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THE

CANADIAN NATURALIST.

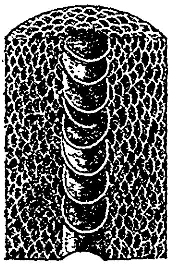
SECOND SERIES.

NOTES ON SOME OF THE MORE REMARKABLE GENERA OF SILURIAN AND DEVONIAN FOSSILS.

By E. Billings, F.G.S.

(*Continued from page* 198.)

Genus Beatricea, Billings.



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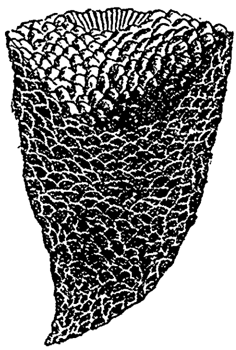

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1. A specimen of *B. undulata* from the upper part of the Hudson River formation, Rabbit Island, Lake Huron. The original is four feet seven inches in length. 2. Diagram showing the internal structure of *Beatricea*. 3. Section of a *Cystiphyllum*.

The fossils of this genus are elongated sub-cylindrical or club-shaped bodies, from one to twelve inches in diameter and from six inches to fifteen feet in length. The largest extremity, most probably the base, is pointed or conical, expanding for a few inches, and then, usually, becoming more slender. From this part upwards the body of the fossil either tapers very gradually or remains cylindrical throughout. The upper extremity appears to be abruptly truncated, and to have a central cup, similar to that of the ordinary cyathophylloid corals, but without radiating septa. The surface is either smooth, longitudinally grooved, irregularly corrugated, or covered with small nodular projections. These markings, in most of the specimens, run in nearly straight lines from end to end, but sometimes they have a spiral arrangement, as represented above, in fig. 1. There appears to be also a thin, minutely perforated epidermis.

The internal structure consists of a central tube running the whole length and divided into numerous compartments by concave transverse septa; outside of this a thick layer of vesicular tissue composed of small sub-lenticular or irregularly concavo-convex cells—the convex side of each cell being always turned outwards. This outer vesicular area is usually arranged in a number of concentric layers, of variable thickness, like those of an exogenous tree. Occasionally, specimens are found in which this lamellar structure cannot be detected. The central tube is from one-third of an inch to fifteen lines in diameter; the outer vesicular area from one-fourth of an inch to five or six inches in thickness. There does not seem to be any constant proportion between the two—for specimens of two inches have the central tube as large as it is in those of twelve inches in diameter.

In polished transverse sections, of those individuals which have the surface smooth, the concentric layers of the outer vesicular tissue are seen as so many uniformly circular or ovate rings. But when the surface is corrugated or tuberculated, the rings are undulated, so that the form of the external ridges or tubercles is repeated on each ring, sometimes nearly to the centre.

The true character of the cup, at the smaller extremity, has not yet been ascertained with the certainty that is to be desired. Indeed it seems to be rarely preserved; for although large collections have been made of these fossils, and Mr. Weston, who visited Anticosti last summer, made a special search for this part, only three specimens have been collected which give any clue to its form. One of these is a fragment four inches in length and twenty lines in diameter. When slit in two, longitudinally, by the lapidary's wheel, and polished, the form of the greater part of the cup is well displayed in section. The fossil itself consists of yellowish white calcareous rock, but the cup is filled with grey compact limestone, holding minute fragments of shells, trilobites, and crinoids. The depth of the cavity is thirty lines, and its width at the bottom eight lines. At eighteen lines from the bottom its width is eleven lines, and it then suddenly widens to thirteen lines. Above this the walls are obscurely preserved, although it can be made out that, on one side, they extend at least one inch higher. The central tube is, in this specimen, filled with calcareous spar, and very indistinctly defined. Remains of several of the septa can, however, be seen—their concave side upwards towards the bottom of the cup.

The second specimen is also a fragment, consisting of the upper fourteen inches. The diameter at the lower end, where broken off, is eighteen lines, and at the supposed margin of the cup thirteen lines. Diameter of the central tube about four lines. Depth of the cup, seven and one-fourth inches. The cup is of the same width as the central tube throughout, except in the upper two inches, where it expands to the width of eight lines. The margin of the cup is not well preserved, but as in the last specimen noticed, is broken so that the entire outline cannot be made out clearly. In this specimen it may be that the cup was not more than two or three inches in depth when perfect, and that its apparent extension downwards is due to the destruction of the septa in the central tube below the bottom.

The third example is a large specimen of *B. undulata*, ten feet five inches in length, eight inches in diameter at the base, and six and a-half at the upper extremity. The cup, exposed by a fracture, is nine inches in depth; width at the bottom about nine lines; at four inches above—twenty one lines; then suddenly enlarging to three inches.

In none of these specimens is the margin of the supposed cup perfect. Not the slightest indication of radiating septa can be detected. In order to determine all the characters of this portion of the fossil, specimens with the cup entirely empty and with the margin perfect as it was during the life of the animal, are required. Numerous individuals were seen lying imbedded in the rocks with the larger end well preserved, but in most instances on approaching the smaller extremity, it was found to become more and more obscure, until it at length blended with the matrix. It would thus appear that the upper end was of a softer and more perishable texture than the lower.

These fossils were first made known to science from specimens collected by Mr. Richardson on the Island of Anticosti in 1856. Occurring in a marine formation, I thought they might be the remains of gigantic sea-weeds, and, in my report for 1857, placed them under the title "PLANTÆ", but next after those that I considered of uncertain class. Since then they have remained in the cases of the museum arranged among the fucoids. In 1858, I took specimens with me to England, and had slices made for microscopic investigation. They were submitted to Dr. Hooker, who at first thought he could detect some traces of plant-structure in them, but on a subsequent examination he came to the conclusion that the evidence was not sufficient to show that they belonged to the vegetable kingdom. Since that time large additional collections have been made, and have been carefully studied by Dr. J. W. Dawson and myself. Dr. Dawson agrees with Dr. Hooker that no plant-structure can be detected, and has long maintained that these fossils constitute a peculiar genus of corals allied to *Cystiphyllum*.* Prof. E. J. Chapman, of Toronto, has also expressed the same opinion.† Prof. J. Hall, and the late S. P. Woodward thought they might belong to the order *Rudistes*. J. W. Salter has made the suggestion that, notwithstanding their great size, they may be annelide tubes.‡ A. Hyatt, jr. excludes them from the vegetable kingdom, and says, that they constitute "a new and interesting order among the Mollusca, closely allied to the Orthoceratites."§

When I first described these fossils I had no specimen that exhibited either of the extremities; the internal structure, with the exception of the central tube and concentric layers, was also unknown. I thought they might be marine plants, but was never perfectly satisfied that they were. The large collections since made have enabled us to ascertain nearly the whole structure.

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* This Journal, vol. 3, p. 85.

† "Their true place is probably among the Corals," CHAPMAN,—Canadian Journal, New Series, vol. 3, p. 331.

‡ "Mr. Salter believes that the Beatricea, though thirty feet long, may be a gigantic annelide tube, allied to Cornulites. Its cellular structure leads him to this view. Amphitrite has a thick shelly tube some feet in length.—Sir R. I. MURCHISON,—'Siluria,' ed. 3, p. 460.

§ Am. Jour. Sci. [2] vol. 39, p. 261.

There still remains some doubt as to the cup and epidermis. Granting that the cavity at the small end is natural and not caused by the destruction of the septa in the central tube, then *Beatricea* has all the essential organic parts which constitute a genus of corals allied to *Cystiphyllum*. This may be seen by comparing figs. 2, 3, above. The most remarkable differences are, the great size of the individuals, and the disposition of the cells in the outer layers of vesicular tissue. In *Cystiphyllum* the convex sides of the cells of the walls of the cup are always turned inwards, or sloping upwards and inwards. In *Beatricea* the reverse of this is the case.

As above stated, *Beatricea* was first made known by the specimens collected by J. Richardson, in 1856. It was afterwards, in 1858, found by the same geologist and Prof. R. Bell, at Lake St. John, on the river Saguenay. Mr. Bell has also collected fine specimens on Rabbit and Club Islands, in Lake Huron. There is a specimen in the Museum of the Geological Society of London that was brought from Anticosti, by Admiral Bayfield, many years ago. Mr. Hyatt says that Prof. J. D. Dana has some fragments of a species resembling *B. undulata* from Kentucky. Its geological range, so far as it is at present known, is from the Hudson River formation up to the Clinton.

NOTES ON THE MEETING OF THE BRITISH ASSOCIATION AT BIRMINGHAM, 1865.

In approaching Birmingham from the west, the visitor learns to appreciate the appellation 'black country,' which has long been enjoyed by the Staffordshire coal districts and their neighborhood. The smoke of hundreds of collieries and furnaces and foundries darkens the air; the green fields give place for miles together to piles of coal, cinders and ashes; and in some places the eye can discern, as far as the murky atmosphere will allow it to penetrate, no green thing. In the day, the aspect of the land is dark and lowering; in the night it brightens with the glow of innumerable furnace fires. It is a pity that the green face of nature cannot be preserved where men toil to extract wealth out of the bowels of the earth; but when both ends cannot be secured, the greater number of people can be supported by thus defacing the aspect of nature. The black country is thus, by virtue of its coal and iron, densely populous, greatly thriving, and a chief abode of manufacturing industry and wealth. All this centres at Birmingham, where the solid material of iron is made the basis whereon is built a vast variety of workmanship, in all sorts of implements and ornaments.

Birmingham itself is rather at the outskirts of the proper black country, on the red sandstone and conglomerate which overlie the coal field. The environs of the town, in consequence, are in some parts very beautiful, and adorned with numerous seats of the wealthy citizens, whose hospitality was extended most liberally to the members of the British Association. Birmingham is not only a great seat of many interesting manufactures, but is in the very heart of England, and in the midst of a network of railways so complicated as almost to puzzle the stranger desirous of visiting it. It has besides some excellent public edifices, well adapted to the meetings of a scientific parliament, more especially its new Town Hall, and the buildings of the Midland Institute and of King Edward's School. Hence the British Association has thrice met at Birmingham, and the success of its last meeting may well induce it to meet there again, should it have opportunity.

The British Association has now attained the mature age of thirty-five years. Its initial meeting at York assembled mainly through the instrumentality of Prof. Phillips; and this eminent geologist, who also presided at the Birmingham meeting, has, as Secretary of the Association, been its most active promoter during its whole existence. At a luncheon given to the members by the Mayor of Birmingham, Sir Roderick Murchison, who calls himself one of the 'Palæozoic members,' thus alluded to its origin:

"In the year 1831, when he was President of the Geological Society of London, his young friend of that day, one John Phillips of York—with whom and his distinguished uncle, the father of English geology, he had previously worked along the coasts of Yorkshire—wrote to him in London, encouraging him to promulgate a proposition which he had, by direction of that most eminent man, William Harcourt, sent up for their consideration. He endeavored to the best of his ability to carry out the wishes of his friend, but what was the result? He could get scarcely anybody to hear of the matter when he first laid it before them, and he could get none to accompany him save his friend Mr. Greenhow, of the Geological Society, and the late Mr. John Taylor. But though London did not respond, Manchester answered to the call, and sent that most eminent philosopher, Dalton; Ireland sent the Provost of Trinity, Dr. Lloyd; and Scotland was represented by Brewster, and one who had been at that meeting—Professor Forbes, the eminent mathematician. Cambridge was not represented; but from Oxford came Dr. Daubeny, with an invitation to the Association to meet there on the following year. Next year they met under Buckland at Oxford, and they had with them the most eminent scientific men of the day."

