professor Wheatstone and Mr. D. Milne.

3. The two remaining instruments are intended exclusively to indicate vertical movements of the ground. They consist of a horizontal bar, fixed to a solid wall, by means of a strong flat watch-spring, and are loaded at the opposite end. If the wall suddenly rises or sinks, the loaded end of this horizontal rod remains from its *vis inertiæ* nearly at rest, and thus can move any light substance (as paper or a straw) brought against it by the vertical movement of the ground; the light substance being so adjusted as to remain fixed wherever the rod moves it.

Beside the above instruments, a barometer, a double thermometer, and a rain-gauge, have been sent to Mr. Macfarlane, of Comrie, in order that the state of the atmosphere at the time of the shocks, and the nature of the weather generally, during their occurrence, may be ascertained. The Committee, however, think it desirable to procure instruments much more sensitive than any which they yet possess; and they particularly call attention to the importance of carrying on meteorological observations at Comrie, as there seems to exist strong grounds for the opinion entertained by many, of an intimate connexion between earthquake shocks and the state of the weather, or rather the various agents which affect the weather. The Committee have not yet attempted the registration of earthquake shocks in any part of the country except Perthshire; but as the primitive districts of Cornwall and Wales have often experienced shocks, they propose also to send instruments and establish observations in those parts of the country.

Dr. Buckland recommended the establishment of observations along various lines known to be affected by earthquake shocks, such as the Chichester line of fault, Swansea, and Falmouth. The electric state of the earth would probably be found to influence the atmosphere much more powerfully than the air would affect the earth; the earthquake shocks were most frequent in the autumn and winter, and it was worth inquiry how far the rains of that period would affect strata under different electric conditions, such as those brought in contact by the faults and trap dykes of Comrie, and thus, perhaps, afford some clue to the origin of the shocks.

Mr. Sedgwick believed that the small amount of evidence as to movement, which had been or could be obtained in Britain, was not likely to throw much light on the origin of earthquakes, or on their connexion with atmospheric conditions. When regular observations could be established abroad, in regions frequently and powerfully influenced by such movements, we might hope to arrive at the conditions of their occurrence. Atmospheric conditions ought certainly to be noticed, and the coincidence of the shocks in Scotland with particular seasons of the year, well deserve remark. Perhaps the phenomenon was not more remarkable than the fact, that meteors showed themselves in greatest abundance during the passage of the earth through particular portions of its orbit. In saying this, however, Mr. Sedgwick did not mean to express his belief that atmospheric conditions could have any great effect on the deep-seated phenomena of earthquakes.

Sir H. T. De la Beche stated, that as a general rule the earthquakes of South America and Jamaica were felt most severely along the strike of the strata; in some instances, houses built on ranges of solid rock were affected by the shocks, whilst others only a quarter of a mile distant, built on *gravel,* entirely escaped. In all the published relations of the effects produced by earthquakes, much allowance was to be made for the excited feelings of the spectator. Thus the earthquakes which destroyed Port Royal had been described in all the exaggerated language inspired by terror; the real history was very simple; the town was built on a sand bank, encircling a number of small detached coral reefs; the violence of the waves, aided and accompanied by the concussion of the earthquake, washed away all this sand, and with it the houses, those on the coral reefs remaining as strong as before, whilst loose masses of stone, amongst the craggy rocks of the interior, naturally fell down from the effect of the same vibration.

Mr. Nicholson, of Kendal, described a slight earthquake, which had occurred on the 13th of the present month, on the shores at Morecambe Bay. The shock, which was sudden and violent, took place at 2 A.M.; there had been six weeks of drought previously, and on the day before the shock the thermometer stood at 94° in the shade, being 9° higher than it had risen in that neighbourhood since the year 1826. At 2 P.M., of the same day, the rain set in heavily. This earthquake was felt for ten miles round Kendal.

On the Structure and Mode of Formation of Glaciers by James Stark, M.D.

The author stated that he employed the word glacier to signify the entire icy masses which filled the upper as well as the lower valleys of snow-covered mountains, and extended downwards to the cultivated valleys or sea shore. He was induced to overlook the artificial division of these masses into *Firn*, *Mer de Glace*, &c, believing such divisions did not exist in nature, and were inapplicable to the glaciers of the Polar regions. From an examination of the accounts given by Saussure, Auldjo, Desor, and others, Dr. Stark was of opinion that there existed no constant differences in the crystalline structure of the ice in different parts of glaciers; perfect glacier ice, both as to purity and compactness, occurred at all heights; from which he inferred, that after the crystalline particles of snow became once consolidated into compact ice, no farther change, or enlargement of those particles, occurred till the mass was finally dissolved. The ice of glaciers had always been described as arranged in regular layers, but their position and mode of formation, as explained even by the latest writers, was stated by Dr. Stark to be so obscure, that having carefully examined the facts, he had formed conclusions, of which, as they differed from those usually entertained, he proceeded to give a summary, classifying the differences observable in the structure of glacial masses under the following divisions:

1. *Horizontal strata.* The author remarked that this was usually termed *banded structure,* and seemed to be confined to the upper regions of the mountains. The planes invariably coincided with the surface of the glacier, the layers being usually 1 to 3 feet in thickness. They were mentioned by almost all writers on glaciers, and represented in the plates of M. Agassiz's work. Most writers considered them as marking the annual additions to the glacier; but as the amount of snow falling on the average during the six winter months would produce a much greater thickness of ice than the horizontal layers indicated, Dr. Stark considered that each band denoted a separate fall of snow unless it should appear that snow and ice wasted with nearly as much rapidity in the upper as in the lower regions.

2. *Longitudinal and vertical strata.* Dr. Stark stated that

this structure had been described by Grüner in 1760, by Desmarest in 1779, Scoresby in 1824, and other authors, and during the last winter had been claimed as a new discovery by Prof. Forbes, who styled it ribboned or banded structure. These layers he described as always of great tenuity, forming planes more or less vertical, but always parallel with the length of the glacier or its retaining walls. The explanation of this structure offered by Dr. Stark is as follows:

During the spring and summer months it is probable that glaciers advance from 1½ to 3 feet daily, and as the valleys occupied by them generally widen as they recede from the higher regions, every movement would leave a space between them and their containing walls; these fissures would continually fill up with fresh snow and ice, increasing the breadth of the glaciers, and forming a new series of vertical planes. The frequent occurrence of mud, gravel, and fragments of rock in the same planes, was considered by Dr. Stark to be much in favour of this explanation of their origin. This structure, he remarked, was likely to be found wherever pillars and needles of ice were met with, since fissures and crevices generally divided glaciers transversely; and in passing over rough ground, the unequal pressure on a combination of transverse fissures and longitudinal lamellæ would break up the ice into vertical prismatic columns.

3. *Horizontal combined with longitudinal and vertical strata.* Although no such combination as this had hitherto been described, Dr. Stark thought it must exist. Horizontally stratified ice was confined to elevated regions, where the thickness of glaciers was three or four times greater than in lower valleys. Dr. Stark inferred that these beds gradually wasted away as the glacier descended until only the lower, or vertically stratified, portion remained.

4. *Inclined strata.* This structure Dr. Stark endeavoured to explain as one superinduced after the accidental destruction of the lines of stratification which formerly existed. In conclusion, Dr. Stark observed, that all the above forms of stratification might be expected to occur in the extent of a single glacier.

Dr. Richardson observed, that snow constantly disappeared in great quantities without melting; in dry frosty air, with a temperature below zero, it would disappear rapidly by insensible evaporation. The prismatic form of ice, which occurs on lakes where it has attained a thickness of 6 or 8 feet, takes place only in the spring when it begins to melt; the particles were considered to undergo a new arrangement when the temperature of the mass was elevated to the melting point.

Col. Sabine had seen the ribboned structure of glacial ice mentioned by Prof. Forbes, but doubted whether it had ever been seen in polar ice: he had never met with it, and did not think it would have escaped his observation.

On the Western States of North America, by Dr. Dale Owen.

The Memoir was illustrated by Maps, Sections, and Diagrams of Fossils.

The grand feature of the country is the Illinois Coalfield, equal in extent to all England, separated from another coalfield, that of the Ohio, by an axis of much older rocks; the object of the memoir was to identify those lower rocks with the systems which supported our own carboniferous series. But we need not give an abstract of this paper at present, as it will be read at the next meeting of the Geological Society.

Mr. Phillips compared the extreme simplicity in the succession of strata and distribution of organic remains observable in these districts of N. America under consideration, with the great breadth occupied in Ireland by calcareous beds of the carboniferous era, where a similar deficiency existed in the middle and superior members of the series. This particular American series was deficient in tertiary rocks; its cretaceous system was deficient in white chalk, the Neocomean beds and the oolites were all absent, the lias and new red sandstone were also deficient; and then came the coal, succeeded by limestones, sandstones, and shales, and these by altered strata and granite. The analogy between the American cretaceous deposits and those of Europe was very striking; though specific differences did exist between the fossils of the two countries, yet these differences were very slight, merely marking the effect of local influence; regarded as a group, the two deposits were identical, and there could be no question of their contemporaneous deposition. Passing from the cretaceous deposits, we did not meet with the series which in Europe succeed to them, but we passed suddenly to the coal formation, without a trace of the fossils of the intervening beds; whilst the plants of the American coal measures, although they might differ specifically from those of Europe, belonged to the same leading groups—Stigmaria, Pecopteris, Neuropteris, Sigillaria, &c. In the limestones under the coal was shown the state of the sea of that period. These were the Productas, (of the P. antiquata group), and the Syphonophyllia, resembling those of the English and Irish carboniferous limestone, and the Pentremites sufficiently characteristic to afford a good temporary designation for the deposit. One fossil would seem to have strayed from its proper place, the Calceola, but as no single shell could be regarded as marking the boundary of a formation, this was not an *exception* to the law; the evidence given by a large number of forms proved these beds to be the equivalents of our carboniferous limestone. Beneath this limestone occurred a fine sandstone; the identity of its fossils was doubtful; it were unsafe to call them Silurian; the Spirifer represented was evidently one of that peculiar Producta-like group, with tranverse bars, belonging to the carboniferous limestone, and the other fossils seemed to indicate an intermediate term of life. In the lower limestone, a Pleurorhynchus was found—a genus which occurred in Devonian, but not in the Silurian rocks; Pentremites were also figured as belonging to this deposit. The lowest deposits, forming the basis of the series contained the usual Silurian forms, Orthidæ and Spirifera. These rocks appeared as one series of calcareous deposits, formed under circumstances less subject to fluctuation than their equivalents in Europe; and the continuity of specific forms and types of organization seemed to have been much greater than in countries where physical changes produced well defined lines of separation in the deposits. The successive periods of deposition of strata were much better determined by organic forms than by the mineral constitution of the rocks, but in applying this principle, it is impossible to be too cautious, the evidence being not of *time*, but of *circumstance*; the character of the organic remains being determined by the physical conditions of the period. The order of physical changes, and the series of organic life, must be inquired into separately, and their results combined, before we could be safe; he had no intention of interfering with or undervaluing investigations based on other grounds, but he believed he had presented a view which did not clash in its result with that given by investigations of another kind.

Mr. Sedgwick contended, that the expression *law* was not used in a correct sense, if, by using it, we excluded the idea of laws of a higher order: it merely implied that, having grouped together a set of phenomena, we used the term to represent the state of our knowledge at any moment of time. Such were the laws of the distribution of organic remains; it was impossible to ascertain all the conditions which involved the appearance of any particular form of life; and we never have risen, nor can rise, to such laws. With respect to the identification of strata in distant countries by organic remains, in the absence of direct evidence, he considered this evidence was as strong as we could expect to obtain; having proved its correctness in this country, we applied it to more distant tracts. Assuming, in the first instance, a coincidence between the conditions and organic types of our own country and that which we examine, if in this investigation we meet with nothing contradictory, we extend the value of our inductive process. Amongst the lower rocks of that part of America described, there was a carboniferous and pentremite limestone, an intermediate group, and a Silurian group, all bearing a remarkable analogy to those of our own country. The series, as a whole, was more calcareous and, therefore, we might not expect the same tranchant differences which the alternation of masses of shale and sandstone had produced with us. An illustration of these local differences occurred in the interpolation of the calcareous beds, of which the *crumbling* colleges of Oxford were built, between the Oxford and Kimmeridge clays of the south of England. At Cambridge, these clays formed one uninterrupted deposit of mud, 2,000 feet thick. In England all the work was done; the long tiresome narrative like an old chronicle full of enormous detail—like a book, too, some of the leaves were torn out, and others so defaced that no mortal man could read them. To supply this, we looked to other countries; and, believing that nature has no starts, or blanks, seek to supply the deficiencies in our own series, by an examination of those of other countries. In reference to the economical importance of the district which formed the subject of the memoir, Mr. Sedgwick remarked, that this country possessed inexhaustible mineral treasures, and the finest inland navigation in the world, and pictured the influence it might be expected to exert, in the coming period of time, its effect on the fortunes of the civilized world, when all the intellect of the most active and energetic men on that part of the earth should be brought to bear on these treasures; and he rejoiced that men, with English feeling and English blood, should be bringing them into operation.

Sir H. T. De La Beche remarked, that the principal groups of strata were separable all over the globe, and the physical conditions which produced those deposits and governed the changes of organic life must have been the same over large portions of the globe also; he assumed a similarity of condition, not perfect identity; those deposits were formed of the detritus of pre-existing rocks, and as there were not equal conditions for producing and carrying that detritus, there would be more striking deviations from the general rule in one place than another: the deposits might have no representations at all in *time*; therefore, to say that one deposit was perfectly represented by another, would be drawing conclusions without the necessary evidence. Both sections and fossils were necessary; but after all, we could only give names to represent the state of our knowledge; facts much more numerous and much stronger than those on which our divisions were founded, might compel us to alter our names. The division of the older rocks into Carboniferous, Devonian, and Silurian, should be retained as long as possible; but the moment we attained a sufficient body of evidence, we must modify our views. The different value of names in different parts of the world, rendered it useless to attempt to make American deposits square exactly with our own; our definition of carboniferous limestone would not apply to Ireland;* *à fortiori,* we could not expect it to coincide strictly with America; and lastly we should endeavour to make our nomenclature as effective as possible, for distinguishing grouping formations in all parts of the world, so as to make the terms comparable.

Report on British Belemnites, by Mr. Phillips.

Mr. Phillips stated that he had been called upon by the Committee for a report on this subject; he had prepared drawings of some of the most characteristic forms, to which he now desired to call attention, as this class of organic remains had been greatly neglected, and he had experienced considerable difficulty in procuring information on the subject. M. Blainville had pointed out the analogy of structure they presented to certain bodies found in cuttle-fish, and other analogies with the nautilus. Mr. Voltz and Dr. Buckland had also investigated the subject, and published many important results. Mr. Phillips stated that he had himself published several forms of belemnites in his 'Geology of Yorkshire,' but that until he had examined the

* Why then, as carboniferous limestone (a general appellation) is not generally applicable, should Geologists have adopted a term to which they do not assent?—*Ed. Geologist.*

splendid collection at Strasburg, formed by Prof. Voltz, he was not aware of any principles by which they could be separated into groups, and the differences of specific form be accurately determined. Mr. Phillips proceeded to describe the general structure of Belemnites as consisting of a cylindrical hollow sheath, with a radiating fibrous structure, the hollow, or alveolus, conical and slightly curved. He mentioned that the bilaterality of belemnites was generally overlooked; the sides, front and back, being figured indiscriminately in different works on the subject. So little had been done to determine the value of specific characters in this group, that at present we were quite unable to apply them as evidence in determining the conditions of ancient waters; and it was desirable to arrange the facts in such a manner as to give them a general value. He had endeavoured to form such a system of measurement, to be applied in the description of the different portions of which belemnites were composed, as should enable him to form conclusions, not merely as to specific differences, but applicable to the mode of life of groups. The form of the belemnitic sheath would be most frequently found to preserve a certain characteristic form, not specific only, but distributed in groups in various strata. Thus in the cretaceous group of England, Norway, and America, certain forms of belemnite were found with a grove on the anterior side of the *base* of the sheath, extending as far as the alveolus, and this character was associated with a mucronate point. In many liassic belemnites, there was no grove on the point, but two lateral groves at the *apex*. In many oolitic belemnites, there was no grove at the base or on the sides, but a single one commencing at the apex and running down the front. In grouping together these and other facts, and representing them by the term *law*, he wished to be understood as using that expression only in the sense of a *law of phenomena*, and by no means interfered with the idea of a *law of causation*. Used in this sense, the term was extremely convenient, as expressing the explanation attached to a set of phenomena.

Report on the Fossil Fishes of the Devonian System, or Old Red Sandstone, by Prof. Agassiz.

The author commenced by describing the favourable circumstances under which he had examined these remains. The rapid progress which had been made in developing the riches of these deposits since 1834, when Dr. Fleming and Messrs. Sedgwick and Murchison first pointed out the existence of a few scales at Cleishbinnie, and afterwards discovered two new genera of fish at Caithness; four species only were then known, and of these but one was figured. The researches of Dr. Traill and Messrs Murchison and Lyell, had enabled him in a former report to raise the number of genera to ten, and the species to seventeen. Since that time such an impulse had been given to those researches by Mr. Murchison's work on 'The Silurian System,' that on again visiting Scotland in 1840, he had the opportunity of examining double the number of genera, and triple the number of species, which had been lately discovered and not yet described. On this occasion, one of the most remarkable forms of organic life, and one entirely new, the Pterichthys (so named by him from its possessing appendages resembling wings), was discovered by Mr. Miller of Cromartie. Another form, also new, and equally curious, the Coccosteus, was discovered at Caithness, by Mr. Sedgwick and Mr. Murchison, opening to the comparative palæontologist a field of research as fruitful as the discovery of the Plesiosauri and Ichthyosauri a quarter of a century before. These two genera presented characters so different from any known fish, as to have been referred, in the first instance, by able naturalists to the Cheloneæ, Fish, Crustaceans, and even Coleoptera.

M. Agassiz proceeded to notice the researches of Dr. Malcolmson, Mr. Alexander Robertson, and especially the late Lady Gordon Cumming, who had collected these remains and distributed them amongst geologists with the greatest liberality. Lady Cumming had studied the remains with great care, and prepared a series of drawings of all the most perfect specimens with a precision of detail and artistic talent, which few naturalists could hope to attain. The collections of Lord Enniskillen and Sir Philip Egerton had also furnished him with many beautiful specimens, and Dr. Traill and Mr. H. E. Strickland had considerably increased the number of species by their examination of the Orkney schists. In the southern part of Scotland, Prof. Jamieson and Mr. Anderson had collected the species belonging to the upper part of this formation, several of which were figured by Mr. Anderson in his 'Memoir on Fifeshire.' The distant excursions of Mr. Murchison enabled the author to extend his Report to fossil fish of the same age found in Russia, but perfectly identical with those of Scotland. The continental researches of M. Omalius d'Haloy and M. Haeninghausen had also brought to light scales of fish belonging to this formation. M. Agassiz then presented some general considerations on the characters and geological distribution of the fossil fishes found in these strata, first observing, that in examining these remains he had employed the method established by Cuvier—of comparing them with each other and with living species. Wherever this principle had been adhered to, it had given results which had suffered scarcely any modification by time. He first remarked, that all species and nearly all the genera of fish found in the Devonian strata were entirely confined to them, neither extending downwards to the Silurian, nor upwards to the carboniferous series. The genera which had no representatives in other strata, were those which contained the greatest number of species. Pterichthys, Coccosteus, Cephalaspis, Ostrolepis, Dipterus, Glyptolepis, Platygnathus, Dendrodus, Diplacanthus, Cheiracanthus, and Cheirolepis. Those genera which occurred also in the Silurian system and coal measures, such as Onchus, Ctenacanthus, Ctenoptychius, Ptychacanthus, Acanthodes, Diplopterus, and Holoptychius, did not contain a single *species* identical in the separate formations. This result agreed precisely with that which M. Agassiz stated he had obtained in the upper formations, in which the fish, echinodermata, and molluscs of separate formations never extended from one system, or even subdivisions of the strata, to another. In this view, which differed from that entertained by most palæontologists, ne was supported by M. d'Orbigny, and he attributed the similarity of the results, obtained by them from the examination of remains of fish and molluscous animals, to the employment of the same principles in both cases.

M. Agassiz remarked, that the fish found in those formations, and, indeed, in all the older rocks, as compared to those of modern times, were small and even insignificant in size; and he wished particularly to insist on this circumstance, because the idea of colossal dimensions, which we were accustomed to attach to the fossils of all geological epochs, was untrue both as regarded the fish and all other classes of animals, with the exception of a few particular types. The principal exception, was the number of gigantic saurians in the secondary rocks, but their existence was the less remarkable, as at that period mammifers scarcely existed, and the cretaceans and gigantic pachyderms were absent. In speaking of the fish of the old red sandstone, small or middling sized, he meant that generally they did not exceed one or two feet in length. A few genera contained species as much as three or four feet long, but none which could be compared with the dimensions of the sword-fish, shark, &c. of our own seas. M. Agassiz then remarked that there was a singular uniformity of size in the species of almost all genera and families, not only amongst fish, but other classes, which he illustrated by reference to the different orders of mammals, reptiles, insects, &c. In examining the fish of these deposits, considerable diversity of type will be seen, and the species must necessarily be referred to a variety of orders and families.