Since that time the Association has grown to be one of the great institutions of England. Peripatetic and without local habitation, essentially free and easy in its management, loose in its regulations, and democratic in its character, it is the most popular of British scientific societies. Its meetings attract thousands of auditors, and its influence, by the wide circulation given to its proceedings through the press, is felt throughout all parts of the British Empire.

The British Association is by no means to be viewed as a scene of scientific dissipation. Nor must its utility be regarded as confined merely to the diffusion of popular information, though this is no small or despicable use. It has important uses to the cultivators of science themselves. It drags them out of their dens, and brings them face to face with each other and with the world. It gives scope for a free and open interchange of ideas and arguments. It makes those who have attained to high positions, acquainted with the humbler workers in their several spheres. It gives the younger men opportunities of coming forward into notice. It throws those who are the oracles of little coteries at home into the wider competition of the world. It enables scientific men in general better to appreciate the work of each other, and to form more accurate notions of the powers and modes of thought of fellow laborers. It affords excellent opportunities for bringing out new facts and discoveries, under circumstances which give the means of testing their real value, and, if they pass this ordeal, of giving them general currency.

To a student of science, whose ordinary sphere of labor is at a distance from the great centres of scientific work, and who can but rarely have conference with men engaged in similar pursuits with himself, these meetings are particularly valuable, and their value is enhanced by the rarity of opportunities for enjoying them. In our day the aspects of science rapidly change, and the student who depends for his information regarding them on books and on scientific journals, has, after all, but a faint impression of the newer phases of scientific enquiry. On attending the meeting of the British Association at Birmingham, after a lapse of ten years, I had forcibly presented to my mind many changes in men and things. Some of the older men had passed away, or were disabled by age and infirmities from active labor. Those who were young and little known had attained to maturity of years and an established reputation. A host of younger men had risen up. In those departments of science in which I am more especially interested, many new discoveries had been made, or new theories broached. The striking and prolific doctrine of the correlation of forces had been worked out. The method of spectrum analysis had been devised, enabling us to attain a knowledge of the chemical composition even of distant heavenly bodies. The hypothesis of the indefinite variation of species had been revived, and had rapidly become popular among the younger scientific men. The later tertiary deposits had yielded evidences of the possible existence of man in the time of the extinct mammoth; while the oldest rocks, before esteemed azoic, had yielded evidences of animal life. In physics, in chemistry, in geology, and in natural history, a multitude of new and important facts, filling great volumes of proceedings and transactions, had been discovered and given to the world; so that every department of science might be said to occupy a new stand-point, and a host of new subjects of discussion had arisen. When we think of the vast range of study and investigation comprised in the proceedings of the British Association for the last ten years, and look back to the dim beginnings of science in a distant antiquity, and forward to the possible solutions of the hundreds of questions still agitated, it becomes a matter of doubt whether we should congratulate ourselves on the vast progress made toward the right understanding of nature, or should sink appalled in the presence of the apparent boundlessness of the unknown. True science is ever disposed to view its position with humility, and to regard the ever widening circle of knowledge as only ever enlarging our conceptions of the amount of what remains to be known, before we shall meet that point, where the possibilities of the finite understanding shall be overtasked, in the presence of an incomprehensible infinity.

The sessions of the British Association are limited to a week—a period generally found too short satisfactorily to dispose of the business. The proceedings open with a public address by the president for the year. The Association then divides into sections, each taking up a special subject, and organising itself with a president, vice-presidents, and committee. The sections at the Birmingham meeting were those of mathematical and physical science; chemical science; geology; zoology, botany and physiology; geography and ethnology; economic science and statistics; and lastly mechanical science. These sections are known respectively by the letters A to G. Each has its own room, and the meetings take place simultaneously, so that persons interested in different subjects are often sorely perplexed by the claims of rival papers; and it is not uncommon, after a popular paper, to see a section-room almost emptied, by the rush to be in time for some other topic of interest, in another section.

The committees of the sections meet every morning to arrange the business for the next day. The section meetings usually extend without intermission from 11 to 3 or 4 in the afternoon, and the evenings are occupied with social entertainments and lectures. It has of late years been the practice to organise excursions to local objects of interest on the Saturday, instead of the close of meetings as formerly, keeping the sections, or some of them, open at the same time. At the Birmingham meeting there were several interesting excursions of this kind; but there was much difference of opinion as to the propriety of having such excursions on a regular day of meeting: some objecting to this, others saying that the sections should adjourn; the result being that those which did not adjourn were very thinly attended. Those who come for scientific purposes would prefer the sections; those who love pleasure, the excursions; and the local authorities do not wish to postpone the excursions to the end, knowing that, in this way, they lose most of the leading men.

The evening entertainments are not merely great crushes of well-dressed people; but they furnish an opportunity for meeting friends, and they are made the occasion of exhibiting many objects of interest in art, in manufactures, and in natural history. One of the evenings at Birmingham was occupied with an interesting lecture by Mr. Jukes, of the Geological Survey, on the probable extent and duration of the coal of South Staffordshire.

In organising the sections, any person, who is a member of a society publishing transactions, may be placed on the committees, and a few leading men are appointed vice-presidents. In some sections there is a glut of papers, and it is amusing to see the anxiety of some claimants for fame to get their papers in a good place on the list, while the committee is usually desirous to secure for g[illegible] or popular papers the best places. On the whole, considering the hurried manner in which the work is done, there seems to be much fairness, though many who are disappointed complain of cliques and favoritism.

Prof. Phillips, the president of the year, and one of the founders of the Association, is a man of marked features, florid and light complexion, full eye, and large bald head, with thin whitened hair. His countenance is full of genial kindness and quick intelligence, and his step and manner are almost boyish in their elasticity and vivacity. His first scientific work was done on the Yorkshire coast, and he is now professor of geology at Oxford. He is remarkable for that width of information and accuracy of detail which characterise Dana among the American geologists; and, like him, he is a conscientious man, and a cautious generaliser; always to be found in the right place on moral questions, and never carried off his feet by the rush of novel speculations and hasty conclusions. In such questions as the much controverted glacial theories, he busies himself with accurate experiments and calculations of the crushing weight of columns of ic[illegible] and similar essential data; and he has a little astronomical observatory in which he applies, not his hammer, but his telescope to the planets, and has worked out some interesting points in what may be called, for want of a better name, the physical geography of the planet Mars, showing approximately the distribution of its land and water, the movements of its clouds, the advance and recession of its polar snow-patches, and the constitution and temperature of its atmosphere. He is equally at home, and a diligent worker in fossils. Phillips is also a teaching geologist. I spent a most pleasant day with him and his able colleagues, Dr. Acland and Prof. Rolleston, at Oxford, in studying the admirable arrangements in the new museum and scientific library of that university—institutions which are now, thanks to these eminent men and their colleagues, second to none in England, in facilities for the study of physical and natural science. In all that relates to the arrangement of specimens for study, and affording due facilities to the student, Prof. Phillips is as careful and enthusiastic as in his original investigations; and I can imagine no man better suited to cultivate scientific enthusiasm among students, and to send out from the old university, educated naturalists for the next generation.

In the Geological Section, Sir Roderick Murchison, the president, and Sir Charles Lyell, the first on the list of vice-presidents, were the acknowledged heads; Sedgwick, the only other of the great geological leaders, was absent. Murchison is a man of imposing presence and gentlemanly exterior, bland and affable, ever striving to soften the asperities of discussion. Lyell, a man of less majestic aspect, but with a magnificent head, and thoughtful, penetrating countenance, which, now that age is stealing upon him, impresses one all the more with the fact, that his is the greatest and most logical intellect, that has been brought to bear on the earth's history in our day. Murchison is the geologist of the palæozoic rocks, the most successful systematizer of the older formations, which, before his time, were involved in confusion. Lyell is the geologist of the cainozoic, or more recent period of the earth's geological history, the reducer to order of the heterogeneous and widely scattered tertiary deposits. Murchison, like Phillips, is a conservative geologist, slow to adopt new views, and striving to hold the balance between opposing theories. Lyell is the most progressive, and least conservative of the older geologists, and marches in the van of geological progress with as much alacrity as the youngest votaries of the science.

In glancing from these names to those that follow them in the lists of the Association, I feel that there is a wide interval. The present state of natural science in England is that of a rapid transition from an era of giants to an era of mediocre men. This has often been the case in the history of science. One generation produces a crop of great men : the next, perhaps, a multitude of useful, but not brilliant or distinguished followers. It is quite apparent that such men as Lyell, Murchison, Sedgwick, Phillips, Owen, and Faraday have no worthy successors in their special departments of science in England. Not that able, hard-working, and successful men are wanting. There are many such; but it is evident that when the older men die off, their places will be occupied by far inferior minds; many of them mere collectors of facts, others framers of hypotheses which carry them away from truth; the best only fitted to carry forward creditably the work which men of greater genius have originated.

One of the most interesting subjects of geological enquiry at present is the question of the antiquity of man; or, more properly, the question, with which of the later tertiary animals were the first men contemporary? In so far as Western Europe is concerned, there seems to be evidence that several great mammals have become extinct since man appeared on the stage, as, for example, the megaceros, or great Irish stag, the cave bear, and, perhaps, the mammoth and tichorhine rhinoceros. I believe, however, after a careful study of the accounts given of the several deposits in caves and elsewhere, in which these evidences are found, and after personal examination of the celebrated gravel-pits near Amiens, that any inference as to the absolute antiquity of man is altogether premature; and, indeed, the question as to which of the extinct quadrupeds of the later tertiary were contemporaneous with man, is far from being settled. One of the most interesting documents, relating to this subject, presented to the Association, was the report by Mr. Pengelly on the exploration of the cave near Torquay, called Kent's Hole, for which exploration a grant had been given by the Association. This cave presents on its floor four layers of different antiquity. 1. Blocks of stone fallen from the roof; 2. Black loam; 3. Stalagmite or calcareous matter, formed by the dripping of water, and mixed with stones; 4. Red clay or loam. In the upper layers are found modern objects—from the porter bottles thrown away by pleasure parties, to old bronze implements perhaps 2000 years old. In the stalagmite and clay are found a few stone implements, and the bones of animals, many of them now extinct. Much yet remains to be done in this cave, but it seems to have been proved that the flint weapons must be as old as the time when the extinct cave bear lived in England. The mode of exploration pursued is very careful. The interior of the cave is divided into sections, and in each of these the loam is carefully removed, and the objects found in each layer and in each section of the layer are placed in separate labelled boxes, so that every specimen can be referred to the exact spot and depth from which it is obtained. In this way it is hoped that a series of indisputable facts relating to the animals which may have been contemporary with the primitive men of the stone age in England, may be obtained.

Another subject of discussion, belonging to the later tertiary period, is the agency of glaciers and icebergs in distributing the materials of the post-pliocene drift, and in excavating the basins of lakes. Prof. Ramsay, the great advocate of the theory of continental glaciers, was, unfortunately, absent; and most of the leading geologists present, being content with the received ideas of the joint action of icebergs and glaciers, there was little discussion, although several valuable papers were read, the most important being that of Prof. Phillips, on the physical conditions of the existence of glaciers.

Passing from the newest geological formation to the oldest, a very important communication, by Mr. Salter and Mr. Hincks, detailed the discovery of many curious fossils in rocks of the Cambrian period, below the oldest fossils hitherto known in England. They curiously illustrate the fact that, in the beginning of the animal life of the palæozoic period, all of the three lower provinces of the animal kingdom were represented; a striking contrast in this respect to the still older Laurentian, with its one fossil—the *Eozöon*—a representative of one, and that the most humble of the types of animal life. Mr. Salter also applied his discovery, in a very happy manner, to the illustration of the parallelism between the oldest silurian rocks of America and Europe; and more especially to the connection of the gold producing rocks, with the old slates holding *Paradoxides*, one of those curious connections between fossils and useful minerals which are constantly occurring, and which show the practical value of the study of fossil remains.

A paper by Prof. Harkness, on the limestones of Connemara, supposed to contain fossils similar to the *Eozöon* of the Canadian Laurentian, gave an opportunity of explaining to the section the steps by which the discovery of the fossil and its determination had been reached in this country. Prof. Harkness maintained, in regard to the Connemara rocks, that they are really Lower Silurian, not Laurentian, and that they contain no true Foraminiferal remains, but the Canadian discovery was accepted on all hands as undoubted.

The writer happened to be the only representative of Canadian geology at the meeting, and, in that capacity, was honored by appointment as one of the vice-presidents of the section. He presented two communications, one on the succession of fossil plants in the older geological formations as evidenced in America; the other on the conditions of deposit of our boulder clay, and the evidence as to the climate of the period afforded by fossil plants. Both were well received, and led to some discussion; and he can testify, on this as on previous occasions, of the scientific men of Britain, that they are ever ready to receive a colonial brother on equal terms with themselves, and show none of that mean contempt for colonists which is too conspicuous in the political press of England. Scientific bodies, like the British Association and the learned societies of England, do not treat colonists as foreign members. They assign to them the same rights and duties as if they resided in the British Islands, evidencing in this way a truly imperial spirit in regard to the dependencies of the British Crown;—a spirit which would repudiate the Greek or Chinese policy of keeping colonies at a distance until they become strong enough to give trouble, and then casting them off, and would adopt instead the Roman principle of universal citizenship of the empire, extending over all its dependencies throughout the world.

This digression leads me to glance next at the Section of Geography and Ethnology, under the presidency of Sir Henry Rawlinson, the decipherer of the Nineveh inscriptions, and a courteous and amiable man. This is one of the most popular of the sections. Its stirring narratives of foreign travel in the central deserts of Asia, and in unexplored regions of Africa, attract all hearers; and the presence of the men actually engaged in these adventurous expeditions, increases the attraction. At the late meeting there were interesting communications as to the discovery, by Mr. Baker, of additional sources of the Nile, beside those made known by Speke, an exhibition of large paintings of the remarkable Victoria Falls on the Zambesi, and interesting discussions as to the proposed Palestine exploring expedition, and the expediency of another expedition with the view of reaching the North Pole.

A curious and somewhat disturbing element in this section is the presence of the anthropologists, as they call themselves, a small but active body of scientific men, who have established a society in London with the view of studying the natural history of man. The object is, no doubt, good; but, unfortunately, it necessarily becomes mixed up with discussions about the unity of the human race, the probable descent of men from apes, and many other questionable subjects, which repel prudent and conscientious men, and are attractive to people who are eminent in nothing but in differing from other sensible persons. But the anthropologists are ambitious. They publish a journal, and they desiderate a separate section of the British Association. This was declined at the opening meeting of this year, but a compromise was entered into, and the greater part of the papers were handed over to the Geographical Section, coming under the head of ethnology. A very elaborate paper of this class was one by Mr. Crawford on the

African Negroes, in which, while he adduced a vast variety of considerations tending to show their inferiority to other races of men, he nevertheless maintained that it was idle to imagine that they formed a link between men and monkeys. The writer seemed to have hit that exact mean which offends all parties. The more advanced anthropologists were indignant that he had not followed out his facts to the conclusion that the negro is only a better kind of ape. Others were disposed to repudiate as unfounded the alleged inferiority of the negro altogether. One of the points referred to in the paper, was the odor of the negro. To this a clever answer was given by a gentleman from the United States who happened to be present. He said that—"He could say, from actual knowledge and experience in the South, that the offensive smell of the negro was not regarded there. The whites were perfectly willing to associate with them on very intimate terms. No Virginian lady drove out without her negro maid in the carriage with her, and they slept in the same rooms with the young ladies, in the most aristocratic families. The only objection he had heard to the negroes as to their offensiveness, was when they were offensive enough to be free. The fact was, they were only offensive when they were overworked and unwashed, and persons of that class were, to a certain extent, to be found in every country."

Another objection to the negro was that he had not invented an alphabet; but it was urged in reply that the same might be affirmed of the English race—an argument not unlike that adduced by a learned African at the Newcastle meeting of the Association, when he alleged, that the Romans had held that British captives were too stupid to be used as slaves, and since the negroes were already somewhat advanced above that level, good hopes might be entertained of them. In truth, the attempt to establish different species of men has been so completely overthrown by scientific reasoning, and is so abhorrent to right feeling and to revelation, that it is now scarcely tolerated by any intelligent audience in England.

In the Section of Zoology and Botany, presided over by Dr. Thomson, and the so-called Sub-section of Physiology, under the presidency of Dr. Acland, many interesting papers were read. One of the most popular, to judge by the notices of it in the newspapers, was a lengthy exposition of the methods and results of oyster culture, by Frank Buckland. The young oyster is locomotive when first detached from the parent, and in this state the 'spat,' as it is called, must attach itself to some fixed objects called 'cutch' before it can be developed into the perfect native, fit for educated human palates. Shells of dead oysters seem to be the favorite 'cutch,' but mussel shells and shells of other mollusks, and even pieces of earthenware and tiles, are not objected to. The importance of dead oyster shells, to afford holding ground to the new brood, was thus illustrated:

"There are but few localities where the shells of the dead oysters have accumulated in sufficient quantity to give the spat a chance of adhering. It is, therefore, necessary to collect these shells from elsewhere, and throw them down upon localities where the spat is likely to fall. This process is carried out by oyster culturists on a pretty large scale, and it seems almost providential that beds of oyster shells should be found in the neighborhood of the grounds which are cultivated. Thus, for instance, you will see on the map, a place called 'Pan Sand,' at the mouth of the Thames. Now, at this spot there is an accumulation of oyster shells, and dredging boats from various localities dredge up these shells, and carry them on to places nearer in shore and throw them again to the bottom of the sea, knowing full well that if there be spat floating about, and if they be in a proper condition to adhere, that this cutch will assuredly catch it. How this Pan Sand oyster bed came into existense I am quite unable to tell you; but from the appearance of the oysters themselves, I can assert that the oysters were of great age, that they had lived there many years undisturbed by dredgers, and that a considerable time has elapsed since they thrived in this locality."

The oyster culture is now a very important branch of business, and I see that one sanguine theorist proposes to stock the whole estuary of the Thames with live oysters, to feed them on the sewage of London, and then, in turn, feed the whole population of London on the oysters.

The separation of physiology, or, as some prefer to call it, biology, from technical zoology and botany, is an indication of a somewhat important fact, namely, that those naturalists who have devoted themselves to questions of comparative anatomy, of chemical physiology, and researches as to the nature of vital force and the origin of species, regard questions of zoological and botanical classification and of geographical distribution with impatience, and are disposed more and more to separate themselves from the ordinary working naturalist. The effect of this, along with the almost inevitable tendency of specialists to underrate other branches of study than their own, will, without doubt, be in some respects damaging to the true progress of science; and, for some time, we must be prepared to find much good work spoiled by defective and one-sided classification, and crude hypotheses about the production of species by natural selection, and the supposed identity of vital forces with the forces of inorganic nature. The scientific pendulum swings just now in this direction; and it is not unusual to find men framing new classifications on the most petty anatomical grounds, without regard to broader affinities, reasoning about the convertibility of species in precisely the same strain in which alchemists, centuries ago, descanted about the transmutation of the metals, and imagining that because vital force supports itself at the expense of heat, or light, or electricity, that therefore it is identical with them: but the pendulum will swing back, and we shall find, perhaps, that the machine has, after all, kept up with the time; though it is sad to think that the path of knowledge is so tortuous, that so few can reach the goal, and that the oscillations of the pendulum represent so much vain expenditure of highly endowed mind.

It must, however, be admitted that much of the present difficulty in the way of sound biological science arises from the vast extent of the ramifications of the subject, and the impossibility of its being all grasped by one mind. In this way the very enlargement of our knowledge becomes a source of weakness, and the great empires of the earlier zoologists become broken up with petty and powerless principalities. Only those great minds which appear at very rare intervals can rescue natural science from this kind of disintegration; and perhaps the time may come when no possible mind can do this. The question is not yet solved, whether the power of generalization can keep pace with the collection of facts in nature. At present, of English-speaking naturalists we have only Agassiz and Owen who are at all able to grapple with the greater and wider questions of zoology, and both of these men are borne down with an intolerable amount of labor. Dr. Acland thus discoursed in his opening address on the difficulties of the subject:

"Although the wisdom of this Association entitles this meeting a sub-section, I am among the minority who cannot understand the force of the arguments which go to class biology (which term may be now used synonymously with physiology) as a subordinate subject. Being, when properly considered, the most complicated of all the subject matter debated at this Association, it cannot be really subordinate to any, least of all to zoology and botany, which it distinctly includes. It may be an open question whether physiology be a branch of physics and chemistry; it is not an open question whether it includes the knowledge of the characteristics upon which the classification of all entities that are said to have life is based.

"For the purposes of the great scientific question of this age, the causes of the present order of life on the globe, it would seem that the minutest accepted data of biological conclusion may have to be revised under new methods. It is a saying among painters, 'That a draughtsman sees no more than he knows.' It is true in the same way in natural science, that the real signification of a known fact may be concealed for ages. Of this, pathology offers many examples. The older naturalists, notwithstanding the great learning of such men as Linnæus and Haller, had comparatively either very simple or hypothetical and incorrect notions of the complexities of living beings and their constituent parts. Chemistry, the microscope, and the search for the origin of species, have, in this century, widened the horizon of biological study in a way not less surprising than does the dawn of day to a traveller, who, having by night ascended some lofty peak, sees gradually unfolding an extent and detail of prospect which he can generally survey, though he cannot hope to verify each detail and visit every nook in the brief time allotted to him to travel."

One of the ablest workers in these subjects at present, and one whose labors will live, after much that makes more sound now has become obsolete, is Dr. Beale, who read a good paper on "Life in its connection with cell structures and vital force."