1. Thus there are four genera, Ctenacanthus, Onchus, Ctenoptychius, and Ptychacanthus, belonging to the order Placoides, which are furnished with spiny rays in the dorsal fins, similar to the great Ichthyodorulites of the coal and oolitic formations. In the order of Ganoides, the genera Acanthodes, Diplacanthus, Cheiracanthus, Cheirolepis, presented a separate group; for although they were covered with enamelled scales, these scales were so small as to give the appearance of shagreen. The manner in which the fins were sustained by spiny rays, or, in the absence of those rays, the positions of the fins themselves, served as characters for determining the genera.

2. The genera Pterichtys, Coccosteus, and Cephalaspis, formed a second group, in which the size of the head and the large plates which cover it, and also invest a large portion of the body, and the moveable wing-like appendages placed at the sides of the head, give them a most extraordinary appearance. The large bony and granulated plates of the Coccosteus caused it to be referred to the Trionyx. The crescent-shaped head of the Cephalaspis, and peculiar scales resembling transverse articulations of the body, made it easily mistaken for a genus of Trilobites. Another curious point in the structure of these genera, was the association of exterior bony plates, with a soft and cartilaginous verte-

bral column resembling that of the sturgeon, a character common to the greater part of the species found in those ancient rocks. He remarked the great difficulty of comparing these forms to any recent types, the resemblances being only partial, and confined to particular parts of their structure. Thus the helmed heads of the sturgeons and the granulations which protect the heads of Trigla, Dactylopterus, &c., resemble a little the Cephalaspis and Coccosteus. The appendages of Pterychthys might, perhaps, be compared to the moveable suborbitaries of the Acanthopsis, or with the elongation of the preoperculum of certain species of Trigla and Cephalacanthus. He pointed out the analogy between the imperfect developement of the vertebral column, and the interior position of the mouth in these genera, with the form of the dorsal chord and position of the mouth in the embryo of fishes.

3. A third group of the fish of this formation, were characterized by the structure of the ventral fins, which in the genera Dipterus, Osteolepis, Diplopterus, and Glyptolepis, were double, resembling the caudal fin in appearance; these genera differ from another in the structure of their teeth.

4. A fourth group were distinguished by their large conical teeth placed in the side of the jaws alternately with smaller teeth. This structure obtains in the genera Holoptychius, Platygnathus, and Mr. Owen's genus Dendrodus. This original diversity of types in the fish of so ancient a formation, M. Agassiz regarded as a great argument against the theory of the successive transformation of species, and the descent of all living organized beings from a small number of primitive forms. The result of all his observations concurred in proving the appearance of new species with each formation.

Mr. Murchison exhibited the drawings of fish belonging to the genera Pterychthys, Coccosteus, &c., and referred to in M. Agassiz's memoir; he also mentioned the remains of gigantic fishes allied to the Pterichthys, which had been discovered in Russia; he believed that M. Agassiz would be obliged to modify his statement of the comparative insignificant dimensions of the fish found in the older rocks. He remarked, that it would scarcely be safe, in the present state of our knowledge, to draw divisions in strata upon zoological evidence only. In that case, the occurrence of fish in the upper Silurian strata would make it necessary to include those deposits in the old red sandstone. The evidence of Mr. Owen, in his Report on Fossil Saurians, and that of M. Agassiz in the present Report, agreed in disproving the transmutation of species, in passing from one stratum to another.

Mr. Sedgwick referred to a recent statement by Professor Owen, that the remains of an Ichthyosaurus found in the lower chalk, greensand and gault, were identical with those of a species common in the lias, showing a greater range than had ever been suspected in an animal so highly organized.

Sir H. De la Beche stated, that from all our knowledge of the distribution of species, and their continued existence from one deposit to another, he was disposed to doubt the statement of M. Agassiz, as to the limited range of species. He could not regard the fish of the tertiary as entirely distinct from those of the present time; yet he believed that M. Agassiz regarded not merely the fish, but the *shell* of the tertiary, as altogether distinct from the existing Fauna.

Mr. Phillips observed, that the amount of reliance to be placed upon M. Agassiz's views of the distribution of fish in the older rocks, must depend upon the degree of completeness of that evidence. A few years ago, comparatively little was known; now we are acquainted with more than eight hundred forms. The state of our knowledge of fossil fish was still imperfect, and in order to make the evidence given by it of equal value with that of other departments of zoology, ten times the amount of research would be needed. And not merely were the data insufficient as regarded the old rocks which had been the especial objects of examination, but the strata of Russia and many other countries where fish remains were found, must be examined and brought into comparison with the results previously obtained, before we should be justified in adopting such views as some of those entertained by M. Agassiz. Mr. Phillips proceeded to describe some remains of a small fish resembling the Cheiracanthus of the old red sandstone, scales and spines of which he had found in a quarry at Hale's End, on the western side of the Malverns. The section presented beds of the old red sandstone, inclined to the W.; beneath these were arenaceous beds of a lighter colour, forming the junction with Silurian shales; these again passing on to calcareous beds in the lower part of the quarry, containing the corals and shells of the Aymestry limestone, of their agreement with which stronger evidence might be obtained elsewhere. He had found none of these scales in the junction beds, or in the Upper Ludlow shales; but about sixty or one hundred feet lower, just above the Aymestry limestone, his attention had been attracted to discoloured spots on the *surface* of the beds, which, upon microscopic examination, proved to be the minute scales and spines before mentioned. These remains were only apparent on the surface, whilst the "fish bed" of the Upper Ludlow rock, as it usually occurred, was an inch thick, consisting of innumerable small teeth, spines, &c. Future observations would probably show that many forms supposed by M. Agassiz peculiar to certain deposits, would, at other localities, be found occupying a higher or lower level in the series. That fish remains might be met with in many localities not hitherto suspected, was shown by researches in the Ardwick limestone near Manchester, by Mr. Binney and his friends, which had been hitherto considered a part of the magnesian beds, until the discovery of numerous fish and shells proved it to belong to the carboniferous period. By renewed search, we might expect to obtain evidence of this nature, by which many discordances in our system would be adjusted, and the correspondence in distant parts of the same series rendered much closer than it was seen now.

MINERALOGICAL SECTION.

Account of the Mineralogical and Geological Museum of the Imperial Mining Department of Vienna, by Prof. Haidinger.

The basis of this collection existed in the museum of the mining department previous to the appointment of Prof. Mohs. Under the presidency of Prince Augustus Lobkowicz, the museum was considerably augmented, both by the exertions of the mining department and by contributions from private collectors. The method of arrangement employed in the museum was suggested by Mohs himself, and followed out by Prof. Haidinger after the death of the former. It consisted in dividing the mineral products of the empire into four great general divisions, having in the centre those obtained from the rivers, and those procured from the principal chains of mountains, as the boundaries of either side. The cabinets were so arranged as to form a kind of section of the various geological formations. The upper portions of the cabinets are filled with the rocks and minerals from the heights or mountainous districts, whilst the lower divisions contain the specimens taken from the valleys. This arrangement has been found greatly to assist the memory, and to afford numerous points of comparison to those who study the constitution of the mountain chains. The Professor concluded by some speculations on the changes which gradually take place in the metamorphic rocks, and which he considered might all be reduced to processes of oxidation or reduction.

On some new Oxides of certain of the Metals of the Magnesian Family, by Dr. Lyon Playfair.

Dr. Playfair first adverted to our defective knowledge of the history of the magnesian oxides. Chemists were more intimately acquainted with this family than with any other; but still the actual amount of their knowledge was very scanty. Manganese, for example, possesses six degrees of oxidation; whilst magnesium, the type of the family, possesses only one. Iron and chromium possess sesquioxides, but copper and zinc do not; yet a complete identity in the structure of their molecules has been pointed out, affording new proofs of chemical analogy. Dr. Playfair showed a diagram representing all the magnesian oxides now known, in contradistinction to those which analogy leads us to expect. In this tabular statement, he denied the existence of peroxides of copper, zinc, and calcium, although it is well known that these oxides are admitted by chemists as having been discovered by Thénard. The compounds obtained by Thénard and to which he had ascribed the general formula $R\ O_2$ were obtained by the action of peroxide of hydrogen on the protoxides of the metals. But these bodies did not possess any of the characters, which analogy would lead us to ascribe to magnesian peroxides. In fact, they possess all the properties of peroxide of hydrogen itself: they decompose spontaneously and detonate with combustibles. Potash accelerates their decomposition, while acids, under certain circumstances, retard it. Their action with acids is opposed to our conceptions of such unstable peroxides; for they dissolve in cold acids, without decomposition, which even peroxide of Maganese, stable as it is, cannot do. All these anomalous properties led Dr. Playfair to look for another composition for M. Thénard's compounds. In the course of his examination of the magnesian oxides, he found that the peroxides had a great disposition to unite with the protoxides, forming compounds of the general formula $R\ O + R_2\ O_4$. Now hydrogen itself is a magnesian metal, or, at all events, possesses the characters of one, and its peroxide should share the disposition to unite with protoxides. The author therefore, drew the conclusion, that Thénard's compounds were in reality similarly composed, having the formula $M\ O + H_2\ O_4$. And in confirmation of this view, he stated, that Thénard's own analyses coincide with it much better than with his own view of their being peroxides. This chemist obtained always too little oxygen to agree with his theory of their composition. He ought to have procured oxygen in the proportion of 3 : 6; whilst on Dr. Playfair's view, the proportion would be 3 : 5, a result which approximates closely to Thénard's analyses. From these considerations, the author considered that he had a right to affirm, that the peroxides of copper, zinc, and calcium, as far as Thénard was concerned, were yet unknown, and remained to be discovered. We cannot here enter into the details of Dr. Playfair's *modus operandi*, and omit them with less regret since he stated, that his 'Memoir on the true Peroxides' will shortly be published. We shall therefore confine ourselves to an enumeration and brief description of the compounds described by him. *Peroxide of Copper* is of a brownish black colour. It yields oxygen on being dissolved in acids and chlorides. He obtained a hydrate of this compound oxide. By a strong heat this oxide is further decomposed. The next oxide to which the author referred, was the *peroxide of iron*. His attention had been directed, a few days since, to an ambiguous sentence in the "Comtes Rendus," in which M. Frémy appears to have got *indications* of this oxide, although no description is given of it. Dr. Playfair stated, that if M. Fremy had published a detailed account of it, of course the priority of publication entitled him to the priority of discovery, but he had seen no such account. The peroxide of iron resembled in character the peroxide of copper. Like that oxide it contained 2 atoms of water, of which it lost 1½ atom in *vacuo*. The author then described a peroxide of aluminum, which differed from the others in its relations to water. The water in this oxide played a very important part. The oxide was soluble in potash. It could be obtained in a crystallized state and formed compounds of considerable interest, as throwing light upon the constitution of corundum and other minerals. He then announced some new oxides of zinc, the examination of which would shortly be completed. He had kept himself from examining the metallic acids which might be derived from them, as M. Frémy was engaged in their examination, and he had no wish to interfere with the researches of that able chemist. The author pointed to the necessity of doubling the atomic weights of the magnesian metals. He had shown that these peroxides possessed the formula $R_2 O_4$ and not $R O_2$.

Taking the case of copper, we have the series

$$Cu_2 O—Cu O—Cu_2 O_3—Cu_2 O_4.$$

In all these oxides, the copper unites in *two* atoms, except in the case of the protoxide. But by doubling the atom, we would have a uniform series—

$$CuO—CuO_2—CuO_3—CuO_4$$

—the oxides in this case increasing the arithmetical progression. He showed, that in many of the salts, there was evidence of this double atom. Sulphate of copper absorbed 2½ atoms of ammonia; a sulphate of lime was known with ½ an atom of water, &c.

Professor Graham said, that chemists had long looked for these oxides with much anxiety, and nothing could be more welcome than their discovery, as they would serve to clear away many objections to the doctrine of isomorphism.

Dr. Daubeny thought the close analogy shown between water and oxide of copper of much importance, in confirming the views originally proposed by the President (Prof. Graham).

Dr. Apjohn stated, that he had on one occasion obtained a hydrate of the peroxide of manganese in beautiful crystals. He was unable to state from memory, the proportion of water which it contained, but thought its correct examination might be of some use in connexion with Dr. Playfair's views of the important functions of water in the peroxides described.

Dr. Daubeny read a paper "*On the Causes of the Irregularities of Surface which are observable in certain parts of the Magnesian Limestone Formations of this Country.*" The magnesian limestone rocks in some of the quarries in Derbyshire, presents a remarkable appearance. They do not possess an undulating surface, as the limestones generally do, but the surface is covered with irregular elevations and depressions of a very marked character. Prof. Sedgwick had cursorily noticed the configurations which these magnesian limestones possess, and ascribed it to an arrangement of the particles of the rock which took place in the act of its consolidation. Dr. Daubeny, however, was inclined to ascribe them to the action of atmospheric influences, and to that of water impregnated with carbonic acid.

REVIEWS.

The Old Red Sandstone, or new walks in an Old Field, by Hugh Miller, 8vo. 1842. *John Johnstone, Edinburgh; R. Groombridge, London.*

"You must inevitably give up the Old Red Sandstone," said an ingenious foreigner to Mr. Murchison, when on a visit to England about four years ago, and whose celebrity among his own countrymen rested chiefly on his researches in the more ancient formations, "you must inevitably give up the Old Red Sandstone; it is a mere local deposit, a doubtful accumulation huddled up in a corner, and has no type or representative abroad." "I would willingly give it up, if nature would," was the reply, "but it assuredly exists, and I cannot." Mr. Miller introduces this dialogue as one of the main arguments, contained in the excellent volume which he has recently published on that particular formation; the style of which is attractive both to the Geologist and the general reader. The best example which we could select from the work, as a specimen of the fluency of the style, is a passage which relates more immediately to the importance of the fossil remains of this formation; and we insert it for the benefit of our readers generally, and as an introduction to the subject. "It will be found," says Mr. Miller, "that this hitherto neglected system yields in importance to none of the others, whether we take into account its amazing depth, the great extent to which it is developed both at home and abroad, the interesting links which it furnishes in the Zoological scales or the vast period of time which it represents. There are localities in which the depth of the Old Red Sandstone fully equals the elevation of Mount Etna over the level of the sea, and in which it contains three distinct groups of organic remains, the one rising in beautiful progression over the other. Let the reader imagine a digest of English history, complete from the invasion of Julius Cæsar to the reign of that Harold who was slain at Hastings, and from the times of Edward III, down to the present day, but bearing no record of the Williams, the Henries, the Edwards, the John, Stephen and Richard, that reigned during the omitted period, or of the striking and important events by which these several reigns were distinguished. A Chronicle thus mutilated and incomplete would be no unapt representation of a geological history of the earth in which the period of upper silurian (*so called*) would be connected with that of the mountain limestone, or of the limestone of Burdie House, and the period of the Old Red Sandstone omitted.*"

A lengthened description follows of this formation in the south of Scotland, but we shall pass this over without any remark as a mere inspection of any geological map will convey more readily than words, an idea of its extent

* We append in a note, apart from the comments on the merits of this work, our objections to the insertion of these local terms, especially in this present instance; we find Mr. Miller vitiating the assertions of some foreign Geologists as to the absence of the Old Red Sandstone formation; and condemning them for the omission of it in their synoptical tables, but in the paragraph, almost next following to that in which he states his opposed views, he proceeds to make a comparison in which he speaks of strata by their local appellations, and introduces fresh subjects for dispute.—*Editor of the Geologist.*

and boundaries. The notice of its probable depth we shall treat in the same manner, on the ground urged by the author, of the doubtful nature of the *calculations* of the Geologist; and shall, therefore, at once transcribe the assertion of Mr. Miller, "that the fossils of this formation are exceedingly numerous, and in a state of high preservation."

The variety of forms displayed by these productions of nature need not be noticed, although here again our author displays his power of language and intimate knowledge of fossil Ichthyology. His delightful description of the *Pterichthys*, its first discovery, its varieties, and the evidences of its violent destruction are all graphic; that of the *Coccusteus* is equally instructive; Mr. Miller states that he is already acquainted with four species, viz: *C. ———?; C. latus; C. cuspidatus; C. oblongus;* and that he has laid open in a few square yards of rock the remains of a dozen different individuals belonging to the second and third species of the form above named. His notices of the *Osteolepis, Dipterus, Diplopterus, Glytolepis, Cheirolepis, Diplacanthus* and *Cheiracanthus* are all equally good.

This enumeration is in itself saying much for the work, but not more than it really deserves, for excellent as are these descriptions individually, we were still more gratified by the detail of the classification of the Ichthyolites of this formation, to which in its turn we purpose devoting a short space.

After detailing the respective peculiarities of each order, the Cuvieran system of classification, and those of the genera of the fossil remains found in the Old Red Sandstone, and thence pointing out their peculiarities, he remarks that there is something very admirable in the consistency of style among the Ichthyolites of that formation. In no single fish of either group do we find two styles of ornament, in scarce any two fishes do we find exactly the same style. Yet there is unity of character in every scale, plate, and fin—"unity," Mr. Miller says, "such as all men of taste have learned to admire in those three Grecian orders from which the ingenuity of Rome was content to borrow, when it professed to invent—in the masculine Doric,—the chaste and graceful Ionic,—the exquisitely elegant Corinthian; and yet the unassisted eye fails to discover the first evidences of this unity; it would seem as if the adorable architect had wrought it out in secret with reference to the Divine idea alone. Again we will let Mr. Miller speak for himself, with reference to the other fossil productions of this formation; preferring his descriptions to any abbreviated remark of our own:

"Till very lately it was held that the Old Red Sandstone of Scotland contained no mollusca. It seemed difficult, however, to imagine a sea abounding in fish, and yet devoid of shells. In all my explorations, therefore, I had an eye to the discovery of the latter, and on several occasions I disinterred what I supposed, might have formed portions of a cardium or terebratula. On applying the glass, however, the punctulated character of the surface showed that the supposed shells were but parts of the concave helmet-like plate that covered the snout of the Osteolopis. In the Ichthyolite beds of Cromarty, Ross, Moray, Banff, Perth, Forfar, Fife and Berwickshire, not a single shell has been found, but there have been discovered of late, in the upper beds of the Lower Old Red Sandstone in Caithness and Orkney, the remains of a small delicate bivalve, not yet described or figured, but which very much resembled a Venus. In the Tilestones of England, so carefully described by Mr. Murchison in his work "the Silurian system," shells are very abundant; and the fact may now be regarded as established, that the Tilestones of England belong to a deposit contemporaneous with the Ichthyolite Beds of Caithness and Cromarty. They occupy the same place low in the base of the Old Red; and there is at least one Ichthyolite common to both, and which does not occur in the superior strata of the system in either country, the *Dipterus macrolepidotus*. The evidence may thus be summed up;—We learn from the geology of Caithness that this species of Dipterus was unquestionably contemporary with all the other Ichthyolites described;—we learn from the geology of Herefordshire that the shells were as unquestionably contemporary with it. These two shells—are of a singularly mixed character, regarded as a group uniting, says Mr. Murchison, forms at one time deemed characteristic of the more modern formations of the later secondary, and even tertiary periods, with forms the most ancient, and which characterize the molluscous remains of the transition rocks. Turbinated shells and bivalves of well nigh the recent type may be found lying side by side with chambered Orthoceratites and Terebratula."

The vegetable remains of the formation are numerous but obscure, consisting mostly of carbonaceous markings.

We will again borrow rather largely from the pages of this work, that we may the more clearly demonstrate the style in which Mr. Miller treats many of the most important departments of the subject. In speaking of the distinctive characters of the various rocks, he says, to use his own words. "Physiognomy is no idle or doubtful science in connection with geology. The physiognomy of a country indicates almost invariably its geological character. There is scarce a rock that does not affect its peculiar form of hill and valley; each has its style of landscape; and as the vegetation of a district depends often on the nature of the underlying deposits, not only are the many outlines regulated by the mineralogy of the formations which they define, but also in many cases the manner in which these outlines are filled up. The colouring of the landscape is well nigh as intimately connected with its Geology as the drawing. The traveller passes through a mountainous region of gneiss, the hills, which, though bulky are shapeless, raise their huge backs so high over the brown dreary moors, which, unvaried by precipice or ravine, stretch away for miles from their feet, that even amid the heats of midsummer the snow gleams in streaks and patches from their summits. And yet so vast is their extent of base, and their tops so truncated, that they seem but half finished hills notwithstanding—hills interdicted somehow in their forming, and the work stopped ere the upper stories had been added." In this same graphic manner does he lead his reader through the varieties of scene presented by the geological features of a district, for the purpose of presenting to his mind's eye, those of the Old Red Sandstone district.

The Old Red Sandstone has also its peculiarities of prospect, which vary according to its formations, and the amount and character of the disturbing and denuding agencies to which these have been exposed. The great antiquity of this deposit is unequivocally indicated by the manner in which we find it capping, far in the interior, in insulated beds and patches, some of the loftiest hills, or, in some instances, wrapping them round, as with a caul, from base to summit. It mixes largely, in the northern districts, with the mountain scenery of the country, and imparts strength and boldness to the outline to every landscape in which it occurs. Its island like patches affect generally a bluff parabolic or conical outline; its loftier hills present rounded dome-like summits, which sink to the placid on the one hand in steep, slightly concave lines, and on the other in lines decidedly convex, and a little less steep. On the sea-coast of Scotland this deposit presents striking peculiarities of outline. The bluff and rounded precipices stand out in vast masses, that affect the mural form, and present few of the minor irregularities of the primary rocks. Here and there a square buttress of huge proportions leans against the front of some low-browed crag, that seems little to need any such support, and casts a length of shadow athwart its face. There opens along the base of the rock a line of rounded shallow caves, or what seem rather the openings of caves not yet dug, and which testify of a period, when the sea stood about thirty feet higher on the coasts than at present.

The higher summits of the formation are well nigh as bare as those of the primary rocks; and except when covered with diluvium, it seems little friendly to vegetation.