In the somewhat inverted order in which I have noticed the sections, we come next to those of Mathematical and Physical Science, presided over by Mr. Spottiswoode; of Chemical Science, under the presidency of Prof. Miller, of King's College, London; and that of Mechanical Science, whose president was Sir William Armstrong of the guns. In the first of these sections a prominent place was occupied by the aeronautic exploits of Mr. Glaisher of the balloon committee, who, instead of slowly and laboriously collecting meteorological facts on the surface of the earth, visits the region of the clouds, and catches the rain and snow in mid-air, making us shiver with the information that at certain heights above the earth our summer showers are represented by drifts of snow. One of the most interesting facts in the present year's report, is the almost constant occurrence of south-west wind in the higher regions of the air over England—a fact satisfactorily explaining its warm and moist climate. Another most interesting subject, which occupied much of the time of this section, is the observations now being made by many astronomers on the superficial appearance and physical structure of the sun and other bodies of the solar system. Much attention has been given to those vast and remarkable disturbances in the luminous envelope or atmosphere of the sun, known as the solar spots, and it is probable that their laws of occurrence will soon be as well understood as those of the hurricanes and typhoons of our own atmosphere. The exploration of the surface of Mars, by Prof. Phillips and others, I have already referred to; and an elaborate map of the moon is in progress, in which every ridge and ravine of her scarred surface will be represented in such a way as to enable future observers to decide the question whether any physical changes are now in progress in our satellite. Most remarkable results have been obtained by the application of the method of spectrum analysis, and, among others, the interesting fact that the nebula of Orion, which had been resolved into apparent stars, is, after all, a gaseous mass with brighter spots or nuclei of gaseous matter, a fact tending to revive the evidence for the so-called nebular hypothesis of the formation of the solar system. Luminous meteors or shooting-stars were also the subject of a report, in which it was stated that the average height of these bodies is sixty miles above the earth, that the average number in our atmosphere in a day rises to the astonishing amount of seven and a half millions, and that at any one instant there would be found in the space occupied by the earth and its atmosphere 13,000 of such bodies, all of which are supposed, like the greater planetary bodies, to be pursuing orbits of their own. Time would fail even to name the vast number of new facts of industrial importance brought before these sections—the Atlantic telegraph—the improvements in gun cotton—the applications of photography—researches in organic chemistry—new methods of coating iron with copper—machinery for extraction of coal—Bessemer's process for making steel—and the improvements in furnaces, are only a few of these subjects; and, with regard to one of these, it was stated by Sir W. Armstrong that it is not uncommon in ordinary furnaces to have two-thirds of the heat produced absolutely lost, while it would seem that in steam-engines no less than nine-tenths of the force generated is wasted.

In connection with this, and with a matter of interest to this country, where peat is already being worked, it was stated that a material named Torbite, suitable for the purposes to which coal is applied, may be made from peat, and sold at from 10s. to 12s. per ton, and that there are in Great Britain and Ireland no less than five millions of acres of peat, with an average depth of twenty feet.

The Section of Statistics was presided over by Lord Stanley, a man of unprepossessing appearance, with a somewhat nervous manner, but a close thinker and able speaker, markedly distinguished by a certain dogmatic utterance of plain common sense. In his opening address, he thus vindicated the claim of statistics to a place in the work of the Association:

"It has been questioned how far such subjects ought to form part of the business of a strictly scientific association; and I do not think the question unreasonable, for it must be admitted that, while our political economy itself, in its present state, is rather a collection of practical maxims, supported by reasoning, and tested by experience, than a science, in the same sense that astronomy or optics is entitled to that name, the topics to which the statistical method is applicable are infinitely various, and have little in common except this one characteristic—that in every case we appeal either to the numerical test of accuracy in figures, or else to fixed and recognised rules, which are assumed to have the same kind of certainty as prevails in physical science. How far that assumption holds good in practice must depend on the judgment both of those who read papers, and of those who comment upon them. The truth is, in my opinion, that our functions here are rather those of suggesting and stimulating than of originating thought. Discussion, no doubt, we shall have, and in discussion new ideas are constantly generated, and new lights thrown npon previously unfamiliar topics; but it is not in crowded meetings, it is not in debating speeches, that any profound and original investigation can be carried on. Meetings like ours answer two purposes, apart from that of social enjoyment; one is the diffusion — not the origination, but the diffusion—of ideas. Books and newspapers and reviews, no doubt, are the main agents for doing that work. Still it is, I think, indisputable that as seeing is proverbially more impressive than hearing, so what we hear orally delivered makes upon us a stronger impression than that which lies on a printed page on which our attention may or may not dwell. The other is the stimulus given to enquiry by the mere fact of investigations of this kind, or the result of them, being brought prominently or conspicuously before the public. Men go home with their heads full of subjects on which they perhaps never thought seriously before; and since, as I believe, nothing once known is ever really forgotten, since an idea which has once found lodgment in the mind, though its presence there may long have been barren, and though we ourselves may have been unconscious of it, will often spring up into life, after a long interval, it is difficult to determine what crop will not grow, sooner or later, out of the seed thus cast about apparently at random."

The following counsels to the readers of papers and speakers in the discussions, might be advantageously given to other bodies as well, and with them I shall close these notes;

" Let me only offer to those who take part in our discussions one or two suggestions. The first is, time runs fast. You can say all you have got to say in a few words, if you will think it over beforehand. It is want of preparation, want of exact thought, that makes diffuseness. Again: we don't want preambles or perorations. We are not a school of rhetoric; and in addressing an educated audience a good deal may be taken for granted. Lastly, we only wish to get at the truth of things. All ideas are welcome, but mere verbal criticism is of no value to us." J. W. D.

NOTICE OF SOME NEW GENERA AND SPECIES OF PALÆOZOIC FOSSILS.

By E. Billings, F.G.S.

Genus Calapoecia, (N. G.)

Corallum composite, forming hemispherical or sub-spherical colonies. Corallites slender tubular, perforated as in *Favosites* and with their outside striated by imperfectly developed costæ. Radiating septa (in the species at present known) about twenty-four. Tabulæ thin and apparently, in some instances, not complete. When the corallites are not in contact, the space between them is filled with a variously formed vesicular tissue. This genus resembles *Heliolites*, but differs therefrom in having double the number of septa and the walls perforated.

C. CANADENSIS.—This species forms small hemispheric or irregular masses with the corallites about one line, usually a little more, in diameter and generally in contact although still remaining circular. Three tabulæ in one line, in the specimens examined. Mural pores in horizontal rows running all round the tube, one row between each two tabulæ. It occurs in the Black River limestone near Ottawa. E. Billings.

C. HURONENSIS.—Corallites somewhat less than one line in diameter with a few others much smaller between them. They are, in the same colony, in some places so closely crowded as to become nearly hexagonal and elsewhere either in contact or separated half their diameter from each other. The only specimen collected seems to be a part of a tuberose mass. It is closely allied to *C. Canadensis*, but has the corallites, in general, more slender, and presents a different aspect. Hudson River formation, Cape Smith, Lake Huron. Prof. R. Bell.

C. ANTICOSTIENSIS.—Corallum forming depressed hemispheric masses. Corallites a little more than one line in diameter with smaller ones between them, sometimes in contact, but, in general, distant from one-fourth to one-half their diameter. Costæ forming a fringe around the apertures and also seen in vertical polished sections. Intercellular tissue composed principally of thin, undulating or flat horizontal diaphragms extending from tube to tube and subdivided into square cells by the costæ at the surface of the walls. Tabulæ obscurely seen, in the specimens observed, apparently very thin. There are about three diaphragms and tabulæ in one line. The radiating septa form thin, sharp, strong, elevated striæ on the inside of the tubes where exposed in weathered specimens. Closely allied to the two last, but has the corallites, in general, somewhat larger and more distant. West side of Gamache Bay, Anticosti; Division 1; Anticosti group; Middle Silurian. T. C. Weston.

Genus HELIOLITES, Dana.

H. SPECIOSUS.—Corallum clavato-turbinate or sub-pyriform; cells a little more than one line in diameter, on an average, usually about half their width distant from each other, but occasionally in contact and sometimes more widely separated; their margins thin, elevated above the general surface, crenulated or ornamented with twelve small rough tubercles. The septa seem to be only incipiently developed, but they can be distinctly seen in the inside of the cup as so many small vertical ridges; there appear to be twelve of them. The tabulæ are somewhat irregular, being either horizontal, oblique, flat, convex or concave, from two to four in one line, The cœnenchyma is composed of small vesicular cells from one-sixth to one-third of a line in diameter. The surface between the cells is, when perfectly preserved, covered with small rough tubercles. When the specimens are worn. the surface presents only the circular apertures of the cells and is destitute of granulation.

Only six specimens of this species were collected, and they are all of the clavato-turbinate form. It is possible that hemispherical or globular colonies may exist as there is much variety in the form in species of this genus. Some of the cells are nearly two lines in diameter, others less than one line.

By the size of the cells this species is distinguished from all others of the genus except *H. megastoma* (McCoy) and *H. macrostylus* (Hall). From these it differs in the structure of the tissue between the tubes. In *H. megastoma* the cells of the cœnenchyma are arranged in polygonal columns. Such, also, seems to be their structure in *H. macrostylus*. The species which Edwards and Haime have placed in their genus *Lyellia*, *L. Americana* and *L. glabra*, have the tubes rather more widely separated and the septa more strongly developed. Occurs at Junction Cliff, Anticosti; Division 1; Anticosti group; Middle Silurian. T. C. Weston.

H. AFFINIS.—Corallum hemispheric, globular, pyriform, clavato-turbinate or tuberose, sometimes incrusting other fossils in a thin layer; cells usually circular, often sub-polygonal, in contact with each other or barely separate, from half a-line to little less than one line in diameter, the more common width being about two-thirds of a line, their margins thin, distinctly elevated above the general surface, and, in perfect specimens, crenulated or serrated with twelve small, rough, pointed tubercles. Septa rudimentary, rarely visible but in certain conditions of preservation distinctly striating the inside of the cells and tubes below. The tabulæ are usually horizontal, three or four in one line. Owing to the close arrangement of the tubes there is very little cœnenchyma, and this is vesicular.

When the cells are closely crowded together they become more or less prismatic with polygonal apertures, and, it is then difficult to distinguish the specimens from certain species of *Favosites*. In general, however, they are circular although in contact or nearly so. Colonies are occasionally found with the cells distant about half their diameter.

The species to which this is most nearly related is *H. tubulata* (Lonsdale), common in the Wenlock limestone. That species however, as described by McCoy, Edwards and Haime and others, has the cells in general somewhat smaller and the apertures not so strongly serrated.

The crenulations on the margins of the cells are only visible when the surface is not at all abraded. The least wearing removes them, and the apertures are then simply circular or sub-polygonal.

This species has been found at Wreck Point, Anticosti; in the Hudson River formation. Also at White Cliff, Junction Cliff, Walls Cove, South Point and other localities, on the same island, in Divisions 1, 2 and 3; Anticosti group; Middle Silurian. J. Richardson and T. C. Weston.

H. EXIGUUS.—Cells about half a line in diameter and somewhat more than their own width distant from each other, with thin elevated margins, apparently not crenulated. Septa not visible in the only specimen collected. Tabulæ numerous, four to six in one line. Cœnenchyma minutely vesicular.

As the specimen is somewhat worn, it is possible that the margins of the cells when perfect may be crenulated. The cœnenchyma appears to be vesicular, but more specimens are required to decide this point.

This species, on account of the small size of the cells and their greater proportional distance from each other, seems to be distinct from all the others.