With these extracts, we will take our leave of a volume, the perusal of which has given us more satisfaction than ordinary, and which to say the least of it—and that with more especial reference to its literary merits—proves one of the ablest advocates of geology; we have put it in the hands of many friends, strangers to the beauties of this science, and Mr. Miller's "New walks in an Old Field" have converted their *heathenism*, and added new votaries to the number of the adherents of Geology.

MONTHLY NOTICE.

September 1st. 1842.

The late meeting of the British Association, the report of which we conclude this month, has proved an exception to the general lethargic character which has been attributed to that body, in so far at least as concerns the geological section. The communications, valuable in themselves, have been enhanced in our estimation by the able remarks made by several members of the committee, respecting the light in which we ought to view the generalisations of geologists founded on the present state of our knowledge of the earth's structure; there was a beautiful simplicity yet wholesome truth in Professor Sedgwick's remark that no "*law*" could be said to exist in geological science—so often had phenomena warranted (with every semblance of incontrovertible proof,) the definition of certain geological agencies, which, when least expected, had been disproved by other unforeseen occurrences. Geology having always embraced much speculative knowledge, lays claim to its present exalted station as a branch of science solely on that ground, and as we find that its most ardent followers acknowledge a truth, one which has always been cast in our teeth by those diffident as to the value of the science—we were naturally curious to learn how it was that they ventured to hazard an opinion, which if not well explained, would have afforded an additional reproof in the mouths of the opponents of geology.

Professor Sedgwick implied, according to our own construction of the expressions, nothing more, than that geology should not be *made a science of speculation*, as the data which we now possess, however extensive they may be in point of number and accuracy, have not extended far enough compared with the superficial area of the globe, to warrant any generalizations—or such, to say the least, as should entail dissensions on the part of the naturalists from whom they may emanate and the geological public;—would that the authorities on geological subjects were more matter of fact and less speculative! We have asserted, that the interest of geology is mainly attributable to the scope given to the fancy—much less, then, would we attempt to confine the powers of speculation engrafted in the human mind by deprecating their employment; but Professor Sedgwick has said,—in a public capacity, at a public meeting, and as a public and high authority on the subject, to whom even the leading members of the London Geological Society pay great deference)—*that geology cannot be said to comprise "laws," but is founded upon extensive data, which establish the modus operandi, in this quarter of the globe only*, but which may be opposed to appearances in other parts yet unknown and unexplored.

We have rarely heard such a candid expression as this from a person held in such estimation as an authority upon any one branch of science, and when we heard of its being made use of on this occasion, we were naturally not a little surprised, at the same time as we were greatly pleased—and it would be a source of much gratification to find geologists in general taking Professor Sedgwick's views of the case, before they attempt to speculate as to the extended operations of nature in the transformation of the crust of our earth.

The late meeting of the Association is also interesting from the variety of subjects brought under its notice in the other departments of science of which we treat, and these exhibit far more talent and research than most of those yet submitted at any previously held.

THE EDITOR.

Ammonites Zoologically and Geologically considered.

(Continued from p. 146.)

CHAPTER II.

§ 1. *Critical examination of the number of species amongst the Ammonites.*

By uniting all the names given by authors of all countries to the Ammonites of the cretaceous formations hitherto described, I find that prior to the present work 78 species were known. Of this number, *nine* only (*A. Goodhalli*, Sow., *Concinnus*, *trisulcosus*, *Hiatrix*, Phill., *Stobæi*, Nilson., *vertebralis*, Sow., *cinctus*, Mantell, and *Polyopus*, Dujardin), are unknown to me, either from not having been able to obtain specimens, their not being found in France, or lastly that they have been too imperfectly figured to enable me to recognise them. I have thus been able to examine comparatively *sixty-nine* species of Ammonites noticed or described from the cretaceous formations. On subjecting these species to a severe revision: 1st as to the synonymes, to correct the double use of different names given to the same Ammonite; 2nd as to the differences caused by the preservation of individuals with or without a shell; 3rd as to the enormous differences caused by age or sex, which I have pointed out in the former chapter, I am satisfied that out of the number of 69, *thirty-eight* species, or more than one half, are merely nominal or simple varieties of the others; and when my analysis was terminated, there only remained *thirty-one* distinct species out of the 69 which I have had opportunities of personally examining.

Had I but found these 31 species in France, it would have been considerable as regards the Ammonites known elsewhere; but an appeal to the parties in France, who occupy themselves with geology or interest themselves in the advancement of the science, has always found them ready to forward my labours; and thanks to their valuable communications, collections from every part of France, added to those in my cabinet which I have myself procured, in the researches I have made for that purpose, for more than seven years, have placed at my disposal the most complete collection that can possibly be procured to illustrate a single point, whether of individual species, or of specimens of each of the latter, the only means of rigourously restricting their limits. Far from having but 31 species of Ammonites I find myself in the possession of the immense number of *one hundred and forty-four* species from the cretaceous formations, of which *one hundred and thirteen* were unknown prior to my work. I have at this moment the lively satisfaction of proving that France, so little known as regards its fossils, and only small portions of which had been partially studied in this point of view; that France, I say, in this respect, proves itself one of the richest fields in the world, when taken on the whole, and does not yield before any of the numerous difficulties presented by this method of studying it.

The great number of species of Ammonites in France is not, in my opinion, of purely numerical interest. I hold it of little consequence to describe some hundreds more or less of new species; but, as my chief aim is the application of zoology to geology, the more the number increases, the more the value of the materials for the application augments, by furnishing me, both with a larger number of species for each formation, and also with a greater number of identical forms which may serve for the determination of the formations themselves. In fact, after having studied the species of Ammonites in this point of view, after having compared all the other fossils which are always found with certain Ammonites, after having personally verified in the north, south, west and east of France, the superposition of the inclosing strata, and the order of succession of the same strata I am able, without noticing the colour or the argillaceous or siliceous nature of the rocks, to determine without doubt by means of the Ammonites and the other animals preserved with them: 1st that there has been evidently *three grand geological periods*, entirely separate and distinct, in the cretaceous formation; and 2ndly that each of these periods had a separate and well characterised Fauna, especially amongst the Ammonites found in each.

§ 2. *Division of the cretaceous formation into three distinct groups.*

To understand the generalisations which follow, I have thought it advisable to explain the three grand divisions of the cretaceous formation, such as I conceive them to be, with their synonymes in different authors and languages.

1st Group. NÉOCOMIEN.—This is the *Terrain crétacé inférieur* of M. Élie de Beaumont; the *Terrain Néocomien* of M. Montmollin and the *groupe inférieur* of M. d'Archiac.* I divide it into two series of deposits.

The LOWER NÉOCOMIEN, comprising the *limestones, clay à spatangues* and *blue marls*† of Haute Marne, Saint Dizier and Wassy; the equivalent limestones of Vendeuvre, Marolle (Aube) and Neuchâtel (Switzerland); the limestones and marles of Girondas (Vaucluse), Saint Julien (Hautes-Alpes), Escragnolle, Lattes, Caussols (Var), Lagne, Castellane, Cheiron, Sisteron, Robion, Barême, Leons (Basses-Alpes), Cassis (Bouches-du-Rhône), &c. &c.

UPPER NEOCOMIEN, comprising the upper marls of Cassis (Bouches du Rhône), Vergons (Basses-Alpes) and Gargas (Vaucluse); the *clays with oysters and plicatulæ*,

* Perhaps the weald or weald clay may form a portion of the Néocomien.

† These deposits have been described by M. Carnuel de Wassy.

argiles ostréennes and *argiles à plicatules*, of Bailly-aux-Forges, Wassy (Haute Marne), which we find also at Villeneuve, between Erve and Marolle (Aube), and in the environs of Auxerre (Yonne). The *lower green sand* of Mr. Fitton ought to be placed in this group.

2nd Group. GAULT.—*Glauconie sableuse* of M. Brongniart, the *grés vert inférieur* and *gault* of the French, the *blue clay, blue marl, gault* and *galt* of Mr. Smith, the *lower green sand* of the English, *grüner Sandstein* of M. Boué. This is the *groupe moyen* of M. d'Archiac. I also divide it into two series of deposits.

The LOWER GAULT, comprising the clay of Wissaut (Pas-de-Calais), the sandstones of Machéroménil (Ardennes), Varennes (Meuse), Copt-Point, Remgeuer and of Lyme-Regis and Ridge (England).

The UPPER GAULT, comprising the clays of Gaty, Maurepaire, Ervy, &c. (Aube), of Valcourt, Droyes, Montier-en-Der (Haute-Marne), Saint Florentin (Yonne), Sénéfontaine (Oise), the green sands of the Perte du Rhône (Ain), Cap la Rève (Seine-Inférieure), the green sands of Escragnolle (Var), the black rocks of the Mountain of Fis (Savoy), &c.

3rd Group. CHLORITIC CHALK.—Glauconie crayeuse of M. Brongniart, the *grés vert supérieur, craie tufau, craie blanche* and *craie supérieure* of the French, the *upper green sand, chalk marl* and *chalk* of the English, and the *Chloritische Kreide* of the Germans.

LOWER OR CHLORITE CHALK. I comprise in this the upper green sand, the tufaceous chalk of Cape Gris-nez (Pas-de-Calais), of Rouen and Havre (Seine Inférieure), the green sand of Honfleur (Calvados), the chalk à baculites of Valogne (Manche), the tufaceous chalks and green sands of Sarthe and the banks of the Loire, the green sands of Uchaux (Vaucluse), Auxon, Laubrecel (Aube), Montblainoille (Meuse), Malle d'Escragnolle (Var), Vergons, Barème (Basses

Alpes), Cassis, Ciotat and Cadières (Bouches du Rhône), and the chalks and green sands of the basin of the Pyrenees, &c.

Upper Chalk. The *white chalk* of Paris and the whole of the Parisian basin, the upper chalks of Tours, Flêche and Vendôme, in the basin of the Loire; the chalk of Maestricht, Ciply, &c. This latter series of the cretaceous formation does not appear to contain any Ammonites.

(*To be continued.*)

PROCEEDINGS OF SOCIETIES.

THE BRITISH ASSOCIATION.

(Conclusion.)

Notice on the distinction between the Striated Surface of Rocks and Parallel undulations, dependant on the original structure, by R. I. Murchison, Esq.

Mr. Murchison called attention to a paper just published and sent to him by the Author, Mr. M'Laren, "On the Striated Rocks of the Corstorphine Hills, near Edinburgh;" his object, in so doing, being to urge geologists to distinguish between appearances caused by *mechanical action*, and those resulting from structure. The existence of abraded surfaces of rocks in these hills was, he stated, pointed out long ago by Sir J. Hall; but when they were inspected by himself in 1840, in company with Mr. M'Laren and Dr. Buckland, the surfaces which he then saw were marked by sets of many parallel grooves or undulations (precisely similar to the casts sent formerly to the Museum of the Geological Society of London), which appeared to him to belong to a class of phenomena distinct from the *striated* surfaces, so common around Edinburgh, and in many parts of Scotland. This opinion was confirmed by discovering in the newly quarried body of the same rock of the Corstorphine Hills, and at various levels, undulations, and grooves precisely similar to those on the surface, which were then shown to belong to original structure. He (the President) was opposed to the terrestial glacier theory of Agassiz, as applied by that naturalist, and Dr. Buckland, to the low countries of Scotland, over which they contended that *glaciers* had advanced which had scored all the rocks, and on melting had left *moraines* of gravel and sand. He believed that, whilst floating ice-bergs most probably produced the striated surface, the wavy undulations are unequivocally due to the original structure of the rock.

Dr. Buckland stated, that he had examined the valleys of Snowdon subsequently to Mr. Bowman's visit to that district, and had observed phenomena which he considered to afford decided confirmation of the glacial theory.

Sir H. T. De la Beche observed, that the views advanced by the advocates of the glacial theory were probably true to a certain extent, as when applied to Wales and Cumberland, but if extended further, they only would lead to physical impossibilities.

Professor Johnston made a brief verbal summary of the second part of his Report on Chemical Geology.

In this communication, which was confined to the igneous rocks, there were three principal points to which the author wished to direct attention, the nature and chemical composition of these rocks, their immediate source, and the effects they produced upon other rocks. He stated, that all geologists were now agreed that these rocks had been originally in a state of fusion, and portruded from the earth in a liquid form; this had taken place in several different ways: sometimes they appeared as if forced up through the stratified rocks, and remaining amongst them at various angles; at other times they overlay the stratified rocks, or were found alternating with them. He then pointed out different modes in which the igneous rocks affected the beds with which they were associated, and stated that he agreed with Mr. Lyell in considering, that where two beds are differently affected by such contact, it was owing to differences in their chemical constitution. The phenomena of volcanic eruptions he attributed to the chemical action of certain substances existing in the interior of the earth, either amongst themselves, or by coming in contact with water.

Sir H. De la Beche stated, that in the Silurian region there was decided evidence of eruptions corresponding to the volcanic action of the present day; there were beds of volcanic ash of the same chemical composition as trap, and, when consolidated, undistinguishable from greenstone, but containing organic remains; and these deposits occurred in the series mingled with solid igneous rocks, and were evidently the result of the same general cause. He, therefore, contended that modern volcanic action, as it was termed, was not confined to recent periods.

Dr. Buckland was gratified to observe the steady advancement of the opinions founded by Hutton, and remarked as an act of justice, that Dr. M'Culloch was the first to entertain those views as to the origin of gneiss, mica slate, &c. which regarded them as rocks altered more or less by heat, up to the extreme amount of alteration nearest fusion.

Prof. Owen's Report on Fossil Mammalia.

The first part of the Report communicated by Prof. Owen, included the fossil Quadrumana, Cheiroptera, Insectivora, Carnivora, Rodentia, Marsupialia, and Cetacea of Great Britain. This enunciation alone made known the Professor remarked, the surprising fact, that one order of mammalia, the Marsupial, had now totally disappeared from the Old World, and a second order, recognised as European only, by the few monkies which breed on the rock of Gibraltar, had formerly representatives in the land now constituting the British islands. The existence of a species of Macacus has been determined by Prof. Owen, from fossil teeth and fragments of jaw discovered in a stratum of the Eocene tertiary period, at Kyson, near Woodbridge, Suffolk. The anatomical characters and comparisons by which this very remarkable fact was established, were given in detail. The evidence was stated to be as complete as that which had proved the existence of another quadrumanous species, a long-armed ape, in a contemporary formation in the south of France. The most generally interesting and remarkable fossils described in the present part of the Report, were those of the large carniverous quadrupeds, as the bear, tiger, leopard, and hyena. With respect to the genus Ursus, Prof. Owen commented on the difference which England presented, as compared with continental Europe, in the number of fossil bones of bears in diluvial caverns and drift. These, which are so abundant on the continent, are very rare in England, where, on the other hand, the remains of the hyena predominate, which are very rare fossils in the German bone caves. He thought it worthy of consideration how far this difference in the geographical distribution of the two genera, at the ante-diluvial, or ante-glacial epoch, indicated the insular separation of Great Britain at that period. The richest depository of bears' bones at present known in England, is the cave called Kent's Hole, near Torquay. The oldest depository of ursine fossils in England, was stated to be the tertiary red craig, below the so-called mammaliferous crag; the locality named was Woodbridge. After enumerating the several caverns and other localities, in which the remains of a large species of the hyena have been found, Prof. Owen next entered upon the question of its character and affinities to the known existing species. The ancient British cave hyena more closely resembles the *Hyæna crocuta* of South Africa, than the *Hyæna vulgaris* of North Africa and Asia Minor. The numbers of the *Hyæna spelæa* in

England may be conceived, when the remains of not fewer than from 200 to 300 have been discovered in a single cavern as that at Kirby Moorside. Fossil hyenas have been shown by Dr. Buckland to be found in this country, as on the continent, in situations of two kinds, viz. caverns and drift, or the so-called diluvial gravel. In the latter formation, they were first discovered in England in the year 1822, at Lawford, near Rugby, associated with the bones of the mammoth, rhinoceros, equus, bos, &c. The remains of a feline animal, surpassing in size the largest lion or tiger, have been found in the bone caves of Mendip Hills, and those of Oreston, at Kirby Moorside, and in Kent's Hole. Of this remarkable species, to which the name of *Felis spelæa* has been given, most of the characteristic bones have been discovered in the caves at Gailenreuth, proving its true feline structure. Order Cetaceæ: most of the remains of this order of mammalia have been in Great Britain found in gravel beds adjacent to estuaries, or large rivers, in marine drift, or diluvium, and in the subjacent clay beds; but although these depositories are the most superficial, and belong to the most recent periods in geology, the situation of the cetaceous fossils generally indicates a gain of dry land from the sea. Thus the skeleton of a balænoptera, seventy two feet in length, found embedded in clay, on the banks of the Forth, was more than twenty feet above the reach of the highest tide. Several bones of a whale discovered at Dunure Rock, Stirlingshire, in brick earth, were nearly forty feet above the present level of the sea. The vertebræ of a whale, discovered by Mr. Richardson in the yellow marl, or brick earth of Herne Bay, in Kent, were situated ten feet above the occasional reach of the sea on that coast. A large vertebræ of *Balæna mysticetus* was discovered fifteen feet below the surface, in gravel, by the workmen employed in digging the foundation for the new Temple Church. The tooth of a cachalot has been discovered by Mr. Brown, in the diluvium of Essex. Many analogous localities were cited, from which cetaceous remains had been obtained of the genera Balæna, Balænoptera, Physeter, Delphinus, Monodon, and Phocæna. Order Marsupialia: In the eocene sand, underlying the London clay, at Kyson, near Woodbridge, Sussex, a small portion of jaw, with a spurious molar tooth was found. This had been referred to the oppossum (Didelphys); but Prof. Owen, to whom the specimen had been submitted, by Mr. Lyell, considered that the evidence it afforded was insufficient to establish the conclusion, although the resemblance was sufficiently close, to render its accuracy probable. Additional specimens were required to demonstrate the existence of a Didelphys in British eocene formations as satisfactorily as had been done by Cuvier, in regard to the small oppossum from the contemporary strata in France. In conclusion, Prof. Owen dwelt on the interesting correspondence between other organic remains of the British oolite, and existing forms now confined to the Australian continent and neighbouring seas. There the Cestracion swims, which has given the key to the nature of the " palates" from the oolite now known as teeth of congeneric gigantic forms of cartilaginous fishes (Acrodus, Psammodus, &c.) Living Trigoniæ and Terebratulæ abound in the Australian seas, and afford food to the Cestracion, as their extinct analogues probably did to the Acrodi, &c. Araucariæ and cycadeous plants flourish on the Australian continent where marsupial quadrupeds abound, and thus appear to complete a picture of an ancient condition of the earth's surface, which has been superseded in our hemisphere by other strata, and a higher type of mammiferous organization. The second and concluding part of the Report on British Fossil Mammalia, it was stated, would contain an account of the fossil herbivorous, or ungulate, species of mammalia, many of which constituted the prey of the lions, bears, hyenas, wolves, &c., which co-existed in Great Britain, with gigantic deer and oxen, rhinoceroses, hippopotamuses, elephants, and, still stranger pachyderms, in the antediluvial and tertiary periods.

On the Action of the North American Lakes, by Mr. Schoolcraft.

Mr. Schoolcraft's observations on the American lakes were made during a residence of nearly twenty years in that district, chiefly in the immediate vicinity of Lake Superior, and he was thus enabled to devote particular attention to the action of the lakes on their boundaries, under fluctuations of level, by which they have been either considerably enlarged, or otherwise modified. In this respect Lake Superior, perhaps, affords more scope for observation than any other; its large area and great computed depth, serve more fully to develope the action of its waves upon the sandstone rocks which surround its southern margin. This is nowhere better shown than along the twelve miles of mural coast locally known as the *pictured rock;* the force of the waves, impelled by the equinoctial gales, has fretted and riddled these rocks into the most singular architectural forms; colossal caverns, into which large boats can enter, are formed under the impending rock. Along this coast of winding bays and headlands, extending altogether 450 miles, the action of heavy currents has broken and comminuted the sandstone and greywacke, piling up the sand thus formed into elevated ridges, or spreading it out over wide plains. The most extensive field of action occurs between the eastward termination of the primary rocks, near Granite Point, and their reappearance in the elevated mountainous range of Gros Cape, at the head of St. Mary's Straits. Vast hills, or *dunes* of sand, 300 feet in height, are formed along this line, and present a very remarkable appearance, from their perfect aridity, their elevation above the lake, and the generally uniform level of their summits; they appear to rest upon more compact beds of clay and gravel, and have evidently been washed up by the waves and driven landward by the wind. Tempests of sand are thus formed, which spread inland, burying the tallest trees, and carrying desolation in their track. The same wind and wave action is described by the author as taking place on some parts of the coasts of Huron and Michigan; *dunes* are first formed, and then spread inland, bearing sterility over thousands of acres, formerly fertile and well wooded. Another effect produced by this drifted sand, is to occasion the formation of pools and morasses along its shifting boundary line, thus injuring other large tracks of country. The recent date of this formation is often shown by buried trees and freshwater shells found at great depths in excavating, or exposed by irruptions of the waves. M. Schoolcraft describes other arenaceous deposits forming broad sandy belts, bordering the lakes, and supporting a light growth of pines, poplar and birch; these he considers due to a similar action, at an earlier period, when the water of the lakes stood at a higher level and occupied a wider area, a condition which is further indicated by the occurrence of wide lacustrine deposits in the same neighbourhood. On the shores of the lakes there sometimes occurs a deposit of iron sand, often a foot in thickness, formed from the magnetic oxide of iron, which exists abundantly in the sandstones, and is set free by the action of the waves in comminuting the rocks.

Mr. Philips referred to similar accounts, given by Lieut. Nelson, of the influence of the wind in the Bermudas, in transporting sand, shells, and corals inland; he considered it highly probable, that many of the beds of new red sandstone, overlying those in which the cheirotherium footsteps were found, and to which they owed their preservation, were due to drifting by wind.

On the Great Lancashire Coal Field, by Mr. E. W. Binney.

The Lancashire Coal Field commences with the lower millstone girt, and extends upwards into the limestone of Ardwick, near Manchester, now generally considered the highest portion of the coal measures, hitherto observed in England. The author divides this series into three groups in descending order.

1. *The Manchester Coal Field,* containing the limestone of Ardwick, and the isolated coal measures of Clayton and Bradford, near Manchester, occupying the low tract of country adjoining the new red sandstone plains.

2. *The middle field,* comprising the thick coal seams of Poynton, Ashton, Middleton, Worsley, Wigan, &c., occupying the rising ground between the new red sandstone plains, and the higher parts of the country, and containing the richest portion of the field.

3. *The lower coal-seams,* found in the elevated parts of the country, along the sides of the Penine chain, and the moorlands of the northern parts of Lancashire; comprising those of Whaley Bridge, Mellor, Glossop, Rochdale, Todmorden, Colne, Blackburn, Chorley, &c. Seams of no great thickness, but valuable from their quality and position, and remarkable from their adjoining shales containing remains of the genera Pecten, Goniatites, Posidonia, and other shells of marine origin. The total thickness of the deposits varies in different parts of the field; in a line from Manchester through Ashton, to the limestone shales of Hollins Brook, the thickness is about 2000 yards; and there are 75 beds of coal exceeding one foot in thickness, forming altogether 150 feet. In a line

through Worsley, Bury, Burnley, &c. to the limestone shales of Pendlehill, there are 36 seams, only ten of which are less than one foot in thickness, amounting to 93 feet of coal; in these sections the smaller seams are not taken into account.

I. *Roofs*. The deposits forming the roofs vary in different places, even over the same seam. There are four kinds of roofs.

1. A fine mixture of alumina and silica, with oxide of iron, and a trace of the carbonates of iron and lime; these are generally known as *blue binds*, and are of most frequent occurrence; they almost always contain ferns, and remains of Stigmaria, Sigillaria, Ulodendron and Lepidodendron, and beds of the Unio and other shells. The Sigillariæ are by far the most common; at Pendleton and Dixon-fold they occur as abundantly as they could possibly have grown: the author had observed three specimens at Pendleton, 24 feet high, and about 3 feet in circumference, standing in a shaft 11 feet in diameter.

2. *Roofs of Sandstone* are not common, and where they do occur the coal is generally inferior in quality; the fossils found in the sandstone are usually prostrate coal plants, Stigmariæ, &c.

3. *Black shale roofs* are frequent, and cover most of the best house-fire and caking coal; they seldom contain plants, though, in a few instances, upright Sigillariæ have been found. Bivalve shells, detached scales and teeth of fish frequently occur in them, and with the *Microconchus carbonasius* and casts of Cyprides sometimes constitute nearly the entire mass; almost all the black shale roofs of the lower field teem with remains of Pecten, Goniatites, Posidonia, and remains of fishes.

4. *Shales with highly bituminous schists*, forming roofs, are not of frequent occurrence; they are found at Peel and Pendleton, and contain abundant remains of fish, mostly

entire. At Bradford and at Ardwick, in the roof of thin coal intercalated with the limestones, the detached teeth, bones and scales of fish occur, mingled with countless myriads of the remains of Cypris and Microconchus.

II. *Coal and Cannel Seams.* The author describes two varieties of coal, the *cubical* where the cross cleavage runs at right angles to the main cleavage, and the *rhomboidal* where it makes an acute angle; the first form generally occurs in the upper and lower portions of the field, the latter prevails in the middle. The main cleaveage, he observes, is, in most cases, parallel with the principal fault in the vicinity. The beds of *cannel* are generally found on the top of the coal, and nearly always contain remains of fishes, often bivalve shells, but hitherto have exhibited no trace of Microconchus, and rarely any leaves or stems of plants, whilst the upper portion of *coal* seams frequently exhibit traces of Sigillariæ, Lepidodendra, Calamites, &c. The coal seams are either simple, and continue undivided over large tracts of country or split and divide into several distinct seams; the former generally occur in the lower portion of the field, the latter in the middle and upper part. Independently of the tendency to divide, many seams diminish in thickness till they become evanescent; this is chiefly observable in the lower division of the coal-field, and in the simple seams six beds which have been worked in that series, give decisive evidence of this fact. The best examples are the *caking coal* of Rochdale and the *Foot mines,* beds known by various names in different parts of the country, but easily identified by the remarkable nature of their floor, which is a hard crystalline stone, called *Gannister,* full of *Stigmaria ficoides,* and employed as a material for mending roads. At Dulesgate, near Todmorden, the upper or "Gannister coal" is 5 feet 8 inches in thickness, and the Foot coal, about 12 yards below it, is 7 inches thick; the author has traced these seams about 11 miles to Quarlton, and ascertained that the Gannister coal gradually diminishes in thickness to *one inch*, while the Foot coal increases to *two feet*, the floors retaining the same character throughout.

III. *Coal Floors*. The stratum on which the coal rests is always carefully noticed by practical miners, who believe that where a thin seam is found on a thick argillaceous floor full of Stigmariæ, it is certain to become workable if followed. The floors are of three kinds—the *fire clay*, which is the most abundant; the *warrant*, a clay mixed with a larger amount of silica occurring frequently; and the *rock* floors, of which but two instances are known, namely, the floor of the Featheredge coal at Walmersley, which is a rough quartzose sandstone, and the Gannister, before noticed. The latter is merely a fine grained admixture of silica and alumina, varying from 8 inches to 2 feet in thickness, always graduating into a fine fire clay at its bottom. All the floors, with the exception of the rock floor of the Featheredge coal, contain *Stigmaria ficoides*, from the thin seams of the Ardwick limestone, to the two seams in the millstone grit of Gauxholme, near Todmorden, a thickness of nearly 1600 yards; all the fifteen floors of the Manchester coal-field contain it, and at least 69 beds in the middle and lower divisions. The Stigmaria generally occurs with its leaves attached, and in all instances of *true floors* without any intermixture of other plants. These facts seem to indicate that all the deposits were formed under nearly similar conditions; the roofs and floors were evidently very quietly deposited, and formed a strong clay, well adapted for the growth of the vast masses of vegetable matter required for the formation of the coal seams. The absence of alkalies in the clay of the floors, might be expected from the exhausting properties of plants, and seems to strengthen the supposition that these beds supported the vegetation which now constitutes the coal. The remains of bivalve shells and fishes in the *cannel* beds, prove that they were formed under water; but in the Lancashire coal-field, no remains of fishes or shells have yet been found in the *coal*, nor is there any indication, either by admixture of sand or silt in the seams of coal, to show that they were drifted into the places they now occupy by rapid currents of water. The occurrence of forests of large trees standing upright on the seams, the pure vegetable matter composing the coal itself, with scarce any admixture of foreign ingredients, the position of the coal upon a rich alluvial deposit well adapted to sustain a luxuriant vegetable, seem to prove that, in most instances, the vegetation matter forming it, grew upon the spot where the coal is now found; whilst the splitting and alterations in the thickness of the seams themselves, show that the surface was most probably subject to frequent subsidences.

Dr. Buckland remarked, that the observations of the late Mr. J. E. Bowman, Mr. Logan and Mr. Binney, had obliged geologists to modify their opinions. He now believed that the greater part of the coal-measures had been formed from the Lacustrine deposits, whilst certain portions were still to be considered of marine origin, and probably drifted into estuaries and embouchures of rivers, and interstratified with terrestrial and fluviatile remains.

Sir H. T. De la Beche observed, that the under clay had been found retaining the same characters in Glamorganshire, in the neighbourhood of Bristol, in Yorkshire, in Scotland and Ireland, and Mr. Logan had discovered it as constantly in the coal-fields of Pennsylvania and Nova Scotia; and he thought some common cause ought surely to be assigned to phenomena so widely diffused. That the coal itself was of vegetable origin there could be no doubt, and the researches of Liebig had shown that such a change might be effected chemically under certain conditions. With respect to the subsidences supposed to have attended the formation of coal, he considered such occurrences to have been frequent up to a very later period; submarine forests composed of standing and prostrate trees were common, and he described one in the bay of Swansea, where the fundamental rock was covered with clay and peat, and above were the trunks of trees, standing as they grew, with their roots in the peat;

the land must have been depressed, and then the deposit became covered over, in some places, with drifted mud and sand and gravel, so as to represent precisely the circumstances under which the trees were found at Bolton. If similar submergences took place in tropic seas, coral reefs would form over the peat and trees, and thus account for the occurrence of limestone, as well as sandstone, shale and conglomerate, over the coal. The formation of coal might be accounted for in various ways, and there could be no doubt that drifted materials did form thin beds of coal under precisely the same conditions, the vegetables being drifted so unmixed with detrital matter, as to form a purely vegetable deposit; but under coal seams thus formed, there were no under clays with Stigmariæ. He, therefore, regarded the question of drift only as one of *amount:* if the drift of vegetable matter was large, a bed of coal might result; but he had never seen a *workable* coal bed which did not bear out Mr. Binney's conclusions.

Mr. Philips remarked, that in the Lancashire coal-field there were only about eighty-five beds of coal associated with a thousand beds of sandstone and shale, which had been unquestionably drifted by water, but whether in a river, estuary, or deeper water, there were no data to determine. The evidence derived from the occurrence of trees *in situ* at St. Etienne, as originally adduced by Brongniart, was not very conclusive, from the various positions of the trees, and their fragmentary aspect; but this argument derived great confirmation from the trees at Dixonfield, which were all at right angles to the plane of the coal-bed on which they rested: a position in which drifting by water could not be expected to place trees of different species, and possessing roots with different structure, with so much regularity. It had occurred to him that the abundance of cones at the base of the trees was also opposed to the idea of drifting, as it would require different forces of water to drift large trees and cones. The third class of phenomena was the occurrence of shells and fishes, associated with and forming extensive layers over the coal seams; many of these shells were analogous to those living at the present day in fresh waters; the upper strata especially appeared to be of fresh water origin. From all these facts, Mr. Philips stated, a certain limited inference might be drawn; but he thought it was far more important to establish a strict and logical process of reasoning, to be employed in future investigations, than to arrive at any positive conclusion in the present case.

Mr. Sedgwick admitted, that the occurrence of trees *in situ* had been distinctly proved, and also the high probability of much of the coal having been formed on the spot; this view, he stated, was not a new one, it had been contended for by all the Scotch geologists; Dr. Macculloch had supported it, and one Professor had even attempted to estimate the period required for the formation of a seam of coal, by the time occupied in forming a peat bog.

Mr. Griffith illustrated the mode in which he considered the coal measures had been formed, by describing the general condition of the peat bogs in Ireland; they appeared to occupy basins which had originally been lakes, but the peat moss had grown up to the level of the water, and afterwards by capillarity twenty or thirty feet higher. The base of these bogs consisted of clay, covered by a layer of peat composed of rushes and flags, above which was another bed of peat closely resembling cannel coal, possessing a conchoidal fracture, and hard enough to be worked into snuff-boxes; it yielded twenty-five per cent of ashes, and contained a large proportion of oxide of iron. This bed was covered with black peat, containing branches and twigs of fir, oak, yew and hazel, only the bark being left; and where whole trees occurred, the roots were entirely gone; the surface was formed of ordinary bog-moss (*Sphagnum*) nearly white. The whole amount of peat, in this bog, Mr. Griffith thought would form a coal seam at least three or four feet thick. Mr. Griffith also mentioned some of the tertiary lignites of the basaltic region in the north of Ireland, which exhibited a variation in thickness of from three to thirty feet, in the space of a hundred yards. At Lough Neagh these tertiary formations attained a thickness of ninety-eight yards, composed of alternations of wood, coal, clay and sand.

Dr. Fleming observed, that in attempting to explain any class of phenomena, it would be well to begin with the distinct and end with the obscure; with this view, he recommended inquiries to be instituted into the present character of peat, which presented many analogies to coal, and, like it, was of several different kinds, and found under various circumstances. He then described a bed of submarine peat off the Shetland islands, resting on and covered by gravel; a lake had been formed within a barrier of sand and gravel thrown up by the sea, and rendered impermeable to water by a lining of mud brought down by rivulets; this basin had been filled up by the growth of plants, and subsequently the sea had again reduced the barrier, and covered the whole with gravel and shells. In the bay of Aberdeen, after very severe storms, large masses of solid peat were thrown ashore, not unlike cannel coal in hardness and fracture. This deposit seemed to have been formed by the vegetable matter carried down by the Dee and Don, constituting a marine coal formation, in which the leaves of the oak and thorn were found, mixed with Sertulariæ and marine productions.

The Marquis of Northampton remarked the importance of studying causes now in action, with the view to determine the origin of ancient phenomena; and he expressed a hope that Dr. Fleming would make a full and detailed report on the structure and formation of peat at the next meeting of the Association.

On the Remains of Insects in the Lias of Gloucestershire, by the Rev. P. B. Brodie.

The President read a letter from Mr. Brodie, stating that his former discovery of insects in the Wealden formation of Sussex had led him to close investigation of the strata in the neighbourhood of Cheltenham, where such fossils were comparatively of great rarity, having hitherto been found only once in the lias. The remains detected by Mr. Brodie consisted of the elytra of one or more genera of Coleoptera, one or two minute beetles, and a few wings resembling those of the Libellulæ. They were generally of small size, the largest elytra being little more than half an inch long, and the largest wing about an inch in length. The beds in which they occur consist of thin courses of blue, green, and white limestone, forming some of the lower beds of the lias formation, so extensively developed in the vicinity of Cheltenham and Gloucester.

Mr. H. E. Strickland mentioned a wing of a Libellula twice the size of the largest British species, found in the lias of Hatherleigh, near Gloucester. The remains of insects probably indicated shallow water, and the proximity of land.

On the occurrence of Boulders in the valley of the Calder, by Mr. J. Travis Clay.

The author describes the valley of the Calder as a narrow, and almost always level tract of land, bounded on both sides by upright hills of the regular coal strata, and destitute of boulders. The level of the valley is composed, near the surface, of sand, clay, and small pebbles; but at the depth of five feet there is a bed of much larger boulders, chiefly derived from the neighbouring rocks, and also many of granite. The peculiarity of the deposit consists in its being confined to this narrow stripe, frequently not a quarter of a mile in width, yet extending continuously east and west for many miles; the author had traced it from Hebden Bridge, near Halifax, to Wakefield, a distance of twenty miles, and he had no doubt it extends further east, till it unites with the great mass of drift occupying the vale of York. The author considers this deposit to have originated when the elevation of the land was much less, in which case the level parts of the country would be submerged, and the narrow dales of Yorkshire sea-lochs, like those of Scotland, along which glaciers detached from the Cumbrian mountain would be floated in every direction.

Mr. Philips remarked, that the granite of these boulders resembled that of Ravenglass, and not the granite of Shap Fell; the others were common Cumberland and Westmoreland rocks, the metamorphic rocks of Hart Knot, and some belonged to the gadnister of the coal. He considered these phenomena as belonging to the same class with the dispersion of the rocks in the neighbourhood of Manchester.

On the occurrence of Vegetable Remains in the new Red Sandstone of Staffordshire, by Mr. J. Dawes.

The strata in which these remains occur, were exposed in forming a canal between Birmingham and the collieries near

Tipton, through Gravelly Hill, Perry, and Great Barr. At the latter place, the author states, Silurian limestone has been found close to the surface, with traces of carboniferous rocks and coal, dipping under the new red sandstone on the Birmingham side of the axis; thus affording evidence in favour of the recently expressed opinion, that the South Staffordshire coal field extends under that town.

Notice of the Fossil Footsteps in the new Red Sandstone quarry at Lymm, in Cheshire, by Mr. Hawkshaw.

The quarry in which these footsteps were detected was situate at a short distance to the east of Lymm, south of the turnpike road to Altringham; the general dip of the strata was about 5^0 to the S.S.W., and the quarry was near the outcrop of the beds, which consisted of alternations of red and grey sandstone in beds of a few inches thick, grey marls, and laminated shales; the rock underlying these strata was a thick bedded sandstone, deeply impressed with oxide of iron, and very indistinctly stratified. The impressions varied in length from $\frac{1}{2}$ths of an inch to $1\frac{1}{4}$ inch long in some slabs; on others they were 3 or 4 inches in length, and upon one dark red slab was an impression 10 inches long, and of a peculiar form, as if the foot which made it had been furnished with claws. On a slab of 20 inches diameter there were two impressions, a small one preceding one which was $9\frac{1}{2}$ inches in length; another similar footstep was $7\frac{1}{2}$ inches long. Both these last-mentioned footmarks were covered with small papillæ, about 100 to the square inch in the larger specimen, and about 220 in the smaller; their distinct appearance and arrangement were described by Mr. Hawkshaw as suggesting the idea that the feet of the animal which formed them was furnished with a rough skin.

Mr. Murchison observed, that the sandstones at Lymm appeared to belong to that great series which he and Mr. Strickland had referred to the keuper; whilst those described by Mr. Dawes in the previous paper were perhaps to be considered a part of the lower new red, which was now acknowledged to belong to the carboniferous group.

On the stratified and unstratified Volcanic Products of the West of England, by the Rev. David Williams.

This communication was supplementary to that which Mr. Williams made last year at Plymouth. Subsequent investigation, on a far more extended scale, had confirmed him in the results he then announced, viz. that granite, gneiss, mica-schist, porphyry, greenstone, tufaceous ash, breccia, grit, chlorite, talc, and clay slate, were all volcanic products, and that no such distinction as the so called "plutonic rocks" really existed in nature—they were, in short, associated together by evidences of their common origin, and connected together by a series of mutual dependencies, and as such were capable of definite classification, as erupted products, as rocks *in situ*, which have been fused, semi-fused or had been in some other particular stage of fusion, and as rocks simply altered by contact with injected burning lavas.

His object was to reduce the entire family of ancient volcanic products within the scope of recognised laws, and the ordinary operations of nature. He pointed to a diagram he had constructed, of an ideal volcanic centre in a phasis of activity, which, by admitting modifications to a greater or less amount, he submitted might serve as an illustration of the process of fusion and conversion, so far as the rocks of the earth had been submitted to our view, throughout all regions and all times. He supposed an internal nucleus of white incandescent lava, whose outer border was surrounded by a zone of gneiss, the zone of gneiss by an outer concentric zone of mica-schist, and the mica-schist by any sedimentary strata, as the case might be; under certain circumstances, he contended that these strata, and the inner concentric zones of mica-schist, and the gneiss would be invaded by ramifying and anastomising veins emanating from the internal fluid, to an extent proportionate to the temperature; these veins would convert the zone of gneiss into incandescent lava, the mica-schist into gneiss, and a proportionate thickness of the sedimentary strata into mica-schist; and if the *vis à tergo* of heat should be maintained, such transformations would progressively advance till the superincumbent or outermost strata being reduced to their point of least resistance, they would necessarily yield to the pressure or expansive force of the augmenting volume of the liquid matter, and present all the phenomena of a crater of elevation. From the whole amount of his observations, taken round the granite of Dartmoor, Bodmin Moor, &c. he considered that if Von Buch had not proposed the theory of "Elevation Craters," geologists would eventually have been constrained to have recourse to some hypothesis of the kind to explain the appearances presented by those granitic domes. A series of specimens might be gathered from many localities in South Devon and Cornwall, which would show an insensible transition from the coarser volcanic grits and breccias into the finest clay slate, every variety of which he had traced up to those more typical products. Mr. Williams stated, that his inquiries had resulted in the conviction that granite gneiss, mica-schist, clay, slate, &c., are no evidence of age, or position, in the geological scale, but that they appertain to all formations, from the most ancient to the most recent; he considered gneiss and mica-schist were not simply "metamorphic" rocks, but rocks in a particular or definite stage of fusion; and, he therefore, suggested that they should be termed intermediate products, and granite, porphyry, trap, breccia, grit, ash, chlorite, talc, and clay slate, immediate products of volcanic action.

REVIEWS.

First, second and third Reports on the Geological survey of the province of New-Brunswick, by Abraham Gesner, provincial Geologist, 8vo. Saint-John, New-Brunswick, 1839, 1840, 1841.—*Remarks on the Mineralogy and Geology of Nova Scotia, by C. T. Jackson and F. Alger, 4to. Cambridge, U.S.* 1832.

The completion of the official reports on the Geology of New-Brunswick by the issue of the third part of Mr. Gesner's work in the autumn of last year, is a good opportunity for us to enter into a disquisition on the merits of his labours and more especially with reference to their utility and scientific import. We have likewise appended to these works, the notice of another bearing upon a tract not very remote and therefore in a degree connected with the former in point of geological construction.

The object of the geological survey to use the words of the author of these reports, "was the discovery and application of such substances as have been found most important to the interest and support of commerce, agriculture and manufacture," without direct reference to the *science* of Geology; and its connections—in a few words as the summary, "to shew that New-Brunswick not only possesses vast mineral wealth, but also contributes largely to that collection of facts upon which a true theory of the earth can only be founded."

This report extends over the district south and west from the river St.-John to the Bay of Fundy, and the American Boundary line on the St.-Croix, including the British Islands in the Passamaquoddy Bay.