H. SPARSUS.—Cells varying from half a line to one line in diameter, distant from one to three lines from each other. Radiating septa much developed, sometimes meeting in the centre. The cœnenchyma varies in structure, being in some places entirely vesicular, and elsewhere composed of vertical series of square cells as in *H. megastoma*. These variations are seen in the same specimen. Chicotte River, Anticosti; Division 4; Anticosti group; Middle Silurian. J. Richardson.

H. TENUIS.—Cells, in general, a little less than half a line in diameter, and half their own width distant. The walls are excessively thin and rarely distinguishable, not forming a distinct ring as in the others above described. Cœnenchyma, as seen upon the surface, composed of minute polygonal cells. This species may, perhaps, belong to the genus *Protaræa*. Gamache Bay, Anticosti; Division 3; Anticosti group; Middle Silurian. T. C. Weston.

Genus FAVOSITES, Lamarck.

F. PROLIFICUS.—Corallum forming large hemispheric or irregularly convex masses. Tubes about one line in diameter. Tabulæ thin and either complete or imperfect, sometimes filling the tube with vesicular tissue. They are often very numerous, there being sometimes six or seven in one line. No septa or mural pores have yet been detected, and it may be that this species should be placed in another genus. Hudson River group and throughout the Middle Silurian; Anticosti. J. Richardson and T. C. Weston.

Genus STENOPORA, Lonsdale.

S. BULBOSA.—This species is found in small globular or subpyriform masses from six to thirty lines in diameter. There is often a small shell buried in the base. The tubes are about the size of those of *S. petropolitana*. Gamache Bay, Anticosti; Division 1; Anticosti group; Middle Silurian.

Genus PETRAIA, Munster.

P. OTTAWAENSIS.—Turbinate and either straight or more or less curved, enlarging to a diameter of about an inch in a length of two and a-half inches, irregularly constricted at various intervals and usually engirdled with fine wrinkles. There are, apparently, about fifty principal septa with smaller ones between, where the diameter is about one inch. Cup, nine lines in depth. Differs from *P. corniculum* in the irregularity of its surface. Ottawa, Trenton formation. E. Billings.

P. SELECTA.—Base acutely pointed; above, rather slender for the first few lines, then more rapidly enlarging. Depth of the cup about two-thirds of its width at the margin, septal striæ four or five in two lines. The plane of the margin of the cup is, in all the specimens I have seen very oblique, always inclining towards the curved side. Length of largest specimen seen fifteen lines; width of cup twelve lines. In general, the individuals are more slender. West end Lighthouse, in the Hudson River formation; also at Gamache Bay, Anticosti; Division 1; Anticosti group; Middle Silurian.

P. PULCHELLA.—The two specimens on which this species is founded are acutely pointed and moderately curved. The following are their dimensions. One of them is nine lines in length and six and a-half in diameter at the margin of the cup. The other is ten lines in length and seven in diameter. There are about sixty septa in each. In a polished longitudinal section, the cup is found to extend about half the length of the whole fossil downwards and to have a conical elevation in the centre. The septa, above the bottom of the cup extend inwards about one line gradually diminishing in height to the margin. Junction Cliff and White Cliff, Anticosti; Division 1; Anticosti group; Middle Silurian.

Genus ZAPHRENTIS, Rafinesque.

Z. PATENS.—The specimen is broken off at nine lines below the margin of the cup. Diameter of the lower extremity, twenty-one lines, and of the cup at the margin, thirty-three lines. It thus expands, in this part, one inch in a length of nine lines. It may have been more cylindrical below. In the cup there are thirty-six large septa nearly three lines apart at the margin. Between these are thirty-six smaller ones, which are scarcely half a line in height, and have their edges serrated with small denticulations about three in one line. There is a deep septal fossette on one side. Surface and lower parts unknown. Cormorant Point, Anticosti; Division 3; Anticosti group; Middle Silurian. J. Richardson.

Z. AFFINIS.—Three or four inches in length, expanding to a diameter of eighteen lines at the height of three and a half inches, moderately curved, sometimes with strong irregular annulations. In a polished longitudinal section the tabulæ are seen to be thin flexuous, closely crowded together and extending all across or nearly so. There are about two septal striæ on the surface in one line, and thus, where the diameter is eighteen lines there must be, at the margin, about one hundred septa. In part of a weathered cup some of the septa run along the upper surface of the tabulæ nearly to the centre. This species is allied to *Z. Canadensis*, but differs in having the principal septa more developed and in its more irregular growth. The cup has not been seen. It is possible that this and *Z. Canadensis* may belong to a different genus, perhaps to *Omphyma*. Wreck Point and White Cliff, Anticosti. In the Hudson River group and in Division 1; Anticosti group; Middle Silurian. T. C. Weston.

Z. BELLISTRIATA.—Turbinate, gradually enlarging from an acutely pointed base, moderately and sometimes irregularly curved. There are about sixty septa where the diameter is one inch. Many of these, in the lower part, reach the centre, but above the height of two inches, (as shown by a polished section of a specimen) the central area is filled with irregular tabulæ. The cup, in a specimen four inches in length, is eighteen lines in depth, conical, or much narrowed towards the bottom. Surface with five strong, rounded septal ridges in the width of three lines. On approaching the base these are more closely crowded together than they are in the higher and main body of the coral. They are crossed by fine engirdling striæ just visible to the naked eye. Length of the largest specimen observed four inches. Numerous small straight individuals from one inch and upwards occur with the larger. Wreck Point; in the Hudson River group; and, also, in numerous localities in Divisions 1 and 2; Anticosti group; Middle Silurian. J. Richardson and T. C. Weston.

Genus ERIDOPHYLLUM, Edwards and Haime.

E. VENNORI.—Corallites about two lines in diameter and either in contact or at various distances from each other up to two or three lines. The normal distance appears to be about one line, but where the corallites are crooked, as they are in one of the specimens collected, considerable variations occur. There appear to be from twenty-four to thirty septa, some of which meet in the centre. The tabulæ are imperfectly developed, but are seen, in some of the corallites, forming with the septa square cells near the margin. The connecting processes are from one to three lines apart. Surface with obscure septal striæ and transverse undulations. This species may form the type of a sub-genus, differing from the above in the greater development of the septa and rudimentary tabulæ. Manitoulin Island; Clinton formation. Prof. R. Bell, and H. G. Vennor; dedicated to the latter.

Genus CHONOPHYLLUM, Edwards and Haime.

C. BELLI.—Sub-turbinate, enlarging from a pointed base to a diameter of eighteen lines in about two inches, then becoming more cylindrical. Length three or four inches; greatest diameter observed, at the cup, thirty lines. Cup, in the largest specimen seen eight lines wide and six lines deep with slightly sloping walls, apparently flat in the bottom with the exception of a rough styliform projection in the centre; edge of the cup narrowly rounded, a broad flat or gently convex margin all round which is nearly horizontal or slightly sloping outwards and downwards. In the inside of the cup there are about seventy thin, sharp, slightly elevated septa, alternately larger and smaller. These, in radiating outwards across the broad, flat margin to the periphery, are gradually changed into rounded ribs, some of them half a-line wide. The body of the fossil, as shown in several weathered and silicified specimens is composed of numerous irregular infundibuliform layers which are, in some places, in contact, and elsewhere, separated, sometimes three lines apart. Surface, unknown, This species shows that *Chonophyllum* and *Ptychophyllum* are closely related genera. East side of the village in the bight of West Bay, Manitoulin Island; Clinton formation. Prof. R. Bell, H. G. Vennor. Dedicated to the former.

THE NATURAL HISTORY OF THE SANGUINARIA CANADENSIS, OR CANADA BLOODROOT.

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In January, 1860, I had the honor to read before the Medical Society of London, a lengthy paper upon the Natural History, Properties, and Medical Uses of the Sanguinaria Canadensis, with the chief object of making the medical profession in Britain acquainted with a plant which I had employed for some years, with decided advantage, in many affections of the chest and windpipe. My observations were the result of many years study of the plant in Canada, where I had made myself familiar with everything concerning its growth and natural history.

That part of the paper comprising the description, composition, and preparations of the Sanguinaria was published in the Pharmaceutical Journal for March, 1860; the account of its physiological effects, properties, and medical uses appeared in the Glasgow Medical Journal for July, 1860; whilst that portion relating to its natural history has not yet been published. Having carefully revised this last, it has occurred to me that the most suitable place for its consideration would be the Natural History Society of Montreal, a body on whose behalf I zealously laboured as curator for some years, before taking up my residence in London.

As far as traditional evidence can be traced, this plant has been used for hundreds of years by the various Indian tribes of North

America, as a pigment, a dyeing agent, and a medicine. For what maladies it was originally given as a remedy, it is impossible now to determine. Charlevoix appears to be the first writer who mentions its employment as a medicine, when using the expression, " s'est souvent servi de la racine de cette plante pour provoquer les mois," in other words it was administered as an emmenagogue. The first printed notice of the plant is briefly given in the " Historia Canadensium Plantarum" by Jac. Cornuti, Paris, 1635. He describes it as the *Chelidonium maximum Canadense* αχαυλον,—receiving this name, he observes, from its similitude to the Chelidonium species of plant, and from its flowering in the spring.

The second notice of it occurs in a curious old book, entitled " Theatrum Botanicum, or the Theatre of Plants, by John Parkinson, apothecary, London, 1630." At page 617, is given an erroneous description of the plant, but under the same name as that adopted by Cornuti, and styled in English, the " Great Celandine of Canada." Singularly enough, however, at page 327, the actual plant itself is very correctly given with woodcut, and wrongly named *Ranunculus Virginiensis albus*, the white Virginian Crow-foot. The error thus committed did not escape the notice of a subsequent writer, of whom I shall presently speak. It cannot be positively inferred from Parkinson's writings that the plant was cultivated in England; probably it was, and seen by Parkinson himself, else he could have hardly given such an accurate account of it. Morrison, however, settles the point of its early culture in that country, when he states that seeds of the plants had been sent to him from Canada and Virginia, which had propagated abundantly in a suburban garden near London.

Charlevoix—no mean authority in anything pertaining to Canada—has adopted Cornuti's name in his description of the plant, and moreover styles it the Dragon's Blood of Canada, " Sang Dragon du Canada." He gives a more correct account and extended description of it than Cornuti, and a woodcut somewhat more accurate than that given by Parkinson.

The clearest and most accurate description, however, of this interesting plant, is to be found in the " Hortus Elthamensis seu Plantarum Rariorum," of Joh. Jac. Dillenius, in which several figures of the plant are given, colored most naturally, under the name of *Sanguinaria major et minor*. The name was derived from *Sanguis*, blood, from the blood-red color of the juice which flows from the rhizome and petioles when wounded. On looking at this splendid work for the first time in the Library of the British Museum, I found the illustrations to be perfect imitations of the plant, as it presented itself to my notice hundreds of times, growing wild in the woods and mountains of Canada. The plate in Charlevoix's book gives an idea of the plant, and is correct in many particulars; but on comparing it with that of Dillenius, the leaf is not altogether so natural, being too much serrated, and perhaps the root is too insignificant. Any one, however, familiar with the plant would observe that Charlevoix meant it for that, and must have seen it himself. Dillenius speaks of the plant as vulgarly named *Chelidonium Canadense*, and says the thick and fleshy roots are not unlike Tormentilla. He has freely entered into its previous history, and shows the errors into which writers—especially Parkinson—previous to his time (1732) had fallen regarding this plant. In 1731, the year before the great treatise of Dillenius was published, appeared Catesby's large work on the Natural History of Carolina.