The peninsular of St.-Andrews, which is first noticed, consists of new red-sandstone, covered with clay, gravel, &c.; the general course being the N.E. to the S.W., and the dip at an angle of 15° to S.E. The strata are underlaid in many instances by conglomerate, and the upper portions are generally variegated, and more or less of a marly or slaty texture. Various marine plants, and one especially, closely resembling *Laminaria Saccharina* (kelp) are found in it in the shape of casts. The lower beds contain numerous charred remains of land plants, and from their resemblance to the Sandstones of the coal formation, seemed to indicate the existence of coal; which, however, remains undetermined. Trap dikes, also occur near St.-Andrews.

The general fertility of the soil in this locality is also mentioned and accurate statements given of the situations of the marl beds to which it is mainly attributable, as also of those abounding in peroxide of iron.

Syenite occurs at St.-Stephens, a little further to the west, alternating with Greywacke; a stratum of graphite also occurs, and a medicinal spring, in which sulphuretted hydrogen and sulphate of lime predominate. The character of the islands in Passamaquoddy Bay is precisely similar, the original formations having evidently been the limestone and older members of the sandstone group, which have been much disturbed by the intrusion of innumerable trap dykes, basaltic veins, and greenstone.

Proceeding in a north-easterly direction, and following the line of the coast, trap and greenstone occupy the shore almost exclusively, and thence extend in a northerly direction until replaced by syenite and granite. In many places a slaty texture is observed, and from the abundance of vegetable remains and corallines contained, it is clear that the intrusion, of the former rocks has had a very material influence upon the former geological constituents of the district. Mr. Gesner discovered veins of copper ore in amorphous felspathic rock near the entrance of the Bigdequash, averaging 76 per cent of copper, and increasing in thickness, as they are further removed from the surface. The new red sandstone and conglomerate appear again at Mascarnie head, but are much disturbed by trap dykes. Limestone is found on the shores of l'Etang Harbour, the course of the strata being N.E. and S.W., the dip N.W. at an angle of 80^0; it is also penetrated by numerous veins of greenstone in the direction of the strata.

These same formations prevail throughout the adjacent islands, as well as along the coast to the entrance of the river St.-John.

The section presented on examining the interior, from the mouth of the Magaguadavie to the river Oromocto, includes a succession of the same formations as already detailed, with the addition of shales, which occur on the banks of the north branch of the latter river, and which abound with the remains of plants. Ten miles up this stream there is an outcropping of coal between strata of bituminous shale, the beds increasing in thickness in proportion as they are deeper situated.

Eastward of the head of the Oromocto, the slate appears, and is succeeded occasionally, by the old red sandstone, and carboniferous limestone, dipping beneath that part of the coal-field, which is situated beneath the south side of the St.-John. Thus, it may be said, that the district, the subject of Mr. Gesner's first report contains a series of rocks from the carboniferous limestone to the granite, and seldom, as our author remarks, are the several formations found succeeding each other in the great scale of superposition with that beauty, regularity, and order, which they here display.

The coincident appearances which Mr. Gesner records throughout his first report, establishes the correctness of the supposition, that the rocks forming each lofty peak, were produced by similar causes throughout.

To use the words of our author, "the rocks constituting this range of high lands, are such as are believed by almost every Geologist, to be of volcanic origin; a doubt on this subject cannot remain in the mind of the unprejudiced after their characters are fully examined, and the general appearance of the country where they are situated, is compared with the theatre of volcanoes still in operation.

In the first report our author traces an extensive granitic range from the Chiputnecticook river, to the river St. John, opposite the entrance of Belle-isle Bay. It becomes narrower as it proceeds eastward, and at the latter place the true granite disappears; it is met by an extensive tract of syenite in Charlotte county, and the two become associated in a most irregular manner, passing into each other by intimate relations and proving the identity of the forces excited to produce their eruption.

The syenite proceeds onwards in an easterly direction; forming a remarkable belt across the peninsula of Kingston, between the Belle-isle and Kennebeckasis rivers; it then forms the tract of country in the neighbourhood of Loch-Lomond, until it reaches Shepody mountain where it terminates and is met by rocks of a sedimentary character, its average breadth in this part being about twelve miles, and often it approaches near the coast.

The limestone has been shown to extend from the entrance of the St.-John, eastward, to Hammond river, meeting the syenite, and are there lost. The slate, greywacke, and greywacke slate occupy a considerable portion of the county of Charlotte, and crossing the river St.-John, reappearing to the east of the Harbour, and terminates in an easterly direction near Loch-Lomond. They reach northward to the Kennebeckasis and southward to Emerson's creek. These rocks, judging from the fossils contained, belong to the so called "silurian group."

The greywacke and slates of this group also appear on the coast of the Bay of Fundy, between Great Salmon river, and Salisbury Cove, accompanied by soft argillaceous limestone and serpentine, but wherever they have been found in this part of the province are injected with dikes of trappean rocks, and have suffered much from volcanic causes.

We now proceed to take a cursory view of the coal districts of that division of the province, to which the second report more immediately refers. The first of these was observed to embrace the whole of capes Meranquin and Enrage; but these are small portions of the Cumberland coal-field in Nova-Scotia, and at present require no further consideration. Commencing at Shediac, the coal-field of the county of Westmoreland extends along the eastern shore as far as Tedish river, then running along an irregular line southward it approaches the villages of Sackville and meets the new Red Sandstone near Dorchester islands; a line drawn from "Shediac to the Petitcodiac, about 10 miles below the Bend," will mark its northern side. This tract of country embraces that part of the coal-field which is situated on the east side of the Petticodiac, except a small group of strata, observed near the road leading from Bay Verte to Sackville. The coal-field then becomes more narrow, and crossing the river, maintains an average breadth of ten miles westward, until it reaches Sussex vale; here its extremity is forked; one branch is curved towards the north-west, until it meets the source of Studholm's millstream, the other becomes very narrow and disappears beneath the conglomerate, a few miles westward and southward of Sussex church. About eight miles north of Shepody the coal strata meet the syenite, and cross the sources of Turtle creek, and Coverdale river; at the head of

Pollet river they are overlaid by the New Red Sandstone, and conglomerate. These rocks also meet and conceal the bituminous strata along the whole length of their northern side.

The whole length of this coal-field is upwards of seventy miles; its average breadth, estimating the area on each side of the Petticodiac, is about seventeen miles. The outcropping of the coal has been discovered at a number of places within its borders, and the examinations which have been made, and the facts disclosed by them, will prove of great importance to the province. The remaining part of the country examined in this report, is composed of New Red Sandstone and conglomerate, containing numerous deposits of gypsum, limestone, and rock salt, with mineral springs.

Of the vegetable fossils of this coal-field, our author gives the following summary. Four species of *Syrengodendron* were procured at different situations along the coast, and were of considerable size. *Cactæ* are rare, and the greater quantity are comprised amongst the *Calamites* and *Sigillaria*, with one species of the *Phytolithus* (Steinhauer). With these remarks we will dismiss the notice of the second report, leading the concluding portion of our review and our general opinions until a future number.

MONTHLY NOTICE.

October 1st. 1842.

THE "glacial theory" has, after a lengthened discussion, sunk gradually into the "study of glaciers;" for everywhere we find examinations being conducted as to the nature of ice and its present effects;—if this opinion is not true to the letter, it most decidedly is, in so far as it concerns the prevalent knowledge of the subject.

It might, however, be argued, in contradiction of our remarks, that in order to substantiate the theory, the facts must first be observed and carefully recorded; and for this opposition we are naturally prepared, and with what truth in our defence, the following comments will prove.

When Professor Agassiz first hinted at the effects of glacial action, he brought before the public an elaborate theory as to the extent of their agency in the transformation of the superficial soil by abrasion, transportation, and subsequent diluvial subsidence; he produced arguments tending to demonstrate the existence of numerous important centres of action (vide *Geologist*, vol. i, p. 13), and we should have thought would have continued enlightening the public as to this subject until the theory was substantiated or disproved, or at least until his observations had elicited some decided opinion, which might guide the public on this point, and guard them against the reception of his "extended glacial theory," without a minute criticism on their part previous to so doing. Yet, without first having effected this purpose, we find the "extended glacial theory" mentioned (as *decided*) in all essays on the subject; in fact, Professor Agassiz has gone so far as to lead the public to suppose his views altogether correct, and has, therefore, given cause to the prevalent adoption of his general ideas, disapproved as they are by almost all the leading geologists of the day, who taciturnly regard the innovation, and thus give their apparent assent.

Now let us look to the operations of the Professor himself. We find his extended theory thus publicly adopted, from the guarantee afforded by his own name;—we find him writing on the subject, and stating his ideas with equal certainty at no very distant period, and yet what has become of the theory at this moment, in so far as concerns the light in which it is to be viewed by the student of geology?

We find in letters addressed by him and M. Desor to the Institute of France, and from a friend, an eye-witness of the transactions, that a party have ascended the glacier of the Aar, and encamped at its summit in a small hut, to be henceforth known as the "*Hôtel des Neufchâtelois*," that they have been engaged in boring through the ice, and inserting measured poles in order to ascertain the diminution in size effected by the thawing of the upper stratum; and we learn that this has varied from seven to twelve feet in the course of their short sojourn in those regions. Again we find them boring through the ice, and introducing a coloured liquid into the holes thus made, to test the porosity of the glacier, and M. Desor records the fact that this colouring matter required two hours to pass through a mass of ice twenty feet thick and of great hardness—deducing from this latter fact, that the porosity of the ice affords means for the percolation of waters derived from the surface, which undermine the glacier and contribute to its descent; which latter occurrence they prove by recording the advance of the Hôtel des Neufchâtelois since Sept. 1841, of 207 feet, and between the 11th and 21st July, 1842, of an additional thirteen feet.

These facts may be very serviceable to the developement of natural processes; but whether a glacier is porous or not, is a matter of little moment to the geologist, and Professor Agassiz should have been careful as to how he advanced the subject, ere he first divulged his theory; or, now that he has divulged it, he should not hesitate to correct any erroneous impressions to which his opinions have given rise; for, in our opinion, every new observation or discovery made by him, tends simply to *prove* a comparatively insignificant scene of action; although even its present effects in the abrasion and transportation of blocks of stone are very considerable. We are afraid that the real scientific character of the "glacial expedition" is lost; for we find with these scanty results before the public, there is much lecturing at the summit of the Aar, and the table d'hôte at the Hôtel des Neufchâtelois is by no means despicable—far different from the "scientific" fare of Hugi in his previous ascents.

We shall look anxiously for further results from this expedition, but fear very greatly that we are doomed to be disappointed, from the accounts which we have received from our friends.

THE EDITOR.

Ammonites Zoologically and Geologically considered.

(Continued from p. 281.)

Division of the Ammonites in the separate groups.

Having defined the three groups of the Cretaceous formations, an inquiry as to the number of species of Ammonites which have existed at each epoch, gives the following results:

Néocomien period . . .	75 species.
Gault	42 „
Chalk	27 „

Thus, without noticing forms, I find that the species of Ammonites which are so numerous in the Jurassic formation, are in the Cretaceous formation: 1st. at the maximum of their numerical development, in the Néocomien formations;

2nd. that they have already diminished nearly one half in point of number, in the Gault; 3rd. that they undergo a fresh diminution of one half of the number found in the Gault, at the epoch of the chloritic chalk, and have totally disappeared with the middle beds of the third epoch, when not a single species remains. The race of Ammonites are no longer found in the upper strata of the Cretaceous formation, the white chalks or the upper chalks. The Ammonites have then progressively diminished in number, from the lower to the upper groups of the cretaceous formation.

I shall now proceed to study the species of each group comparatively, and notice the species which are peculiar or common to each.

1st. Group, *Néocomien Formation.*

The 75 species of Ammonites of the Néocomien formation do not all belong to the same geological horizon; and I have little doubt that we shall be able to divide them into distinct stages, by comparing them with the well-defined strata which we observe in the department of the Haute-Marne; but until the analogy of these strata with those which contain Ammonites in Provence and the Alps shall have been determined by attentive observation, I only deem it proper to divide them into the groups of the upper and lower Néocomien.

Species of Ammonites peculiar to the Lower Néocomien.

AMMONITES.	AMMONITES.
Angulicostatus, d'Orb.	*Cassida, Raspail.*
Asperrimus, d'Orb.	*Castellanensis, d'Orb.*
Astierianus, d'Orb.	*Clypeiformis, d'Orb.*
Bidichotamus, Lequerie.	*Compressissimus, d'Orb.*
**Calypso, d'Orb.*(1)	*Cryptoceras, d'Orb.*
Carteron, d'Orb.	*Cultratus, d'Orb.*

(1) The species preceded by an asterisk are those to which I have some doubts of their belonging to the Néocomien formation.

AMMONITES.	AMMONITES.
**Dispar, d'Orb.*	*Morelianus, d'Orb.*
Fascicularis, d'Orb.	*Néocomiensis, d'Orb.*
Didayanus, d'Orb.	*Ophiurus, d'Orb.*
Difficilis, d'Orb.	*Pulchellus, d'Orb.*
Diphyllus, d'Orb.	*Picturatus, d'Orb.*
Gevrilianus, d'Orb.	*Quadrisulcatus, d'Orb.*
Grasianus, d'Orb.	*Radiatus, Bruguières.*
Heliacus, d'Orb.	*Recticostatus, d'Orb.*
Helius, d'Orb.	*Rouyanus, d'Orb.*
Honnoratianus, d'Orb.	*Semistriatus, d'Orb.*
Incertus, d'Orb.	*Semisulcatus, d'Orb.*
Inæqualicostatus, d'Orb.	*Seranonis, d'Orb.*
Infundibulum, d'Orb.	*Simplus, d'Orb.*
Intermedius, d'Orb.	*Sinosus, d'Orb.*
Ixion, d'Orb.	*Subfascicularis, d'Orb.*
Jeannoti, d'Orb.	*Subfimbriatus, d'Orb.*
Juilleti, d'Orb.	*Terverii, d'Orb.*
Leopoldinus, d'Orb.	*Thetys, d'Orb.*
Lepidus, d'Orb.	*Tortisulcatus, d'Orb.*
Ligatus, d'Orb.	*Verrucosus, d'Orb.*
**Macilentus, d'Orb.*	

Species of Ammonites peculiar to the Upper Néocomien.

AMMONITES.	AMMONITES.
Belus, d'Orb.	*Crassicostatus, d'Orb.*
Cesticulatus, Leym.*(2)	*Deshayesi, Leym.**
Consobrinus, d'Orb.	*Dufrénoyi, d'Orb.*
Corunelianus, d'Orb.	*Duvalianus, d'Orb.*

(2) The species followed by an asterisk have been noticed in the text and plates of my "Paléontologie française," as belonging to the gault. I have since perfectly convinced myself, during a journey in the Departments of Aube and Haute-Marne, that they all belong to the upper Néocomien formation, or the epoch of the Ammonites of Garges, near Apt, which, in Provence, is the equivalent to the clay à plicatules of Haute-Marne and Aube.

AMMONITES.	AMMONITES.
Emerici, Raspail.	*Matheroni, d'Orb.*
Flexisulcatus, d'Orb.	*Nisus, d'Orb.*
Gargasensis, d'Orb.	*Pretiosus, d'Orb.*
Guettardi, Raspail.	*Raresculatus, d'Orb.*
Impressus, d'Orb.	*Royerianus, d'Orb.*
Inornatus, d'Orb.	*Striatisulcatus, d'Orb.*
Martinii, d'Orb.	*Strangulatus, d'Orb.*

We find, then, that the Ammonites of the Néocomien formation are divided into two distinct epochs, comprising different species, and that the decrease of the number, which I have appropriated to each group, is apparent even in the epochs themselves, as the upper strata contain considerably fewer species than the lower. At present, I am not acquainted with any species of the Néocomien formation, found simultaneously in the Jurassic formation, and none extends beyond the clay à plicatules, composing the upper portion of the Néocomien formation, to the lower strata of the gault. I have not even found, in any instance, a place where these strata are not perfectly distinct and separated by sands; they always contain their peculiar species; thus, all the species I have named are characteristic of the Néocomien formation.

2nd. Group.—*Gault or lower Greensand.*

The 42 species of Ammonites of the Gault or lower Greensand, may also be divided into two series, the one always appertaining to the lower beds, the other to the upper; but these divisions are much less strongly marked than in the Néocomien formation, as we sometimes find the two series confounded together, which does not appear to be the case in the Néocomien formation. It is true that here the thickness of the strata is never so great, and changes are much more frequent. Whatever it may be, the following are the species divided according to the upper and lower beds.

Species of Ammonites peculiar to the lower beds.

AMMONITES.	AMMONITES.
Archiacianus, d'Orb.	*Milletianus, d'Orb.*
Auritus, Sowerby.	*Mosensis, d'Orb.*
Bicurvatus, Michelin.	*Nodosocostatus, d'Orb.*
Bouchardianus, d'Orb.	*Puzosianus, d'Orb.*
Cristatus, Deluc.	*Quercifolius, d'Orb.*
Denarius, Sow.	*Raulinianus, d'Orb.*
Fissicostatus, Phillips.	*Regularis, Bruguières.*
Fittoni, d'Archiac.	*Splendens, Sow.*
Guersanti, d'Orb.	*Tardefurcatus, Leym.*
Lautus, Sow.	*Tuberculatus, Sow.*
Michelinianus, d'Orb.	

Species of Ammonites peculiar to the upper beds.

AMMONITES.	AMMONITES.
Alpinus, d'Orb.	**Latidorsatus, Mich.*
Beaudanti, Brongniart.	*Lyelli, Leym.*
**Brottianus, d'Orb.*(1)	*Mammillaris, Schlot.*
Camatteanus, d'Orb.	**Mayorianus, d'Orb.*
Clementinus, d'Orb.	*Parandieri, d'Orb.*
Delarnei, d'Orb.	*Roissyanus, d'Orb.*
Dupinianus, d'Orb.	*Senequierianus, d'Orb.*
Hugardianus, d'Orb.	*Varicosus, Sow.*
**Inflatus, Sow.*	*Velledæ, Mich.*
Interruptus, Bruguières.	*Versicostatus, Mich.*
Itieranus, d'Orb.	

The species of the Gault, like those in the Néocomien formation, are divided into two Faunas, an upper and lower one, but not so distinctly separated. We sometimes find the same species in the two beds, when they belong to different basins, and I am acquainted with some species proper

(1) The species marked with an asterisk are found highest of all, and the only ones which are found mingled with the Ammonites of the chloritic chalk.

to both, although some are more common in the lower beds, to which they appear specially to belong (*Am. denarius, cristatus)*, and the others are more peculiar to the upper beds, where they are much more numerous (*A. mammillaris, Beaudanti, Dupinianus*).

I have already stated that no species of the Néocomien formation has been found hitherto, among the species of the gault. This is also the case as regards the latter, which I have never found in the beds of the Néocomien. But in the group of the Chloritic chalk, I have noticed three undoubted examples, of the species of the Gault, *A. latidorsatus, Mayorianus inflatus.* The first is found with the species of the chloritic chalk, at Cassis (Bouches du Rhône), and at Cape la Hève, near Hâvre (Seine-Inférieure); the second, also at Cassis and at Vergons (Basses Alpes), and the third at Montblainville (Meuse). There are, then, in the gault, three species amongst the upper ones only, which are sometimes found amongst the Ammonites of a higher group. I shall return to this subject when endeavouring to explain the cause of this accidental mixture; I hope, notwithstanding, to demonstrate equally well, that all the species are characteristic of the group to which they belong.

3rd. Group.—*Chloritic chalk, or upper Greensand.*

The 27 species of Ammonites of the Chloritic and tufaceous chalk, or upper green sand, all belong to the lower beds; the upper beds, or the white chalk, do not contain any Ammonites. Nevertheless, in the lower portion of the chalk, there are species which are always found in the lowest beds, and others in the upper ones. The following are the species :

AMMONITES.	AMMONITES.
Beaumontianus, d'Orb.	*Catillus, Sow.*
Bravaisianus, d'Orb.	*Deverianus, d'Orb.*
Carolinus, d'Orb.	*Falcatus, Mantell.*

AMMONITES.	AMMONITES.
Ferandianus, d'Orb.	*Renauxianus, d'Orb.*
Fleuriansianus, d'Orb.	*Requienianus, d'Orb.*
Goupilianus, d'Orb.	*Rhotomagensis, Defrance.*
Lafresnayeanus, d'Orb.	*Rusticus, Sow.*
Largilliertianus, d'Orb.	*Sartousianus, d'Orb.*
Lewesiensis, Sow.	*Tricarinatus, d'Orb.*
Mantellii, Sow.	*Varians, Sow.*
Pailletteanus, d'Orb.	*Veneuilianus, d'Orb.*
Papalis, d'Orb.	*Vibrayeanus, d'Orb.*
Peramplus, Sow.	*Woolgari, Sow.*
Prosperianus, d'Orb.	

Although the whole of the species cannot be divided into epochs, I may, nevertheless, observe that I have always met with *A. Mantellii* in the lower beds of this group, whilst *A. Rhotomagensis* appears to occupy the middle beds; and I have remarked that the two species are rarely found together. In those parts of France where the chloritic chalk is greatly developed, in the south-west, for instance, the Ammonites do not disappear with the last deposits of the lower portion of this group, but in the upper portions of the central beds, there are no longer any traces of Ammonites. Thus, no species is found in the white chalk, at which period Ammonites do not appear to have existed. At present, no species of the chloritic chalk has been found in the gault; it is certain that all the species which I have quoted in the third group are characteristic of it, and may be used for the purpose of distinguishing it, under whatever mineralogical characters it may present itself.

SUMMARY.