The first introduction of this plant into Europe was through the return to France of some of the earlier travellers through Canada. It was cultivated in the gardens of Paris, and this enabled Cornuti to describe it, from recent specimens, in 1635. Many persons have believed, from the title of his work, that Cornuti had travelled in Canada; nevertheless, it is quite certain, that he never was there. The foreign plants he describes may have been from Canada, or other parts of the New World, which he had observed growing in various gardens in Paris. The plants described by Charlevoix, in 1744, which he met with in Canada, in 1721-22, are considered in the first volume of the Transactions of the Literary and Historical Society of Quebec by Mr. William Shepherd, who took the pains to identify them with the nomenclature now in use. This was highly necessary, because some of Charlevoix's descriptions were imperfect and vague; this was so, to a slight extent, with the Blood-root, which had been named by Linnæus some years before Charlevoix published his History of New France. Its Linnæan name soon spread in America, for we find Kalm mentioning, in his travels in that part of the world, under date, "April 6th, 1749, *Sanguinaria Canadensis*, which is here called Blood root—because the root is great and red, and when cut looks like the root of red beet—was beginning to flower, growing in a rich mould." This was in New Jersey.

Botany.—The Sanguinaria belongs to the sexual system *Poly-*

andria Monogynia, and the natural order *Papaveraceæ*. (It was placed by De Jussieu in his natural order *Papavera*, and by Necker in the *Catizophita*).

General Characters.—The Calyx (flower cup) is ovate and concave, has two sepals shorter than the blossoms, and falls off very early. The corolla (blossom) consists of eight petals, but varying from seven to fourteen, which are spreading, oblong, obtuse, concave, narrowed at the base, mostly white, but sometimes tinged with rose or purple. The stamens are numerous (said to be twenty-four) and unequal, and comprise many simple yellow filaments shorter than the blossom (one-half or one-third the length of the petals), with oblong, linear, and innate orange anthers. The pistil is composed of an ovary (germ or seed bud) of an oblong and compressed form, with no style, but with a sessile, thick, persistent stigma, possessing a striated double groove, and is of the same height as the stamens. The pericarp (fruit or seed vessel) is superior, and has an oblong and bulging pod-like capsule about an inch or more long, tapering to a sharp point at both ends, two-valved, forming a single cavity, filled with numerous oval, reddish-brown seeds. The valves of the capsule are caducous, the columella double and permanent. Receptacles or placentas two, filiform, marginal, and persistent.

Specific Characters.—The rhizoma is horizontal, creeping, abrupt, often contorted, half an inch in diameter or about as thick as the finger, two to four inches long, tuberous and perennial; reddish-brown color on the outside and brighter red within, discharging when wounded an acrid, orange-red coloured juice, with a number of long slender radicles, and makes offsets from the sides, which succeed the old plant. There is no aereal stem. From the end of the root arise the scape and leaf-stalks (rarely a pair of leaves) surrounded by two or three large membranous sheathing scales of the bud, at their base. These spring up together, the folded leaf enveloping the flower bud, and rolling back as the latter expands. The petiole (leaf stalk) is from two to six inches long, slender, round, and glabrous. The leaf, which stands upon a long channelled petiole, is radical, reniform, united at the base, somewhat heart-shaped or cordate-reniform, serrated, deeply or palmately lobed, the lobes entire, or repandly toothed, very smooth, of a pale yellowish green (sometimes quite dark) on the upper surface, and glaucous or bluish-white and strongly reticulated by orange colored veins. The scape is erect, round and smooth, often of a purplish color, rising from a few inches to a foot, and terminating in a single flower. Flowers are simple, terminal and white, from one to one and half inches in diameter. Sepals two, deciduous. Petals eight naturally, but increased by cultivation. Stamens numerous. Style none. Seeds numerous, dark, shiny, reddish-brown, half surrounded by a white vermiform appendage. The whole plant is pervaded by an orange-colored sap, which flows from every part of it when broken, but is of the deepest color in the root.

The Sanguinaria cannot be considered a handsome showy plant, nevertheless its humble but beautiful little white flower, and the extreme delicacy of its leaves curiously veined on the under side with a pale orange, at once strikes the observer. With justice it may be called elegant, and can be admired not only for its delicacy, but is interesting from the circumstance of its very early inflorescence, being among the earliest of the spring plants of North America, appearing as soon as the frost leaves the earth, in the months of April and May.

Generally in the month of April. in Canada and Northern States of America, as soon as the sun has warmed the earth and loosened it from its frozen bonds, a number of milk-white buds, elevated on a naked foot-stalk, partially enveloped in a handsome vine shaped leaf may be seen. The flower is at first embosomed in the young convolute leaf and rises in front of it, and long after inflorescence the reniform and lobed leaves, covered with their wax-like veins continue to grow. At first a single leaf and flower generally proceed from each bud of the tuber, enveloped at the base with glaucous and somewhat succulent sheaths. Both the leaf-stalks and scape, which are thus encircled at their origin from the root by a common sheath, are of an orange color, deepest towards their junction with the caudex, and becoming paler near to the leaves and flowers, where it is blended with green. When broken or squeezed, they emit a colored liquor, like that of the root, but paler. The stain of this fluid on paper is a faint yellow; that from the root is much darker. As it appears southward, it flowers in March, and in the states of South Carolina, Georgia, and Florida, it flowers in February.

The Flower resembles the white crocus very closely, for when it first comes up, the bud is supported by the leaf and is folded together with it; the flower, however, soon elevates itself above its protector, while the leaf, having performed its duty of guardian to the tender bud, expands to the full size. The scape, which is uniformly terminated by a single flower, proceeds from one end of the root, and rises perpendicularly to the height of six or eight inches. The flowers are much under this height at the early part of the season; and not unfrequently they are expanded at those periods when the scape has just appeared above ground. By the time the flower is expanded and spreading, the leaf-stalk is not more than half the length of the scape. The flowers possess two deciduous calyx leaves. Michaux says there are three; this is clearly an error. The calyx is so exceedingly fugacious, that it is common for them to fall off before the flower is expanded, hence they are rarely seen.

The flowers have generally but eight petals, varying in size; I have seen them of ten and twelve, and they have been counted from seven to fourteen. They are not, therefore, double. With care, some fine double varieties might be produced, as there is a great propensity in this plant to multiply its petals in favorable situations.

There are, probably, two varieties of the Sanguinaria, founded upon the difference in the form of the petals. One of these is described by Pursh, in his Flora, as having the petals of a linear form; the same peculiarity being noticed by Mr. Lyon of Georgia. The petals, which are for the most part pure white, are often tinged on their under side, and sometimes on their upper, with a delicate rose color. Occasionally a purple tinge replaces the rose. The flower bud is generally rose-colored. The pistil is reddish green. During the heat of the day, the petals are horizontal and spread out; they converge towards the evening, and at night are wrapped up; the leaves, also, partly close towards night.

At the end of a few days, the petals fall, and leave a small rudimentary pod or capsule. This continues to grow till it has attained from one to two inches in length, and when they have become ripe, they turn slightly brown, curl up, and discharge the seeds. This occurs at the end of May or during June, sometimes as late as July. The number of seeds varies from ten to sixty in each capsule.

When the flowering has passed the whole plant becomes much increased in size, frequently attaining by mid-summer, to the height of fifteen inches, but commonly not exceeding twelve. The leaves, having continued to grow, have acquired so large a size as to appear like a different plant, exceeding in dimensions that first observed twice, thrice and four times. During flowering, time the leaves are about two inches wide, and are divided by a couple of sinuosities, giving them, when spread out, a reniform or heart shape, with large rounded lobes separated by obtuse sinuses; but as they increase in size, the sinuosities either remain simply two, or increase up to seven in number, extending half way to the base.

The number of leaves varies from two to six, and several flower stalks are furnished from a single root. The number of flowers depends upon the number of buds or hybernaculæ, usually from three to four; but when the flowering is over, the leaves spring up in profusion.

A single bud terminates the root, but as the root makes offsets from its sides, several buds are formed, which separate as the old root decays, acquiring by this separation the abrupt or premorse form commonly noticed. The hybernaculum is composed of successive scales or sheaths, the last of which, as mentioned before, acquires a considerable size as the plant springs up. If the hybernaculum is dissected in the summer or autumn, the embryo leaf and flower of the succeeding spring may be discovered, and with a common magnifier, even the stamens may be counted. This peculiarity adds greatly to the interest of the plant, which some botanists declare is scarcely known to be equalled in point of delicacy and singularity, from the time its leaves emerge from the ground, and embosom the infant blossom, to their full expansion, and the ripening of the seed vessels.

The plant has been succesfully grown in various parts of Europe, and is an object of attraction and interest to the florist. Still it is very little known in Britain, and is not even mentioned in many of the systematic works on Botany.

Its height, as before stated, varies from five or six inches to upwards of a foot: this will vary according to its geographical position and also to the nature of the soil in which it grows. A dry wood, with fertile soil, is its favorite seat; but on the borders of rich, shady woods and clearings, and on the declivities of hills in a shady situation, and in a light vegetable mould, it thrives and propogates most abundantly, as well as being seen to perfection. It grows also in the shade on a rocky soil, partly covered with light earth, composed principally of decayed leaves. Dr. Barton speaks of it in an arid sandy soil, near the University of Pennsylvania; whilst Pursh says it delights in fertile soil. Moreover, it is found in places where the soil is positively bad, thus showing that it is a hardy perennial. It is never found in open cleared land, or if a plant is there seen, it is small, stunted. and soon dies out. It may be converted into an annual by parting its roots in the autumn, when it will blossom in the beginning of April, and its seeds will ripen perhaps before June. In England it flowers in the beginning of April, as in Canada; its blossoms are fugacious, and fully expand in fine warm weather. Sometimes, in Canada, the flowering may be tardy, if the spring is unusually late; but, as a rule, the moment the snow disappears this charming little plant shows itself and flourishes luxuriantly.

The Sanguinaria Canadensis, or Bloodroot, possesses several names derived from its leading peculiarities and uses. It was called Bloodwort, Bloodroot, Bethroot, and Sanguinaria, from the circumstance of its fleshy roots pouring forth a bright red or orange juice when broken asunder. The color may, perhaps, be pronounced an orange scarlet. This juice is used by the Indians, as a dye, and as a paint, to smear their bodies, and hence called Indian Paint, Indian Turmeric, Puccoon, Red Puccoon, Red Root, &c. The juice pervades all parts of the root, and exudes from a cut or wound on any part of it. It also follows on cutting the leaves and footstalks, but to a smaller extent. In Charlevoix's time the juice was preserved for the purpose of staining furniture.

HABITATION.—Canada is essentially the country of the Bloodroot; hence its name, especially as it was first discovered in that part of the British Empire. It grows in abundance throughout the woods of Canada, and is found plentifully on the shores of Lake Superior. I believe it will be found as far eastward as Labrador, and to the north of the Saskatchewan, on the eastern side of the Rocky Mountains.

It exists throughout the United States, south of Canada, and is found as far as Florida. Professor Barton says, it is found everywhere west of Delaware. And in the course of my investigations into the history of the plant, I find that it luxuriates in every State throughout the great American Union, possibly somewhat varying in its general characters.

The Sanguinaria was found in the eastern woody district, or first of the subdivisions of the First Zone, described by Sir John Richardson, in the journal of his Arctic Searching Expedition, in search of Sir John Franklin. "This zone extends over the eastern side of the continent from latitude 45° to 55°; it comprehends the St. Lawrence and Saskatchewan basins; it rises obliquely, in accordance with the course of the isothermal lines, in going westward, and on the Pacific coast it includes the 49th and 58th parallels, or Vancouver's and Sitka Islands. It is subdivided into three districts; viz, the eastern forest country, the eastern prairies, and the country west of the Rocky Mountains" (p. 320).

It extends a little north of the western part of the Province of Canada. I am informed by those who have resided there, that they have seen it used by the Indians of the Red River; but my friend, the late Mr. Peter Dease, of Montreal, stated it is not found north of that river. He also observed that it is unknown at Hudson Bay—an observation corroborated by Sir John Richardson. The extreme western range of the plant probably extends to Oregon Territory and California, far to the west of the Mississippi and the Missouri Rivers. The geographical range, therefore, of this plant is most extensive, being found many thousands of miles, over a large proportion of the North American continent—its extreme southern limits being the state of Florida, the most southern in the American Union.

The seeds obtained by Morrison, prior to 1680, were from Canada and Virginia; and Dillenius mentions, in 1732, that Bloodroot was a native of Canada, the New England States, Pennsylvania, Maryland, Virginia, and Carolina. Subsequent writers and travellers have still further shown its great range.

The remarkable peculiarity therefore associated with this interesting plant, of a wide and extended range over so large a portion of the North American continent, cannot escape notice. It would appear to grow in rich or scanty soil, overlying strata of diverse and various geological epochs. It flourishes in abundance in the vegetable and woody soil above the Silurian rocks, both upper and lower, of Canada, and on their predecessors the granites and Lautentian rocks of Canada, and those to the north-west of Carolina, Georgia, and the north-east of Alabama. The trap mountains of Canada, especially the Montreal, the Belœil, the Montarville and Mount Johnson, are extremely favorable to its growth. The Devonian rocks and the Carboniferous series of the States of Illinois, Michigan, Ohio, Pennsylvania, Virginia and Kentucky, as well as those of Canada and New Brunswick, are well covered by it. It is even to be found along the thin belt of New Red

Sand stone which skirts the Connecticut valley, and running in a direction of north-east and south-west. Lastly, the soil overlying the cretaceous groups of Alabama, Mississippi, Arkansas, and other States, and the great alluvial tertiary deposits which skirt the eastern shores of those States, along the Atlantic borders from New Jersey, southwards to Florida, comprising the whole of the latter State, and thence spreading along the northern shores of the Gulf of Mexico, taking in portions of Alabama, Louisiana, and Texas, contains this plant in not less abundance than in the more northern regions.

The growth of the Sanguinaria in soils, covering, and at the same time derived from so many distinct formations, proves in a remarkable manner the natural hardihood of the plant; but, I think I am not in error in stating, that its growth is particularly favored by the soils derived from the various rock formations of Canada, which comprise the oldest known of our globe.

It is a plant, like many others, which has flourished subsequently to the existence of the most recent tertiary formations, as no evidence of its presence, nor of any member of its family, the Papaveraceæ, has been afforded in a fossil state.

When we consider what small and easily destructible plants those are which pertain to the order to which this plant belongs, it will not surprise us that no vestiges of their former existence are left on our planet. Whether they ever will be discovered remains a problem which time only can solve. If my zeal for the Sanguinaria will not be considered as carrying me too far, I am disposed to believe it flourished anterior to the last deposition of the Tertiary strata; but from the perishable nature of the materials which belong to the poppy tribe generally, no relics have been left behind.

1 Bryanston Street, London, October 11, 1865.

OBSERVATIONS ON THE DRIFT PHENOMENA OF LABRADOR.

By A. S. Packard, Jr., M.D.

The whole surface of Labrador has passed through a denudation of great extent by continental glaciers. In the southern part of the peninsula, bordering on the gulf of the St. Lawrence, the glaciers evidently moved southward down the slope from the water-shed in the interior. On the eastern or Atlantic coast, at both sides of the mouth of Hamilton Inlet, which is forty miles wide, there are glacial lunoid furrows, like those observed in Maine by Dr. Delaski, which tend to prove by their direction that a glacier forty or fifty miles in breadth filled this great fiord, and moved in an easterly direction from the water-shed in the interior, thence debouching into the sea.

Owing to the powerful disrupting agency of the frost and ice, the rounded and denuded rocks of Labrador have as yet revealed but few glacial striæ. The distribution of the boulders is restricted to the higher levels of the plateau. To find them in any abundance, it is necessary to ascend from 500 to 800 feet above the sea, where they occur in profusion. Below this they have been rolled, rounded, and rearranged into ancient sea beaches. But on the smooth polished quartzites and syenites, the former of which are levelled into broad plains grooved and furrowed and afterward polished almost like glass, with shallow depressions, being glacial troughs filled with water, and forming countless pools, and on the rounded syenitic hills which assume dome-like or high conical sugar-loaf forms, we see everywhere in Labrador, below a level of 2000 feet, the traces of ancient glacier action exhibited on a vast scale.

At the close of the Glacial epoch the moraine matter was re-assorted into marine deposits, which in this country have been exposed to a general and sweeping denudation. Only small patches are found remaining in sheltered positions. These marine deposits consist of finely laminated clays resting upon coarser, more stony, and gravelly beds. The former were evidently estuary deposits, the latter thrown down in deeper water, where the strong Arctic current prevailed. The oldest beds are the coarser strata, which, as in Maine, occur at high-tide mark. The more recent beds occur from ten to twenty feet above the sea level.

The fossil Invertebrata, found abundantly in these beds, afford excellent material for comparison with the present marine fauna of Labrador, and throw new light on the distribution of marine life during the close of the Glacial epoch. The assemblage is thoroughly Arctic in character, but, when compared with lists of the glacial shells of the north of Europe, it is found to bear a very distinct *facies*. It is evident that on each side of the Atlantic, the same faunal distinctions obtained during this period as now. There was, however, a greater range in space of purely Arctic species, and, though the European marine fauna was much more closely allied to our own, owing to the great predominance of exclusively Arctic forms, it is yet evident that the Arctic glacial fauna was divided into a Scandinavian district, and a Labrador district, each the metropolis of a small number of species peculiar to itself and limited to its area.

The assemblages found at various points along the coast from Labrador to Maine are not the exact equivalents of the present faunæ. They differ in containing a very small percentage of extinct species, and in a different grouping of species still living.

Thus, in the Labrador beds are several species of *Fusus* which differ from recent Arctic forms, and also a species of *Bela;* certain forms, such as *Panopoea* and perhaps *Cyrtodaria*, which were abundant formerly, seem to be dying out at the present day. In Maine the change is still more marked. Thus, the most characteristic shell of the marine clays is *Leda truncata* (*Portlandica*), which has wholly disappeared from the seas south of the circumpolar regions, unless future deep-sea dredging reveals its presence in some of the abysses off our coast. An undescribed *Macoma* is also characteristic of the beds about Portland; and other important changes have occurred in the relative abundance of species, and the manner in which they are grouped as compared with the present assemblages in zoological districts farther north, and similar in physical surroundings to the glacial seas.

The Labrador district of the Arctic fauna, instead of being restricted as now to the eastern coast of North America from the Arctic archipelago to the banks of Newfoundland, and shading off into the Acadian district at the present line of floating ice, during the Glacial epoch extended up the St. Lawrence river, and as far as Portland, on the coast of Maine, where it shaded into a more southern assemblage.

In Maine there are two distinct horizons of life. The lowest and oldest is found at the bottom of the boulder-clay at high-tide mark along the coast. The second horizon is composed of rewashed, finely laminated, less stony clays occupying the coast from 25 feet above the sea level to a height, 50 to 100 miles inland, of nearly 300 feet. The species found in this second horizon are rather boreal forms than purely Arctic. In the beds about Saco and Scarboro we find *Leda tenuisulcata* intermingled with the Arctic *L. permula*, as it is not at present on the coast, and *Pandora trilineata* replaces the Arctic *Pandorina arenosa*. At Berwick, *Astarte castanea*, a boreal form, is introduced; while south of this, at Point Shirley, Desor and Stimpson found *Nassa trivittata, Buccinum plicosum, Astarte castanea* and *Venus mercenaria*, species which now, as an assemblage, abound most on the shores of New England south of Cape Cod, and in New York bay. Again, at Nantucket, Desor found a still warmer fauna occupying, apparently, an extension of this second horizon. *Arca transversa, Crepidula fornicata*, with *Buccinum plicosum* and *Nassa obsoleta* were found to abound in this locality, where the warming influence of the Gulf Stream was strongly felt, while the waters of Maine were cooled down by the Arctic or Polar current.

In the beds of this horizon at Gardiner, occur the teeth of the bison, walrus, and bones of other animals, and the *Mallotus villosus*; also in the same beds at Bangor the fossil whale, and in Burlington, Vt., in the Champlain clays, which evidently belong to this horizon, the *Beluga Vermontana* of Thompson.

Thus the two glacial faunæ that have successively gained a foothold in northeastern temperate America, seemed, as regards both their land and marine animals, and also plants (for *Potentilla tridentata* which is found only in Maine, Labrador and Greenland, is also found fossil in the Ottawa clays, according to Dr. Dawson,) to be a purely Arctic American assemblage.* According to the view of Dr. Hooker,† the most ancient glacial flora was derived from Scandinavia. On the contrary, as far as geological evidence at present tends, the cave mammals of Europe were associated with the musk ox, reindeer, white bear, and other Arctic animals which abound in Arctic America, while no features in the Post-tertiary fossils of America seem to be European. These faunal distinctions would seem to be even more strongly marked than now in the distribution of the Vertebrata during the closing part of the Glacial epoch.—*From Silliman's Journal.*

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* [Scarcely "arctic." See Dr. Dawson's paper in Jour. Geol. Soc., London, Dec., 1865. Eds.]

† Trans. Linn. Soc. London, xxiii, part 2.

BRITISH ASSOCIATION.

FIRST REPORT OF THE COMMITTEE FOR EXPLORING KENT'S CAVERN, DEVONSHIRE.

The celebrated Kent's Cavern, or Kent's Hole, is about a mile due east from Torquay harbor. It is situated in a small wooded, limestone hill, on the western side of a valley, which, about half a mile to the south, terminates on the western shore of Torbay.

The hills which surround the district consist of limestone, green-stone, clay-slate, and a reddish grit or compact sandstone. The two last are traversed by veins of quartz: and, with the possible exception of the greenstone, they all belong to the Devonian system. Indeed, the entire Torquay peninsula is exclusively made up of rocks of this age.

According to tradition there were formerly four or five entrances to the cavern, of which two only were generally known; the others being merely narrow apertures or slits through which, until they were blocked up from within, the initiated were wont to enter clandestinely. The remaining two are about fifty feet apart, and occur in the face of one and the same low natural cliff, running nearly north and south, on the south-eastern side of the hill. The northern entrance is in form a rude triangle, about six feet high and eight feet wide at the base. The southern is a natural and tolerably symmetrical arch, nine and a half feet wide at the base and six feet high. Its form is due partly to a small curvature of the strata—the apex of the opening being in the anticlinal axis—and partly to the actual removal, by natural causes, of portions of the limestone beds. The base of the opening, or chord of the arc, consists of undisturbed limestone, so that the entrance may be aptly compared to the mouth of an oven.