After the total disappearance of the Ammonites of the Jurassic formation, we find appearing on the surface of the globe, during the first epoch of the Néocomien, *fifty-three* species entirely different from those buried in the preceding formation. We see these species gradually disappear, during the continuance of the Néocomien formation, up to the upper portion of it, where they are replaced by *twenty-two* species distinct from the first, and which themselves disappear with the last deposits of the Néocomien. With the first strata of the lower gault, twenty-two species of Ammonites appear, but they bear no resemblance to the species of the upper portion of the Néocomien. They are specifically distinct, and furnished with totally different characters. The same as in the Néocomien, the species of the gault gradually disappear, and are, in the upper strata, replaced by twenty-two well-characterized species, none of which survives the epoch of the last portion of the gault. We find, again, with the group of the chloritic chalk, a series of Ammonites essentially different from those of the Néocomien and gault, and distinguished from them by peculiar forms; lastly, these disappear entirely with the upper central beds, at the same time that Ammonites are swept for ever from the surface of the globe. The Ammonites of the cretaceous period have thus been created at five successive epochs; three of which, in particular, present, each time, after the complete extinction of the existing species, the appearance of a new series distinct from those preceding them. We may in consequence observe, that the cretaceous formation not only divides itself into three well-defined geological groups, but also that these groups are each subdivided into two series of the strata, the one inferior, the other superior, each possessing their peculiar species. This important result, at which I have arrived after having compared thousands of Ammonites from all parts of France, and verified the superposition of the strata, evidently proves that it is not only a *few isolated shells, which are characteristic of formations*, as has been hitherto stated, but that all the species of the genus Ammonites, without exception, *are characteristic;* that all positively indicate the formation to which they belong, and do not leave any doubt as to their application, when critically made, and with a perfect knowledge of the species.

It remains for me to explain how some species may be found in a group superior to the one of which they are characteristic, in order to remove all doubts which may be raised respecting them.

Ammonites were doubtless pelagic animals, living in the bosom of the ocean, probably in the same manner as the Nautilus, from which they differed, notwithstanding, by several internal characters, and chiefly by the divisions of the posterior edge of the mantle; but they possessed this character in common with the Nautilus, that in proportion as they increased in size, to compensate for the weight acquired by the animal, the latter filled a fresh chamber with air by means of a septum, so as to restore its equilibrium, as I have already mentioned when describing the zoological characters. Hence it follows, that on the death of the animal, the shell, having the chambers filled with air, would not sink to the bottom; but would be transported on the surface of the water by the winds and currents, in the same way as the shells of Nautilus and Spirula, and consequently cast on shore. This property which the shell possesses of floating, explains two questions: the one zoological, the other geological.

The first consists in the opinion that living Ammonites may yet exist in the present seas. I shall answer this by the single fact of the nature of the shell. If Ammonites existed at present, as the shell could not sink to the bottom of the sea in consequence of the air which it contains, it would unquestionably be cast on some coast or other, in the same manner as the Nautili and Spirulæ, and it could not have escaped the numberless collectors of shells, who have been spread over the surface of the globe for so many ages. We must renounce, then, for ever the hope of finding a living Ammonite.

The second question is purely applicable to what we observe in fossiliferous strata. The shells of Ammonites floating on the surface of the sea, have thus been carried to the shores of the epoch at which they existed, and, consequently, were not deposited in the midst of the seas where the chief depositions took place.

This supposition explains the reason why the number of Ammonites, found in different basins, is in the inverse ratio to the thickness of the deposits. The thickest contain few Ammonites, whilst those which are thinner, have many more. It also explains why we generally find more Ammonites at the circumference of any geological basin than in its centre, the shells being always thrown on its shores. When we only find isolated adult Ammonites in a bed, we may suppose that this bed was formed, when the fauna of that epoch was at its full development, whilst the accumulation of Ammonites of all ages, which we remark in some places, points to general causes which have destroyed all the individuals of a species, and cast them together on the shore; powerful, but unknown causes, in which we must evidently seek the reason: 1st. of the extinction of the species of an entire fauna, 2nd. of their being replaced by the species of another fauna, and 3rd, of the separation of formations, of the groups of these formations, and of the distinction of the strata proper to the groups of the different rocks containing a particular Fauna.

From the shell floating on the surface of the water, can also be explained the cause of the Ammonites, of the lower strata, being found in strata superior to them, without having been in existence at the same period. I imagine that some Ammonites were deposited on the shores of the sea towards the end of a certain geological period, and that they were gradually enclosed in the foreign matter forming the strata. If, from the time when they were deposited up to the period of the commencement of a new fauna, sufficient time elapsed to allow the chambers of the Ammonites, to become filled by chemical action, either with carbonate of lime or sulphuret of iron, as we frequently observe, or with extraneous matter by means of the fractures in the shell, it would remain in these strata in the fossil state, and would not again float on the surface; but, on the contrary, if sufficient time had not elapsed nor more alteration taken place than between our own epoch and the tertiary fossils of Grignon and Dax, the Ammonites would still have their chambers filled with air; the strata destroyed by denudation, would again cause the Ammonites to float: they would be deposited simultaneously with those which existed at the second epoch, and then we should have a mixture of the two faunas, without the species having existed at the same time. It is thus that I explain the union of some species, always the upper ones of one fauna, with those which are the lowest of another, posterior to the first. This explanation satisfactorily accounts for the species of the gault, which I have cited, that this mixture only takes place when the lower group no longer exists, and has been destroyed by denudation, as we observe at Cassis, Vergons, and near Hâvre, where the gault is entirely wanting, and has been removed by some unknown cause.

When we find Ammonites which, from the lightness of the shell, are more likely than other Molluscs, to be transported from one strata to another, belong, notwithstanding, to well defined epochs, we ought to attach more importance to their distribution than to that of other genera; as it evidently proves that between each Geological epoch, during which Ammonites have existed, sufficient time has elapsed to allow the shell to lose its property of floating on the water, or at least, that at this epoch the chemical action was much more intense than it has been from the tertiary period up to the present time, when this action is no longer general. At any rate, Ammonites, belonging to the most perfect Molluscous animals, offer, for this reason and from the fragile nature of the shell, greater guarantee for their geological distribution than those shells infinitely more liable to be covered up in the strata.

§3. *Relation of zoological characters of Ammonites, with the different geological epochs at which they have existed.*

I have stated that all the species of Ammonites, of each geological group, may be considered characteristic. It remains at present to inquire whether, among these species there are groups of forms peculiar to these geological periods and sufficient to distinguish more truly than isolated species, the changes which have taken place at different epochs, thus furnishing to Geologists fresh means of distinguishing by zoological characters these epochs from each other.

If, before entering, into the general consideration of the external and internal forms of Ammonites, to determine the positive characters of groups, we seek, in the purely external appendages, a more general *facies*, which may serve to distinguish the general form of the Ammonites of each geological group, we arrive at the following results:

1st. Amongst the Ammonites of the Néocomien, an external character, which strikes us at once, and belongs especially to this formation is the presence, in thirty Ammonites out of sixty-five, of ridges or transverse ribs, which represent, at certain distances on each whorl, the periods of rest in the deposition of the shell. This remarkable character is especially observable in the following Ammonites:

A. Belus.	*A. Flexisulcatus.*
Calypso.	*Guettardi.*
Cassida.	*Honnoratianus.*
Cesticulatus.	*Inæqualicostatus.*
Difficilis.	*Incertus.*
Dispar.	*Intermedius.*
Duvalianus.	*Juilleti.*
Emerici.	*Lepidus.*

A. Ligatus.
Matheroni.
Ophiurus.
Quadrisulcatus.
Raresulcatus.
Royerianus.
Semisulcatus.
A. Seranonis.
Strangularis.
Striatisulcatus.
Subfasicularis.
Subfrimbriatus.
Tortisulcatus.
Terverii.

We find this character especially marked in the Néocomien, whilst it scarcely exists in the Jurassic formation. In the gault it is only observed in four species, *A. Mayoriamus*, *latidorsatus*, *Parandieri* and *Dupiniamus*; thus we may state that the most predominant exterior form and most peculiar to the Néocomien, is that of having these marks of a cessation of growth.

2nd. Amongst the exceedingly various and diversified forms of the Ammonites of the gault, or lower green sand, where the external ornaments are very prominent, we remark one character which is more general than all the rest; which is the presence, on each side of the back, of a range of salient portions more or less tubercular, formed by the ribs, which, being alternate or in pairs, are interrupted at that place. We observe this character in twenty-seven Ammonites out of forty-two, being more than one half of the whole number.

A. Archiacianus.
Auritus.
Brottianus.
Camatteanus.
Cristatus.
Delarnei.
Denarius.
Fittoni.
Guersanti.
Hugiardianus.
Inflatus.
A. Itierianus.
Interruptus.
Lautus.
Mammilaris.
Michelinianus.
Milletianus.
Mosensis.
Nodosocostatus.
Puzosianus.
Quercifolius.
Raulinianus.

A. Regularis.
Splendens.
Tardefurcatus.
A. Tuberculatus.
Verrucosus.

Although this character is not confined to the gault, as we find it in many species of the Néocomien and in some of the chloritic chalk, I think it may be pointed out as the most general amongst the Ammonites of the gault.

3rd. A character which is more rare in the other formations is observable in the Ammonites of the chloritic chalk or upper green sand; that of having several lateral ranges, and frequently a median range of tubercules, on the sides or back. We find it in the following fifteen species of Ammonites out of twenty-seven, being rather more than one half.

A. Bravaisianus.
Carolinus.
Deverianus.
Fleuriansianus.
Falcatus.
Lafresnayeanus.
Mantellii.
Papalis.
A. Renauxianus.
Rhotomagensis.
Rusticus.
Varians.
Verneuilianus.
Vertebralis.
Woolgari.

We may then consider these ranges of tubercules as characteristic of the greater portion of the Ammonites of the chloritic chalk.

In conclusion, the dominant characters in each of the groups of the Cretaceous formation, when confined to purely exterior forms, are in the Néocomien the marks of periodical cessations of growth; in the gault, two ranges of tubercules near the back; in the chloritic chalk, more than two ranges of tubercules near the back.

When applying more certain and marked characters, arising from the union of external and internal forms, we find the groups of Ammonites, which I have specified when treating of their zoological characters, divided into different formations, as under:

1st. *division.* Groups which are not found in the Cretaceous formation, but are peculiar to the Jurassic.

Arietes, Buch, peculiar to the lower lias.

Falciferi, Buch, peculiar to the upper lias.

Amalthei, Buch, peculiar to the different beds of the Jurassic formation.

Ornati, Buch, peculiar to the Oxford clay.

Capricorni, Buch, from the Jurassic, or Oolitic formation.

Coronarii, Buch, peculiar to the lower oolite.

Armati, Buch, peculiar to the upper strata of the Jurassic formation.

2nd *division.* Groups containing species, peculiar both to the oolitic, or jurassic and cretaceous formations.

Heterophylli, d'Orbigny, peculiar to the upper lias in the Jurassic formation, are only found in the cretaceous formation, in the lower Néocomien and gault. The species, although found in the two formations, are nevertheless clearly distinguished from each other; the species from the Jurassic formation, having their saddles formed of unequal parts, and those of the Cretaceous formation of equal parts.

Macrocephali, Buch, are peculiar to the Jurassic formation, and are also found, but in very small numbers, in the lowest cretaceous strata, (lower Néocomien), the nearest the epoch at which the principal portion of the group lived.

Fimbriati, d'Orb., of which hardly two species exist in the lower Jurassic formation, whilst there are, in the Néocomien alone, twelve species which do not extend to the upper portion of the cretaceous formation.

Planulati, Buch, this group, which is peculiar to the Jurassic formation, has furnished me with three species in the Néocomien.

3rd *division.* Groups peculiar to the Cretaceous formations.

Cristati, d'Orb., these are found in small number in the Néocomien, are at their maximum in the gault, and are reduced to a single species, which is even of a different character, in the chloritic chalk. This group is therefore more particularly proper to the gault.

Tuberculati, d'Orb. They are unknown in the Néocomien, at their maximum in the lower gault, and reduced to a single species in the chloritic chalk.

Clypeiformi, d'Orb. are found in the three divisions of the Cretaceous formation.

Pulchelli, d'Orb. belong to the Néocomien and gault.

Rhotomagenses, d'Orb. Peculiar to the chloritic chalk, the only species of the gault having characters different from the rest.

Dentati, Buch. Only proper to the Néocomien and gault, unknown in the chloritic chalk; they are particularly numerous in the gault.

Flexuosi, Buch. Are only found in the lower Néocomien.

Compressi, d'Orb. Few in number in the Néocomien and gault; they are at their maximum in the chloritic chalk.

Angulicostati, d'Orb. Peculiar to the Néocomien and gault.

Ligati, d'Orb. The species are very numerous, especially in the Néocomien and gault; they are few in the chloritic chalk.

We thus find, that, out of the *Twenty-one groups* established from their zoological characters,

1st. *Seven* are peculiar to the Oolitic or Jurassic formations.

2nd. Ten to the Cretaceous formation.

3rd. Four contain species belonging to both formations.

I shall make a few observations before resuming the subject.

Out of the ten groups peculiar to the Cretaceous formation, four (the *Cristati, Clypeiformi, Compressi* and *Ligati*), are found in all three divisions, but the first is most common in the gault, the third in the chloritic chalk; the last in the two lower divisions. Three groups (the *Pulchelli, Dentati,* and *Angulicostati*) are only found in the two lower divisions, the Néocomien and gault. Two groups, (*the Tuberculati and Rhotomagenses*) are found, on the contrary, in the two upper divisions, the gault and chloritic chalk; the first most common in the gault, the other in the chloritic chalk. After these distinctions, there remains one group, the *Flexuosi,* which is entirely confined to the lower Néocomien. We thus see that although some groups are more or less largely diffused over two or three divisions, they nevertheless appear more particularly to characterise some one or other.

Of the four groups which contain species, common both to the Jurassic and Cretaceous formations, one, the *Heterophylli,* is composed of species which vary according to the formation in which they are found, and will always serve to distinguish them. Two others, the *Macrocephali* and *Planulati,* are peculiar to the Jurassic formation; and if they contain some species belonging to the Cretaceous formation, they are uncertain, as I have not been able to discover the lobes, and they are all found in the lowest division in contact with the Jurassic formation; being the last traces of these forms, indicating that nature has proceeded, in this instance, more gradually than in the other groups. There now only remains the group of the *Fimbriati,* which, as we see by the species, is most common in the Néocomien. It may be observed, in conclusion, that in all the groups which comprise species, belonging to both formations, they invariably are found in the lower divisions of the Cretaceous formation, and never in the upper.

From what has preceded, and which is a faithful exposition of the facts I have myself collected regarding Ammonites, I think we may draw the following conclusions, which are of high interest as to the order of succession of animals on the surface of the globe, and in the application of their forms to enable us to recognise Formations.

1st. There exist distinct and well defined limits between the Faunas peculiar to each Formation or Division, as none of the species of Ammonites pass from the Jurassic to the Cretaceous formation.

2nd. There have been, at each grand geological epoch, not only distinct species, but a series of peculiar, and generally well defined zoological forms, as we see in the distribution of groups into separate formations.

3rd. This change in the form of organised beings, is the more strongly marked, in proportion to the space which intervenes between important epochs; for example, there is a greater difference between the forms peculiar to the Jurassic and Cretaceous formations, than between the different divisions of the Cretaceous formation itself.

4th. The affinities which we remark between the groups of the species of the divisions of the Cretaceous formation, evidently prove, not only that these divisions belong to one of the grand Geological periods, but that they also distinctly divide them, as regards the affinity, from the divisions of the Jurassic formation, which have also their general special characters; thus the Cretaceous deposits may well constitute a *Formation*, distinct from the Jurassic formation.

5th. The different divisions of the Cretaceous formation, whilst presenting affinities and reciprocal passages between the groups of Ammonites, have, notwithstanding distinct external forms, nature having, at each epoch, varied her productions, and given them a general character, or *facies*, which at once distinguishes them.

6th. The different divisions, independently of the general appearance, have, either groups of peculiar form, or at least, a predominant number of species of these groups which may almost always serve to distinguish them.

7th. In every instance, the species of Ammonites are entirely distinct in each formation, and in each division of the formation, and all may be applied to distinguish distinctly the one from the other, under whatever mineralogical character they may be presented.

(*To be continued.*)

REVIEWS.

Conclusion of the Notice on "Gesner's Geological Surveys of the province of New-Brunswick," and "Jackson and Alger's Geology of Nova Scotia."—(From p. 301.)

We have learnt in our former perusal of Gesner's Geological Reports, that New-Brunswick presents a singular aggregation of the older stratified rocks, and trappean and other volcanic productions. These not only appear throughout the interior of the district, but upon a general view, they will be found to extend from the Scoodiac on the American Boundary, in a north-easterly direction, along the coast of the Bay of Fundy to the County of Westmoreland; "Presenting," as Mr. Gesner says, "a vast basin, or trough, which is occupied by the waters of the bay; and perhaps it would not be speculating too far to assume, that the opposite side of this basin, or trough, appears in Nova Scotia, where the schistose rocks are seen sloping from a granite ridge, and dipping towards the centre of this basin.

Here again, we will remark, that the Greywacke and slate rocks, not having been disturbed in their general direction and inclination, have enabled Mr. Gesner to determine their relative positions, and he has, in consequence, declared their identity with the Cambrian and Silurian systems of British geologists; "Terms," he adds, "equally applicable to an extensive class of rocks in New-Brunswick."

By far the most interesting parts of the third report are the several notices relating to the *New Red Sandstone* and *Coal* formations of the County of Westmoreland, portions of that to which had been noticed already in the second report. That to which we now refer, the discovery of coal at Frederick's Brook, a branch of Weldon's Creek, emptying itself into the Petticodiac, is described; the first indications were observed near the confluence of this river with the Memramcook, where the sides of the ravine through which it flows, are composed of sandstone, shale, bituminous shale, and coals frequently concealed beneath detritus and the rubbish of the forest. The strata are here intersected by the stream, and run nearly east and west, with a general dip to the south. The coal was found most abundantly a little higher up the river, existing in several strata, the largest of which is about nine feet in thickness. Almost all the shale, to a distance of a mile along the stream, is highly charged with bitumen. The area of the New Red Sandstone formation may be stated as extending from the head of Belle-isle Bay on the St. John, in a north-easterly direction, along the division line between King's and Queen Counties, to the Cocaigne and Shediac Harbours on the Gulf of the St. Lawrence; and in a southerly direction, to the Kennebeckasis and Petticodiac Rivers.

The fertility of this district of country in New-Brunswick, is very remarkable, in a great measure owing to the character of the sandstone rocks, which disintegrate rapidly when exposed to the changes of the atmosphere, as well as on account of the association of lime and gypsum with their strata, which are of great utility in renovating less productive lands.

Messrs. Jackson and Alger present us in their report, (which, although published some time since, has been found serviceable in our present comparison of the strata of the two provinces,) with observations entirely coinciding with those of Mr. Gesner, as to the character of the strata of Nova Scotia, and their forming a continuation of those of the Province of New Brunswick; we will not, therefore, enter into the distinctive merits of their work, as this brief summary is all that is required for our present purposes.

The older stratified rocks agree in character with those of the neighbouring province, and the volcanic rocks are particularly described as abounding in all the productions which are usually associated.

As regards the merit of Mr. Gesner's reports, upon which we have not yet offered an opinion, we can only state that they must be judged from the particular circumstances for which they were published. Having been undertaken by order of the Colonial Government, we naturally looked for something very superior, both in detail and general completeness, and were much surprised to find such frequent complaints of being obliged to desist from further explorations, which should have been undertaken in order to elucidate points still undetermined, from want of opportunities and means. Yet with all these complaints, we find in the letters addressed by the author to his Excellency the Lieutenant Governor of the province, repeated notices that something in a more complete form will shortly appear, but whether it will turn out to be a more elaborate report, or a geological chart of the province, we are at a loss to determine—we are inclined to expect the latter, from the very great stress which is laid upon the necessity of such a document for general purposes.

Thus much having been said as to what these reports do *not* present to us, let us next dwell upon what their stated object was, and add our confirmed opinion that it has been fulfilled. In the preface to the first report, our author distinctly states that they refer more especially to œconomic geology, and that the popular style under which the facts are presented to the public, is ample evidence that they lay no *great claim* to merit as scientific works, and, therefore, are not to be considered as such.

What has been observed, has been noted down with a great degree of accuracy and care, we should presume, on account of the frequent references which are made in one report to the facts contained in another, and so far as Mr. Gesner proceeded, he has accomplished his work in a scientific manner greatly to his credit; and to mitigate the censure of more expert geologists, it must be borne in mind, that a new country presents many difficulties which are often insurmountable, and, therefore, throw the enquirer from his direct course of observation.

It is essential to remark, that the direct object of the work is gained, inasmuch as the mineral productions of the district are investigated, and, to use the expression of the author, "when but so shortly since it was necessary to import building stone and other mineral materials from the United States, or more distant quarters, now it is shown that the province possesses available resources of a like nature within itself, which will obviate the necessity of such a course hereafter." We look with much pleasure to the further reports of Mr. Gesner, which we hope will contain accurate statements of the fossil contents of the different strata, and sections exhibiting the nature of the different stratifications, and as in this country there are very few maps of such dimensions and prices as to be available to the geological student, we will hope to find such an one inserted in his work, as will enable all readers to follow his arguments and trace his researches. The wood-cuts in the Reports now under our notice, are "bold" enough, but do not speak much for the march of improvement in that art among our Transatlantic brethren.

MONTHLY NOTICE.

November 1st. 1842.

We feel compelled, as it were, to correct this month a very popular error amongst scientific aspirants—that as much may be learnt from the careful study of an elaborate and approved work, as from a comparison of the very subjects there treated of, which exploration has succeeded in raising from the treasuries of nature, and which those who have already studied with success, have arranged for the express purpose of lightening the burden and relieving the tedium of wearisome detail. Now, such a subject is of the utmost importance to the student of Geology; his area of study is so comprehensive, that simplification becomes a matter of necessity; and as all men of sense acknowledge the advantage which research gains by the addition of every fresh record, so it is that a museum containing these discoveries, becomes more and more necessary in proportion as the extent of the subject is increased. It is from an imperfect knowledge of the forms assumed by several shells, for instance, in the various stages of their growth, that many an otherwise clever naturalist, has added unnecessary difficulties to the labours of his successors, by describing, figuring, and naming, imperfect, or as yet incompletely developed shells, as new species.

We would, therefore, recommend to all who desire to make themselves acquainted with so important a department of geology as fossil conchology, a visit to the Museum of the Geological Society of London, which for perfectness of arrangement, and adaptation to utility, is, perhaps, unequalled by that of any public or private museum elsewhere. The care which Mr. Lonsdale has devoted to the examination of the several specimens must have been great, as the most cursory inspection will prove. The hitherto scarcely definable variation from growth is here traced out with exceeding minuteness; so much so, that it will easily be seen how many authors may have committed the errors to which we have alluded, in overlooking the modifications of angular outline and demarcation assumed by the same species at different stages of growth. Independent of this peculiarity, the neatness of the whole arrangement is worthy of all commendation.

But it is to the former, more especially, that we wish to direct the attention of the student, whose course of study would be very much benefitted by an inspection of the various genera in their present arrangement; and this privilege he can obtain without difficulty, by an order from any fellow of the society. And we point out the admirable arrangement the Society has carried out, hoping to find their museum much more frequented, ere long, than it is now, and the science of geology advanced by the addition of well-instructed labourers in the path of practical research.

It is owing to the facilities of comparison, which an universal system of technical appellations has provided, that the fossil shells, so generally found, have been successfully classified; and when each new aspirant to fame is well acquainted with all that has been discovered and proved previous to the time of his proficiency, then will he be enabled to lend *important* aid to the furtherance of science. That such is the only true method, we need but to refer to the writings of Cuvier—the most elaborate observer of minute differences and distinctions—and to the rough sketch of geology to be found in Ray's works, now a century and a half published, in which will be found, as the author before alluded to has said, a very plausible geological theory of the globe, for the details of the foundation of which he had no previous facts to refer to, and which is entirely attributable to the care with which he observed and recorded, what his quick perception in the first instance discovered in the materials of the globe, and which his careful comparisons rendered subsequently available.

THE EDITOR.

Ammonites Zoologically and Geologically considered.

(Continued from p. 327.)

CHAPTER III.

Geologico-Geographical considerations.

In the two preceding chapters, we have considered the zoological characters of the species of Ammonites, and their distribution according to the several formations and the division of each formation; at present, it is my intention to consider the whole series of forms, according to their geographical distribution in the bosom of the basins which constituted the seas of the Cretaceous period, or the different gulfs of those seas, which appear to have had faunas more or less distinct from each other, at contemporaneous periods. The considerations into which I have entered regarding the Acetabuliform Cephalopodes of the present period(1), prove that independently of species common to different maritime basins, there are, at the present time, in each sea, a certain number of species peculiar to each of them. Let us endeavour, by collecting all the facts, to ascertain whether such was not also the case in the ancient seas.

In order to proceed methodically, I shall pass the different geological groups successively in review, and compare with

(1) Annales des Sciences Naturelles, July, 1841.

each other the basins, or the gulfs belonging to the basins, which existed at that period, with relation to the species which lived in each of them.

1st Group.—*Néocomien.*

The Néocomien has been observed hitherto, in the *Provençal basin* and *Dauphiné*(1), formed by the Departments of Gard, Bouches du Rhône, Var, Hautes et Basses Alpes, Vaucluse, Drôme, and Isère. It has also been observed in the *Basin of the Seine*, or *Parisian Basin*, in the Departments of Aube, Haute Marne, Yonne, and Meuse. It is also found in many parts of the Jura, in the Department of Doubs, near Neuchâtel in Switzerland, and in Savoy. I shall give the list of the species found in each of these three geographical divisions in succession.

NEOCOMIEN GROUP OF THE PROVENÇAL BASIN AND DAUPHINÉ.

Lower Beds.

A. Angulicostatus.	*A. Diphyllus.*	*A. Ixion.*
Asperrimus.	*Didayanus.*	*Jeannoti.*
Astierianus.	*Difficilis.*	*Juilleti.*
Calypso.	*Fascicularis.*	*Leopoldinus.*
Carteroni.	*Grasianus.*	*Lepidus.*
Cassida.	*Heliacus.*	*Ligatus.*
Castellanensis.	*Helius.*	*Macilentus.*
Clypeiformis.	*Honnoratianus.*	*Morelianus.*
Compressissimus.	*Incertus.*	*Néocomiensis.*
Cryptoceras.	*Inæqualicostatus.*	*Ophiurus.*
Cultratus.	*Infundibulum.*	*Pulchellus.*
Dispar.	*Intermedius.*	*Picturatus.*

(1) I have here given the limits of these basins, but in future, I shall only indicate them by the titles in italics.

A. Qadrisulcatus.	*A. Semisulcatus.*	*A. Subfimbriatus.*
Radiatus.	*Seranonis.*	*Terverii.*
Recticostatus.	*Simplus.*	*Thetys.*
Rouyanus.	*Sinosus.*	*Tortisulcatus.*
Semistriatus.	*Subfascicularis.*	*Verrucosus.*

Upper Beds.

A. Belus.	*A. Flexisulcatus.*	*A. Matheroni.*
Consobrinus.	*Gargasensis.*	*nisus.*
Crassicostatus.	*Guettardi.*	*pretiosus.*
Dufrénoyi.	*impressus.*	*Strangulatus.*
Duvalianus.	*inornatus.*	*striatisulcatus.*
Emerici.	*Martinii.*	

NEOCOMIEN GROUP OF THE PARIS BASIN.

Lower Beds.

A. bidichotamus.	*A. cryptoceras.*	*A. radiatus.*
difficilis.	*Leopoldinus.*	

Upper Beds.

A. cesticulatus.	*A. Deshayesi.*	*A. Raresulcatus.*
Cornelianus.	*nisus.*	*Royerianus.*

NEOCOMIEN GROUP OF THE JURA.

Lower Beds.

A. astierianus.	*A. Castellanensis.*	*A. Leopoldinus.*
cryptoceras.	*Gevrilianus.*	*radiatus.*
Carteroni.		

Upper Beds.

A. Deshayesi.

From the preceding remarks, we perceive that the Pyrenean basin and the south-west of France have not yet presented the Néocomien formation; which is also the case in the Gulf of the Loire and the northern parts of the country, where the other portions of the Cretaceous formation are so well developed. If we now compare with each other the three local faunas of the Néocomien formation which I have noticed above, we find that they comprise, at present, in the Provençal basin, sixty-eight species; in the basin of the Seine, eleven species, or about a sixth of the number; and in the Jura, eight species, or less than an eighth of the number in the Provençal basin. These numbers alone, without regarding form, ought to prove either a greater development in the Néocomien epoch of Provence, or a distinct fauna, indicated by the greater number of the species. I am of opinion that both causes existed, and that the species will demonstrate it, by the following comparison of the three localities.

1st. In the Provençal basin, I find in the lower beds of the Néocomien, *fifty-one* species of which *four*, *A. difficilis*, *Leopoldinus*, *cryptoceras* and *radiatus*, are also found in the Paris basin, and *six*, *A. astierianus*, *cryptoceras*, *Carteroni*, *Castellanensis*, *Leopoldinus* and *radiatus*, in the Jura. Hence there remains, after the species common to more than one basin, forty-four species at present peculiar to the Provençal basin, in the lower beds of the Néocomien.

I have stated that I am acquainted with *seventeen* species from the upper beds of the Provençal basin, of which, *one* alone, *A. Nisus*, is common to the Parisian basin, and none to the Jura; hence, sixteen species are peculiar to the Provençal basin.

From these facts we must conclude that at the epochs of the lower and upper Néocomien, the Provençal basin was separated from the Parisian, since, though both present common species which indicate the identity of the strata, or contemporaneousness of the two seas, the faunas show a great difference in the composition of the species. If some corresponding strata were wanting, we might imagine that portions had disappeared in the Parisian basin, whilst on the contrary, as I have proved by personal examination of the localities, all the Provençal strata are found there. The lower strata of the inferior system of the Provence, corresponds for instance, to the blue marls of the Department of Haute Marne. The chloritic or compact limestones, containing *A. radiatus*, correspond to the clay and limestone with spatangus of the same place, whilst the black or white limestones, which contain *Nautilus requienianus*, correspond to the limestone *ostréenne* of Haute-Marne, and the clays of Gargas (Vaucluse), and of Vergous (Basses-Alpes), perfectly represent the clay with Plicatules of Haute-Marne and Aube, as these strata contain species identically the same, and bear evidence to their perfect agreement. I think, then, that the Provençal basin, at the Néocomien period, was separated from that of Paris, and that its fauna, as regards Ammonites, has been much the most abundant.

2nd. I find in the Paris basin, among the lower strata of the Néocomien, five species, amongst which, as I have already stated, four are common to the Provençal basin, and three (*A. Cryptoceras, Leopoldinus* and *radiatus*), simultaneously exist in the Jura. There remains after these distinctions, a *single* species (*A. bidichotomus*) peculiar to the Paris basin.

Of the six species of the upper strata, one only, *A. nisus*, is, at the same time found, in the Provençal basin, and only one other, *A. Deshayesi*, in the Jura. There are, then, *four* species peculiar to the Paris basin, of the Departments of Aube and Haute-Marne.

As in the Provençal basin, we evidently see that, independently of the species common to other basins, so there are a sufficient number of distinct species in the Paris basin to establish a fauna different from that of Provence.

3rd. By comparing the species of the Jura with those of the Provençal basin, I find in the lower strata, six species common to both; I find three also, common to the Paris basin, and only one, *A. Gevrilianus*, entirely distinct; in the upper strata I am only acquainted with one species common to the Paris basin.

Allowing that there are some differences between the species of the Jura and Paris basins, if I may judge from the other organized bodies found in each, there has been a perfect identity in the fauna, which we may perceive by the species of Ammonites common to both; thus, judging from the fossils, I should consider the Néocomien deposit of the Jura as forming part of the same sea as the Néocomien formation of the Paris basin.

The conclusions I arrive at, regarding the Néocomien formation are the following: that at the time of the formation of this *Group* of the Cretaceous formation in France, there were two basins, or two contemporaneous seas, the Provençal and Paris basins, whose faunas, although having many species in common, were certainly each more zoologically distinct than the Mediterranean and the Atlantic of the present day; that at this epoch, either from the whole having been raised in equal proportion, or from there not being an aqueous basin in the present basin of the Pyrenees and the Gulf of the Loire, they do not show, at present, any positive trace of the lower Néocomien formation; that these seas, which were distinct at the period of the first deposits of the Néocomien formation, preserved the same conditions to the end of this geological group, is distinctly indicated by the faunas; lastly, that the Provençal basin has, at the same time, a much greater development of the strata than the Paris basin, and a fauna infinitely more abundant in pelagic animals, such as the Ammonites must have been.

I have also made another general observation, which is, that the strata of the Néocomien appear to have been deposited tranquilly, as I have nowhere observed great alterations, such as I have remarked in the Gault.

The species of Ammonites found distributed in all the basins, are: 1st. in the lower strata *A. asterianus, cryptoceras, Leopoldinus, difficilis, radiatus*; 2nd. in the upper strata, *A. Nisus.*

2nd Group.—*Gault or lower Greensand.*

This Group is much more extended over France than the Néocomien. We find it in the Provençal basin at Escragnolle (Var), and at Saint-Paul-Trois-Châteaux. In the Paris basin at Wissant (Pas-de-Calais), at Hâvre (Seine Inférieure), at Beauvais (Oise), and in the Departments of Aube, Yonne and Haute-Marne. In the basin of the south-west, it is noticed, in the Department of Aube. In the Jura, Savoy, and the Department of Ain, it is also widely extended, as well as in the Ardennes. The following are the separate faunas of these different basins or localities.

PROVENÇAL BASIN.

Lower Beds.

A. fissicostatus. *A. Milletianus.* *A. nodosocostatus.*

Upper Beds.

A. Alpinus,	*A. Lyelli.*	*A. Roissyanus.*
Beaudanti.	*latidorsatus.*	*Senequierianus.*
Camatteanus.	*mammillaris.*	*versicostatus.*
Delaruei.	*Majorianus.*	
interruptus.	*Parandieri.*	

PARISIAN BASIN.

Lower Beds.

A. auritus.	*A. Cristatus.*	*A. Splendens.*
Bouchardianus.	*tardefurcatus.*	*tuberculatus.*
bicurvatus.	*Fittoni.*	
denarius.	*lautus.*	
regularis.		
fissicostatus.		

Upper Beds.

A. Beaudanti.		*A. Parandieri.*
Clementinus.	*A. interruptus.*	*velledæ.*
Delaruei.	*Lyelli.*	*versicostatus.*
Dupinianus.	*latidorsatus.*	*varicosus.*
inflatus.	*mammillaris.*	

GAULT OF THE JURA, AIN, DOUBS AND SAVOY.

Lower Beds.

A. Denarius.	*A. fissicostatus.*	*A. Bouchardianus.*
	Milletianus.	
	regularis.	

Upper Beds.

A. Beaudanti.	*A. Itierianus.*	*A. mammillaris.*
Brottianus.	*inflatus.*	*Mayorianus.*
cristatus.	*interruptus.*	*Parandieri.*
Dupinianus.	*Lyelli.*	*varicosus.*
Hugardianus.	*latidorsatus.*	*velledæ.*

GAULT OF ARDENNES AND THE MEUSE.

Lower Beds.

A. Archiacianus.	*A. bicurvatus.*	*A. denarius.*

A. Fissicostatus.	*A. Milletianus.*	*A. Raulinianus.*
Guersanti.	*Puzosianus.*	*regularis.*
Mosensis.	*quercifolius.*	*tardefurcatus.*
Michelinianus.		

The several preceding lists show that the Gault was more extended than the Néocomien; it is, notwithstanding, wanting in the ancient Gulf of the Loire, and it is somewhat doubtful in the south-west of France, and as yet only found in the parts adjoining the Provençal basin. By comparing the several faunas, as I have done in the Néocomien, I find that in the Provençal basin they comprise sixteen species; in the basin of the Seine, or Parisian basin, twenty-five species; in the Jura and Savoy, twenty species; in the Ardennes and Meuse, twenty species. These figures, without regarding the faunas, prove a nearly equal division of species in each basin, and furnish an enormous difference between the relative proportions which existed at the Néocomien period. I shall now compare the forms of the four localities with each other.

1st. In the Provençal basin, I recognise in the lower beds, three species, one of which, *A. nodosocostatus*, is peculiar to them, the others are found in the different basins; and in the upper beds, thirteen species, eight of which are common to the Parisian basin, seven to the Jura and Savoy, and four to Ardennes and Meuse. After these deductions there remain but four species (*A Alpinus*, *Camatteanus*, *Roissyanus* and *Senequierianus*) which at present are peculiar to the Provençal basin, and all belonging to the upper beds. The comparison which I have made is far from furnishing me with the same results as the Néocomien. There are far more common species in the Gault, and everything induces me to believe that at the period of the upper Gault, the Provençal basin had changed its boundaries; that it had greater communications with the other basins than during the Néocomien period; that some dislocations of the strata allowed a greater number of species to pass from one sea to the other, they, nevertheless, retaining still some peculiar species.

2nd. The Parisian basin furnishes me, in the lower beds, with twelve species; five are common to the Jura, five to the Ardennes and two to Provence; there are, notwithstanding, five species peculiar to it, all found at Wissant: *A. auritus*, *Fittoni*, *lautus*, *splendens* and *tuberculatus*. In the upper beds I am acquainted with thirteen species, eight of which are likewise found in the Provençal basin, ten in the Jura, and seven in the Ardennes and Meuse. There remains but one species peculiar to the Parisian basin *A. Clementinus*. Dissimilarities disappear by comparison; we can only say that at the periods of the lower beds of the Gault, the Parisian and English basin had two deposits in the north, those of Wissant and Folkstone, containing species totally different from those found in the other basins at the same period.

3rd. The Jura, perte du Rhône, and Savoy, afford at present, five species in the lower beds, four of which are found in the Parisian basin and four in the Ardennes; leaving but one species peculiar to them. In the upper beds I remark that, out of fifteen species, eight are common to the Provençal basin, eleven to the Parisian basin, and six to the Ardennes; leaving but three peculiar species, *A. Brottianus* and *Itierianus* from the perte du Rhône, and *A. Hugardianus* from the perte du Rhône and Savoy. We see that the greatest analogy exists between the Parisian basin, the Jura and Savoy.

4th. The Gault of Ardennes and the Meuse has furnished at present, thirteen species from the lower beds, two of which are common to Provence, five to the Parisian basin, and four to the Jura; after which, there remain seven species, *A. Archiacianus, Guersanti, Mosensis, Michelinianus, Puzosianus, quercifolius,* and *Raulinianus,* peculiar to Ardennes and the Meuse. The upper beds afford seven species, all found, without exception, in the Parisian basin and the Jura, and five common to the Provençal basin. From these facts it may be concluded with great probability, that the Ardennes, from the species in the upper beds, are identically the same as the Parisian basin, of which they appear to have formed a portion, having, as at Wissant, a thin portion of the lower beds, containing a number of species peculiar to this locality.

In conclusion, at the period when the Gault formed these first deposits, at Wissant, Ardennes and the Meuse, this basin was, at least, as distinct from the Provençal basin, as at the period of the Néocomien. The two seas had slight communication as is indicated by the species; but the numerous dislocations which caused the successive denudations so remarkable at this period, indicated by the species carried along with them, prove that there were then some ruptures between the basins, and that more numerous communications were established; nevertheless, the cretaceous Gulf of the Loire as yet contained no Gault, and it is with doubt that I cite this group, and only at the most southern part of the Pyrenean basin, joining the Provençal basin. These communications, established between the Provençal and Parisian seas, are clearly indicated by the great number of species common to both at the epoch of the upper Gault, differing greatly from the number obtained in the anterior periods, and proving a notable difference in the specific composition of the faunas, which, nevertheless, still preserve distinct species in each basin. The basin of the Pyrenees, and the cretaceous Gulf of the Loire, are found at the termination of the Gault, in the same condition as at the commencement of this epoch.

A fact which I have noticed in all the localities of the Gault, and which strengthens the hypothesis that at this period of the cretaceous formation there have been numerous dislocations, and therefore that many strata have disappeared in certain quarters and interrupted the regular order of succession, is that the strata have almost always been disturbed and abraded, either at the period of their deposit, or posteriorly and at an epoch when their organic remains had become in some measure fossilised. Were I to search for examples of what I advance, I should find evidences of it: 1st. in the lower beds of Wissant; 2nd. in those of the Ardennes and Meuse, where the fossils, enclosed in a very compact black rock, have been thus rolled and deposited in beds, in an argillaceous or siliceous deposit, which is evidently posterior to the former; 3rd. in the upper beds of Gasty and Maurepaire (Aube), where nodules, still harder, doubtless rolled in water, and inclosing *A. Interruptus* in the adult state, and a number of other fossils are disposed in beds in the midst of the upper argillaceous strata, containing *A. latidorsatus*, which is never found in the nodules, and which I have observed, is always found in the upper portions of this division; thus the nodules in these instances belong to an epoch anterior to that of the argillaceous strata in which they are found. These facts, which all geologists may observe as well as myself, easily explain why the Gault only forms thin deposits in general, which we can follow around the several basins, as we find in the case of the white chalk of the Néocomien and likewise of the Jurassic formation. This also proves that the period of the Gault has been marked by extensive denudations; that violent currents, which were either general or produced by dislocations, have, throughout almost all the strata of this period, prevented a gentle and gradual deposit, tearing up the deposits at one place, to bear them to another.

The species of Ammonites found in all the basins are the following: lower beds, *A. fissicostatus* and *Milletianus*; upper beds, *A. Beaudanti, interruptus, Lyelli, latidorsatus, mammillaris, versicostatus.*

3rd Group.—*Chloritic chalk, tufaceous chalk or upper Greensand.*

The Group of the chloritic chalk is much more widely extended in France than the Néocomien or Gault. We find it extensively developed and often of great thickness in the Provençal basin, as also in the Parisian basin, the Gulf of the Loire, in the Pyrenean or south-west basin, in some parts of the Jura, in the Ardennes and Cotentin. The following is a list of the species peculiar to these basins or gulfs:

PROVENÇAL BASIN.

A. Beaumontianus.	*A. Largilliertianus.*	*A. Requienianus.*
Bravasianus.	*Mantellii.*	*Rhotomagensis.*
Deverianus.	*Papalis.*	*Sartousianus.*
Ferandianus.	*Prosperianus.*	*varians.*
Falcatus.	*peramplus.*	
Goupilianus.	*Renauxianus.*	

PARISIAN BASIN.

A. Falcatus.	*A. Largilliertianus.*	*A. Lewesiensis.*
Mantellii.	*Rusticus.*	*Woolgari.*
Rhotomagensis.	*Varians.*	

GULF OF THE LOIRE AS FAR AS SARTHE.

A. Beaumontianus.	*A. Fleuriansianus.*	*A. Mantellii.*
Carolinus.	*falcatus.*	*peramplus.*
Catillus.	*Goupilianus.*	*Rhotomagensis.*

A. varians.	*A. Vibrayeanus.*	*A. Woolgari.*
Lewesiensis.		

PYRENEAN OR SOUTH-WESTERN BASIN.

A. Carolinus.	*A. Pailletteanus.*	*A. varians.*
Fleuriansianus.	*Rhotomagensis.*	*Woolgari.*
Mantellii,	*tricarinatus.*	

JURA.

A. Mantellii.	*A. Rhotomagensis.*	*A. varians.*

ARDENNES AND MEUSE.

A. Falcatus.	*A. Renauxianus*	*A. Catillus.*

COTENTIN AND THE ENVIRONS OF VALOGNES.

A. Verneuilianus.	*A. Lewesiensis.*	*A. Lafresnayanus.*

This series of species furnishes, for the Provençal basin, sixteen species, or more than half of what are known; for the Parisian basin, eight; for the Gulf of the Loire and Sarthe, thirteen; for the Pyrenean, or south-western basin, eight; for the Jura, three; for the Ardennes, three; and for Cotentin, three. We find that the Provençal basin is, as in the Néocomien group, the most abundant in species, and that the cretaceous Gulf of the Loire and the basin of the Pyrenees in the group of the chloritic chalk, furnish as many and more species than the Parisian basin. An examination of the forms will doubtless furnish me with some curious facts, drawn from the comparison of the local faunas.

1st. Out of the sixteen species found in the Provençal basin, five are common to the Parisian basin, seven to the Loire, and three to the south-west. After these distinctions, there remain seven (*A. Bravaisianus, Deverianus, Ferandianus, Papalis, Prosperianus, Requienianus,* and *Sartousianus*), or about the half, which are as yet peculiar to this basin, which would lead one to imagine that it still possessed at this period a peculiar fauna, pointing out its separation from the other basins, and that it was still influenced by the same conditions as at the period of the Gault.

2nd. The Parisian basin furnishes eight species, five of which are found in Provence, six in the Gulf of the Loire, and four in the basin of the Pyrenees. Thus leaving, at present, only *A. rusticus* peculiar to this basin.

3rd. The Gulf of the Loire, out of thirteen species, furnishes seven common to the Provençal basin, five to the Parisian, and six to that of the Pyrenees. There is, then, but one species, *A. Vibrayeanus*, peculiar to the Gulf of the Loire, which, though differing from the Parisian basin, has probably been connected with it.

4th. The basin of the Pyrenees, from Charente-Inférieure to Perpignan, have furnished to the present period, eight species, three of which are found in the Provençal basin, four in the Parisian, and six in the Gulf of the Loire. There remain two peculiar to it, *A. Pailleteanus* and *tricarinatus*. From the comparisons which I have made, it appears that the basin of the Pyrenees, though seeming to have peculiar species, approaches nearer to the Gulf of the Loire than to any other portions of the seas of the period of the chloritic chalk.

5th. The species of the Jura are those which we find indiscriminately throughout all the other basins, and particularly in the Parisian basin.

6th. The species of the Ardennes are nearer allied to those of the Loire than to any of the other basins.

7th. Lastly, the Ammonites of Cotentin, though furnishing two types distinct from those of the other basins, indicates by *A. Lewesiensis*, their identity as regards time, with the third group of the cretaceous formation.

In conclusion, at the first epoch of the chloritic chalk, with which alone I shall occupy myself at present, (as it alone contains Ammonites), the seas of this period changed their form. The two basins of Paris and Provence, of which I have spoken, existed in their full integrity, but the latter had considerably enlarged, extending as far as Cotentin on the one side, and over the whole Gulf of the Loire, until that time devoid of the cretaceous formation; whilst the basin of the Pyrenees, one of the largest of that period, also received throughout its whole extent, the seas of the epoch of the coloritic chalk. Thus, in the third group of the cretaceous rocks, there existed three distinct basins, those of Provence, Paris, and the Pyrenees, containing distinct species; but these basins had undoubtedly more communication with each other than at an earlier period, and therefore furnish a larger number of species common to all, intermingled with those peculiar to each.

The effect of the denudations which occurred at the period of the Gault were still in action at the time of the deposit of the first beds of the chloritic chalk, since, as I have before remarked, we find at certain places where the Gault has disappeared, as at Hâvre and Cassis, a mixture of fossils evidently transported, some of which belong to the Gault and others to the chloritic chalk, the enveloping mass only containing, as I satisfied myself, the foraminifers of the period of the chloritic chalk, which proves that these deposits belong to that group, and that the species of the Gault have been transported thither. The upper portions appear to have been deposited in a more regular manner, especially in the basin of the Pyrenees and in the Gulf of the Loire, where none of these mixtures exist, except in the lower beds.

The Ammonites found in all the basins are the following: *A Rhotomagensis*, *A. Mantellii*, and *A. varians*.

GEOLOGICO-GEOGRAPHICAL SUMMARY.

The geologico-geographicalconclusions which may be drawn from the division of the Ammonites amongst the different strata of the cretaceous formation, are:

1st. That during the Néocomien period, from the first to the last deposits, there existed in France, at least so far as we are at present aware, but two distinct basins, the Provençal basin, bounded on the west by the Cévennes, and on the east by the Alps, and the Parisian basin, whose shore extended from the Department of Aube-et-Yonne by Haute-Marne, as far as the Jura, and on the other side as far as England. These two basins have each their peculiar and distinct fauna, possessing, at the same time, a sufficient number of species common to both, to remove all doubts as to their not being of contemporaneous origin.

2nd. That at the epoch of the lower Gault, these two seas were in the same condition; but that during this first period, the great effects of currents, marked by the transport of species, and arising doubtless from partial dislocations, have apparently opened wide communications between the two seas, since in the upper strata of the Gault we find a much larger number of species common to both seas than during the Néocomien period.

3rd. That the group of the chloritic chalk has entirely changed the aspect of the cretaceous seas. The two first basins remained, relatively to the distribution of species and their proportions, the same as they were at the epoch of the upper Gault; but to the Parisian basin was joined the gulfs of Cotentin and the Loire, up to that period distinct from the cretaceous formation; and the chalk formation invaded, at the same time, the immense basin of the Pyrenees, from the Department of Charente-Inférieure as far as the Eastern Pyrenees; thus, towards the latter epoch of the Cretaceous formation in which Ammonites existed, these seas occupied in France and in the whole of Europe an extension at least double that which they possessed at the period of their first appearance with the Néocomien formation.

REVIEWS.

"Etudes Géologiques dans les Alpes," by M. L. A. Necker. 8vo. *Paris, Langlois et Leclerc.*

The work to which we now purpose calling the attention of our geological friends, is one which adds not only a vast number of facts referring to the theory of glaciers, but also to the more legitimate departments of practical geology. We find in this work geological notices extending throughout the Tarantaise, Little St. Bernard, the neighbourhood of the lakes of Como, Geneva, and Lugano, and the vallies of Sériana, Camonica, Trompia and Adige; then, again, others relating to the districts between Carinthia and Central Switzerland, as well as the Tyrol, from Trieste through Carniola. In addition, it contains numerous details with reference to the passes of the Grunsel, Saint Gothard, Splugen, and Grundelwald, and the vallies of Saint Nicolas and Saas.

Thus much for the sphere of action to which M. Necker's "Etudes Géologiques" extend, and to which we must necessarily refer such of our readers as desire explicit information upon the various parts.

As being amongst the most interesting portions of the work, we would direct attention to the description of the diluvial formations of the neighbourhood of Geneva, considerations deduced from notes on the stratification and structure of the sand-beds at the confluence of the Arve and

Rhône; the reasons of their structure, to which M. Necker has applied the term "*torrentielle*," as evidenced in all arenaceous deposits, and also in the disposition of coal *measures*, which he considers as circumstances of no trivial import as indicative of the origin of these different rocks.

Whilst speaking of the extraordinary depth of the lake of Geneva, and discussing the reasons of this singular feature, various novel ideas are introduced with reference to the position of extensive lakes generally at the base of chains of mountains of a certain geological age, by which our author would imply that their existence and depth is attributable to the sinking down of certain parts, as the natural consequence of the up-heaving which produced the chains of mountains themselves.

A considerable portion of the work relates to the theory of glacial action, in which the author differs greatly from most of the geologists who have made this department their particular study, and although the arguments are with especial reference to the more minute differences, yet in some respects, they are of considerable importance; let us instance that portion which relates to the polished rocks so frequently observed at high altitudes in the Alps, and the striæ by which they are marked. With reference to this subject, M. Necker remarks, after speaking of the quantity of water which exists beneath all glaciers, and consequently which covers the subjacent rocks, that almost all rocks losing half their weight by immersion, the pressure exercised by flinty particles on them would be lessened by one half from what they would effect, if their action took place under ordinary atmospheric influences, and that consequently their agency is comparatively trifling. Now, in this statement (which, if recognized, would nullify the observations of many geologists as to the former and extensive existence of glaciers, as attested by striated and scored rocks, and thereby undermine a portion of the foundations of the theory of glacial influences), our author seems to forget that water, being superimposed upon the rocks, must contain the flinty particles acting upon them, and consequently, both the principal and the agent would undergo the same change, and would act and be acted upon reciprocally, in the same manner as if the ordinary circumstances of their existence were undisturbed. The second point relates to the knotty subject of the transformation of snow into ice, which many attribute to the porous nature of that of which the glaciers are formed, and the congelation of the water which they absorb during the period when the solar influence melts the upper surface. Our author, in this instance, objects to such an explanation of the phenomena, which he says, takes place in regions where the temperature is always below zero, as well as in lower districts; and he cannot conceive how the diminished temperature in such cases can produce a result, for the completion of which, heat is an indispensible condition. In opposition to this view, he quotes an opinion that the transformation of the snow into ice takes place in the lower portions of ravines containing glaciers, *from the pressure of the superincumbent quantity,* and that the action is rendered complete by the melting of the snowy particles, which takes place from the caloric disengaged at the moment when the weight compresses the separate crystals, and condenses the air which is enclosed in this operation. This he deduces, to all appearance, for the purpose of informing his readers of the present theory of the conversion of the surface of the snowy mass into a glacial covering, in order to demonstrate his views; but we waded through the pages, referring to his conjectures with some little difficulty, and certainly without much success. We infer, from what we perused, that the few lines to be found at page 200 of his first volume, give us a great deal better explanation than the ten preceding pages.

He says that the question of glaciers involves more than a simple consideration either of temperature or any other single cause, but the annual falls of snow may be considered as an important agent, inasmuch as the extension of glaciers is derived from this source. There is, he continues, an intimate relation between temperature and snow-storms; and when the one is variable the other follows in the same rule, and this argument he applies with considerable effect to the increase of the glaciers in more elevated districts, and the recession of those situated lower, and after deliberating upon each of these several causes, he informs us that there is a contrast between the advancement of the glaciers of the elevated regions, and the retrogradation of those situated in lower districts, proving that there are real and permanent modifications both of temperature, and the hygrometric state of the air, distinct from each other, in both these situations.

In order to substantiate this assertion, he enters minutely into the consideration of the subject, in which we have neither the inclination nor the means of following him; for however applicable certain reasonings deduced from physical science may be under circumstances of a like nature, we have often found that philosophers have been puzzled by the intervention of unforeseen agents, and an elaborate theory has been overturned by an apparently simple circumstance. M. Necker's reasonings involve much of this species of research, and when we find such an able man as Sir John Herschel hesitating to assign reasons for natural phenomena evinced in localities which he has never visited, we naturally hesitate to put forward our opinions on such dubious matters. It is, moreover, not so much the question of the geologist as the philosopher. *We* acknowledge certain occurrences, and can trace their effects beyond all doubt, and they are alone in the capacity to argue the "why and because" of the phenomena. The work fully merits the title which has been bestowed upon it; and if every naturalist went on his excursions with the same determined spirit of research as our author, we doubt not but that science would receive rapid accessions of facts, and he himself reap a rich harvest of thought.

We have received a notice from Coblentz, on the banks of the Rhine, to the effect, that the shock of an earthquake was felt, in a very distinct manner, throughout a district of country, several miles in length, extending in a south-westerly direction from that place. By reference to any geological map, it will be seen, that this occurred in a district of volcanic origin, constituted of large tracts of basalt and porphyry.

Ed. Geologist.

MONTHLY NOTICE.

December 1st. 1842.

We insert this month an extremely interesting communication from a foreign contemporary, relating to a subject of dispute at the present time amongst "*Glacialists*;" and one, which as M. Elie de Beaumont has expressed it, is likely to add much weight to the *diluvio-glacial* theory. We would, therefore, advise a careful study of the facts contained in it, as they tend, in our opinion, so to modify the glacial theory (so called) as to make it accordant with the more plausible ideas recapitulated in our annual summary for this past year, in opposition, in part, to the glacial theory, of which the following are the principal constituents—viz.:

1.—The movement of glaciers is not the result of their weight, but is owing to an augmentation in the volume of ice, resulting from infiltrated water, subsequently frozen.

2.—Consequently, the movement and transport of large masses is dependant upon the continual change of external temperature between the degrees of heat, whether positive or negative.

3.—The rocks submitted to the pressures of the glacier bear traces of the action of stones and sand, caused by the glaciers, in progressive movements, forcing them against the rocks, which are consequently grounded, and striated in a peculiar manner.

4.—Many circumstances of a comparatively recent epoch, prove that the glaciers, both on the north and south of the Alps, were much more extensive than at present.

5.—No hypothesis explains so clearly the phenomena of erratic blocks, as the presumption that they were transported from their original sites, to those in which they are now found, by the action of the glaciers.

6.—The phenomena (which, it has been said, were more general in former times than at present), were not confined to the Alps alone, but extended over a great portion of central and northern Europe.

This statement extracted from a letter addressed by M. Studer to MM. Leonhard and Bronn, explains in the fewest words, and with the greatest accuracy of any we have yet met with, the whole basis of Agassiz's glacial theory, the joint result of extensive observation, made both by that gentleman and M. Charpentier, Forbes, Heath, Escher, Mousson, Martins, and Bravais; we will not, therefore, offer other reasons for inserting it in this place. Lastly we will remark that our second volume, commencing with January 1843, will be conducted upon the same system as that of this year, which we trust will have been proved a true and faithful record of all investigations connected with Geology.

THE EDITOR.

ORIGINAL COMMUNICATIONS.

On the variation of inclination of the highest limit of the Erratic Zone, and their comparison with the inclination of glaciers and water courses, by M. Elie de Beaumont.

The interesting labours to which the phenomena of erratic blocks, as exemplified in the Alps, have given rise during the last few years, have contributed to elicit an important circumstance relating thereto. *The traces left by erratic phenomena rarely extend to the summits of mountains,* they are confined within a zone around their base, and which is within an altitude already well known. This highest limit is oftentimes marked, either by the transition of rounded into angularlyformed rocks, or by terraces formed of materials of erratic origin.

Within a district of small extent only, this highest limit oftentimes appears defineable in an horizontal line; but in this case it is caused by an illusion, owing to the small degree of inclination in that line. Although but slightly inclined, the highest limit of the erratic zone is nevertheless so circumstanced; this limit is formed by a surface which inclines considerably from the centre of the mountainous region towards its boundaries, cutting the sides of the mountains in very different lines from that of the niveau.

One of the most important, and indeed, essential elements of the problem arising from erratic phenomena, is a knowledge of the inclination of the highest level. At this present moment various opinions exist as to the absolute height at which the traces of erratic phenomena cease; but these heights have never been considered in connection with the horizontal distances of the points at which they were determined, in such a manner at least, as to enable us to determine the superficial limit 1 have made this calculation for the valley of the Rhone; for that of the Drause, St. Bernard to Martigny, and for a portion of the lower Swiss basin, over which the erratic phenomena of Valais are distributed. I have also made it for some portions of the valley of the Aar. Probably the publication of these results may occasion similar researches in the other vallies of the Alps, Pyrenees, and Vosges.

Elevation of the highest limit of the Erratic Zone.

Near the summit of the Grimsel. .	2,300	m.
Near d'Aernen in Valais (Charpentier).	1,813	
Near the basin of Brieg. . . .	1,520	
In the environs of Martigny. . .	1,450	

Near Great St. Bernard. . . .	2,500 m.
The Mountain of Plan-y-beuf, (Charpentier).	1,769
Below Monthey.	1,157
At the rocks of the Mimisse. . .	1,025
At the huts of Playau. . . .	1,222
On the sides of the Chasseron, (Jura).	1,050
The lake of Geneva. . . .	375
Glacier (Névé) of the Ober-Aar. .	2,924
The summit of the Grimsel. . .	2,200
The summit of Brunig. . . .	1,163

Comparing their numbers with the distances between the points to which they relate, measured upon Keller's map, I have formed the annexed table, which indicates the inclination of the highest limit of the Erratic Zone between the points.

Inclinations of the highest limit of the Erratic Zone.

Points of Comparison.	Distance between the points.	Difference of height.	Inclination expressed in decimals.	Inclination expressed in ° ′ ″
	m	m		
Grimsel.............. Aernen...............	25,000	487	0,019480	1° 6′ 57″
Aernen............... Brieg................	16,000	293	0,018312	1° 2′ 56″
Brieg................ Martigny.............	80,000	70	0,000875	0° 3′ 1″
Gt. St. Bernard........ Plan-y-beuf............	15,000	731	0,048730	2° 47′ 24″
Plan-y-beuf............ Martigny............	18,000	319	0,017722	1° 0′ 55″
Martigny .... Monthey.............	18,000	293	0,016277	0° 55′ 57″
Martigny............ Mimisse	44,000	425	0,009659	0° 33′ 12″
Mimisse.............. Geneva................	49,000	585	0,011938	0° 41′ 2″
Martigny............ Playau...............	44,000	228	0,005182	0° 17′ 48″
Martigny............ Chasseron	92,000	400	0,004348	0° 14′ 56″
Playau............... Chasseron............	49,000	172	0,003510	0° 12′ 4″
Plan-y-beuf........... Chasseron	110,000	719	0,006536	0° 22′ 28″
Gt. St. Bernard....... Chasseron	125,000	1,450	0,011600	0° 39° 52″
Grimsel.............. Martigny............	121,000	850	0,007025	0° 24′ 9″
Grimsel.............. Playau...............	165,000	1,078	0,006333	0° 22′ 27″
Grimsel .... Chasseron	213,000	1,250	0,005869	0° 20′ 10″
Aernen...... ...... Playau............	140,000	591	0,004221	0° 14′ 3″
Glacier of Ober-Aar... Grimsel, limit of rounded rocks..	13,500	624	0,046211	2° 38′ 45″
Grimsel .... Brunig.............. The two points only are compared.	29,000	1,037	0,035758	2° 2′ 52″

If this table were extended further, it would demonstrate most completely the distribution of these phenomena, and would be of much service in tracing the former nature of their existence. One might be guided in the choice of hypotheses, by the comparison of this table with others, which also expressed the distribution of other natural phenomena.

In this manner, I have added a memoir on the inclination of various glaciers, at the conclusion of an essay on Etna, published by me in the "Annales des Mines" (3rd series, vol x, p. 565). It would be desirable that this table be extended, so that the lowest limits of inclination, along which glaciers are susceptible of motion, might be determined. To this moment, I am not aware of any glacier of any extent in the whole Alpine regions, which does not move on an inclination considerably less than 3°.

I have also drawn up a tabular statement of the fall in the lines of water courses, giving the inclinations on which a great many rivers and streams run. These inclinations have neither lowest (so to speak) nor highest level, as numerous perpendicular waterfalls exist, and as various parts of the bed of the Seine and Rhone, for example, are situated on ground inclined only 4″ to 8″, if at all. The moveable nature of molecules of water will demonstrate this variation as clearly as inclinations in water courses. But it should be remarked, that the study of the inclinations in water courses, leads to the consideration of inclinations of much smaller extent, in general, than those of glaciers; the Rhone runs on a medium inclination of 0,000553, or 1′ 54″ from Lyons to Arles; the Rhine runs from Basle to Lauterburg, on a medium inclination of 0,000647 or 2′ 13″; both these rivers are very rapid. The Doubs, which runs in the neighbourhood of Besançon on an inclination of 0,001000, or 3′ 26″, is however on the limit almost of navigable rivers. This inclination, however, is hardly a fiftieth or sixtieth part of the inclination of glaciers in extended situations.

The inclinations of the uppermost limits of the erratic zone, are intermediate between those of glaciers and navigable rivers. They are of an inferior order to those of glaciers, whilst they are of the same character as those of the most impetuous torrents. These inclinations, without exception, would be very considerable for rivers of several feet in depth, and would be *enormous* for torrents of water of an equal section with those which the limits of the Erratic Zone determine in the vallies of the Alps—sections often 800 to 1,000 metres in depth. With like inclinations and sections, currents of water would attain a fearful rapidity.

This rapidity of any fluid increases with the inclination of the surface, and the depth of its section; the rapidity which all rivers acquire in the various stages of their increasing size, is a good proof of this fact. It is, on the contrary, to be doubted whether the motion of glaciers of great thickness is governed by the same laws; or whether they would move with less difficulty on a slight incline, than thin glaciers. This is a point of importance which must not be lost sight of when comparing the two classes of motive agents. The *acquired* rapidity in the case of these glaciers, amounts to nothing. Such a difference exists between the laws regulating the movement of ice, and water courses, that, in order to arrive at just conclusions with respect to erratic phenomena, tables, constituted on the plan which I recommended, should contain three comparative statements: the respective phenomena of glaciers, water courses, and erratic phenomena. —*Annales des Sciences Géologiques.*

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