From the time of the researches and discoveries which, forty years ago, rendered the cavern famous, to the commencement of the exploration under the auspices of this Association, the southern entrance has been blocked up, the northern alone being used by visitors. The base of the latter is about 189 feet above the level of mean tide, whilst that of the former is about four feet lower.

The following is the succession of deposits, in descending order which the chamber contained:—

1st. Huge blocks of limestone which had manifestly fallen from the roof, many of them required blasting in order to their removal, and in some instances it was necessary to blast the masses into which they were by this means divided. One of the blocks measured 11 feet long, 5½ feet broad, and 2½ feet thick; hence it contained upwards of 100 cubic feet, and must have weighed fully seven tons. In some cases two or three of them lay one on another and in a few instances were firmly cemented together by a separate cake of stalagmite between each pair; whilst others lay unconformably, with considerable interspaces. Occasionally what appeared to be a boss or dome of stalagmite proved to be a block, or two or three small blocks of limestone, invested on all sides with a stalagmite sheet. Certain masses, lying at some distance from a drop, were without even a trace of stalagmite.

2nd. Between and beneath these limestone blocks there was a layer of mould of an almost black color. It varied from a few inches to upwards of a foot in depth.

3rd. Underneath the black soil came a cake of stalagmite breccia, made up of comparatively small fragments of limestone, so very firmly cemented together with carbonate of lime as occasionally required blasting. It was rarely less, but not unfrequently more, than a foot thick. Everywhere it was firmly attached to the walls, and it occasionally extended completely across the chamber. Not unfrequently, however, the centre of the chamber was altogether destitute of this breccia; in some instances because there is no drip near the apex, in others because it was intercepted by an overlying limestone block.

4th. The breccia is succeeded by the ordinary reddish cave loam, which contained a large number of limestone fragments, varying in dimensions from bits not larger than sixpences to masses but little smaller than those which lay on the surface. They lie at all angles without anything like symmetrical arrangement. In fact the entire deposit is without any approach to stratification—many of the stones are partially encrusted with calcareous matter, and not unfrequently loam, stones, and splinters of bones are cemented by the same substance into a very tough breccia. The presence of a calcareous drip is more or less traceable everywhere. Hitherto the cave earth has been excavated to the depth of four feet only. How far it extends below this, or what may be beneath it, is at present unknown. Where it is not covered with the stalagmitic breccia, the black soil lies immediately on it, but the line of junction is everywhere sharply defined; in no instance do the two commingle.

Since the large masses of limestone occur at all levels in the cave earth, as well as everywhere above it, it is obvious that whatever may be the cause to which their fall is attributable, they cannot be referred to any one and the same period. They fell from time to time throughout the accumulation of the cave earth; they continued to fall whilst the stalagmitic breccia was in process of formation, as well as during the introduction of the black mould, and they are amongst the most recent phenomena which the cavern presents. And even of those which lie on the surface, there is a conclusive evidence that in some cases a considerable length of time must have elapsed between the fall of two blocks, one on the other; an interval sufficiently great for the formation for the cake of stalagmite between them, and which is sometimes full six inches thick. There can be little doubt that some of them fell very recently even when measured by human standards.

It is by no means easy to determine the cause which threw them down. To call in the aid of convulsion seems undesirable, since it would be necessary to do so very frequently. Moreover it may be doubted whether anything short of a violent earthquake would be equal to the effect. Though the roof of the chamber is of very great span and entirely unsupported, and though it presents appearances which are not calculated to inspire confidence, the violent concussions produced by the frequent blastings already mentioned, blastings which not unfrequently throw masses of limestone, weighing upwards of a ton, to a distance of several feet, have never brought down even a splinter.

The fall of the blocks has sometimes been attributed to changes of dimensions in the roof, arising from changes of temperature, but the fact that the cavern temperature is all but constant throughout the year seems fatal to this supposition.

The masses lying on the surface were a sufficient guarantee that the deposits beneath them remained intact. There can be no doubt that they are at once a proof, and the cause of the undisturbed character of the soil they cover. A portion of the cavern so easily accessible as is this chamber would not have been spared by Mr. McEnery but on account of some great difficulty or discouragement; and in fact he states that the fallen masses completely foiled him in his attempts to make explorations in it, excepting in one branch some distance south of the area selected by the committee. Their own characters, moreover, render it absolutely certain that the deposits have never been violated.

The following is the method of exploration which has been observed from the commencement, and which it is believed affords a simple and accurate method of determining the exact position of every object which has been found:—

1st. The black soil lying or accessible between the masses of limestone on the surface was carefully examined and removed.

2nd. The limestone blocks occupying the surface of the deposits were blasted and otherwise broken up, and taken out of the cavern.

3rd. A line, termed the datum line, is stretched horizontally from a fixed point at the entrance to another at the back of the chamber.

4th. Lines, one foot apart, are drawn at right angles to the datum line, and therefore parallel to one another, across the chamber, so as to divide the surface of the deposit into belts termed parallels.

5th. In each parallel the black mould which the limestone masses covered is first examined and removed, and then the stalagmitic breccia, so as to lay bare the surface of the cave earth.

6th. Horizontal lines, a foot apart, are then drawn from side to side, across the vertical face of each section, so as to divide the parallel into four layers or levels, each a foot deep.

Finally each level is divided into lengths, called yards, each three feet long, and measured right and left of the datum line as an axis of abscissa.

In fine, the cave earth is excavated in vertical slices or parallels four feet high, one foot thick and as long as the chamber is broad, where this breadth does not exceed 30 feet; each parallel is taken out in levels one foot high; and each level in horizontal prisms three feet long and a foot square in the section, so that each contains three cubic feet of material.

This material, after being carefully examined *in situ* by candle-light, is taken to the doorway and re-examined by day-light, after which it is at once removed without the cavern. A box is appropriated to each yard exclusively, and in it are placed all the objects of interest which the prism yields. The boxes, each having a label containing the data necessary for defining the situations of its contents, are daily sent to the honorary secretary of the committee, by whom the specimens are at once cleaned and packed in fresh boxes. The labels are numbered and packed with the specimens to which they respectively belong, and a record of the day's work is entered in a diary.

The same method is followed in the examination of the black mould, and also of the stalagmitic breccia, with the single exception that in these cases the parallels are not divided into levels and yards.

With very rare exceptions the cavern has been visited daily by one and frequently by both the superintendents, and monthly reports of progress have been regularly forwarded to Sir Charles Lyell, the chairman of the committee.

* * * * * *

In passing below the black mould we first encounter the stalagmitic breccia. This the workmen carefully break into small fragments in order to detect any articles of interest embedded in it. The search, though not very productive, has not been quite fruitless. In the breccia have been found charred wood, marine and land shells, and bones of various animals, none of which perhaps are extinct.

Immediately beneath this cake we enter the red cave loam, and at once find ourselves amongst the relics of several extinct species of animals. The only differences in the four successive levels in which, as already stated, the red loam is taken out, are simply that the first, or uppermost, is the poorest, and the third, perhaps the richest in osseous remains; and that the three lower levels contain a large amount of minutely comminuted bone, of which there are very few instances in the uppermost foot. In other respects the levels are the same. Everywhere the same in the materials which form the staple of the deposit; in the occurrence of pebbles of various kinds of rock, which differ from those in the overlying black mould only in being less numerous; in the presence of bones in the same condition, and representing the same species of animals; and in yielding flint implements of the same types. It will not be necessary, therefore, to describe each level separately or in detail.

The bones found below the stalagmite are heavier than those met with above it. This distinction is so well marked and so constant as to be characteristic. It would be easy to assign them to their respective deposits by their specific weights alone. Most of those from the red loam are but little discolored; indeed, some of them are of a chalk-like whiteness. A few, however, occur here and there which have undergone a considerable amount of discoloration, a consequence probably, and also a proof of a greater degree of exposure before their inhumation. On most of the latter certain lines and patches of a lighter color not unfrequently present themselves, which may be likened to such as are sometimes left by mosses or lichens on objects on which they have grown.

A large number of the bones, including jaws, teeth, and horns, are scored with teeth-marks, clearly the work of animals of different kinds. Some of the long bones are split longitudinally. Many appear to have been rolled, including most of those which have been gnawed; and in the case of the latter it is tolerably obvious that the rolling was subsequent to the gnawing. Some of those found beneath the large masses of fallen limestone are in a crushed condition, and thus apparently attest the fact that the deposit in which they lay, and on which the blocks fell, was of a compact nature and capable of a firm resistance.

The minutely comminuted bone already spoken of is commonly found converted, with loam and stones, into a firm breccia. Not unfrequently, however, it occupies the hollow cavities of some of the larger bones. With it there sometimes occurs a cream-colored substance, which in a few instances has been met also in the form of small detached lumps, having a low specific gravity. This, as well as at least some of the comminuted bone, has been supposed to be of fœcal origin.

In cleaning the bones it is frequently found to be impossible to remove entirely the earthy matter from them. They are at least partially invested with a thin film which defies the brush and water. On drying, however, this matter commonly scales off, and proves to be a paste or paint, composed of loam and carbonate of lime, the latter probably derived from drip from the roof.

A large portion of the osseous remains occurs in the form of fragments and mere splinters. The identifiable parts are chiefly teeth, which are extremely numerous. Among the animals represented there are certainly the cave bear, the cave lion, the cave hyæna, the fox, horse, probably more than one species, several species of deer, the tichorhine rhinoceros, and the mammoth. Remains of the hyæna are probably the most abundant, after which come those of rhinoceros and horse. The relics of mammoths, both molars and tusks, are those of very young individuals.

It has already been hinted that flint implements occur everywhere in the cave earth mixed up with the remains of extinct mammals. Several of them were found in the presence of, and some of them by the superintendents. Like the bones, they are least abundant in the uppermost foot, and occur in greatest numbers in the lowest zones. Altogether, and without reckoning doubtful specimens and numerous chips, nearly thirty 'implements' have been dug out. Though the designation of 'flint' is given to all, some of them are probably of chert. Of the flints, properly so called, some are of a dark and others of a light gray color, whilst a third kind are almost white, and have a porcellanous aspect. The chert specimens are of a lightish gray color. With the exception of three, they are all of the kind known as flakes, flat on one side and more or less carinated on the other. Some of these are fragments only, others were found broken in the deposit with the parts lying in contact, whilst others again are perfect. Some of the broken specimens of the white variety show that they are not of this color throughout their entire mass, but have a dark central axis or core. The flakes agree in character with those in the black overlying mould. The excepted three are of chert, and are worked on both sides. They were found in the second, third, and fourth levels, one in each. That from the second foot is about four and three-quarter inches long, and where widest two and a-half broad. At one end it tapers to a point, and narrows to no more than three-quarters of an inch at the other. In outline it is rudely a segment of a curvilineal figure, and is slightly falciform. The inner or concave margin is the cutting edge. Unfortunately, the tip of the pointed end was broken off after exhumation. Those from the third and fourth levels are more highly-wrought implements. They are worked to an edge around the entire *perimeter*. In outline they are rather ovoid than elliptical, being narrower at one end than at the other. That from the third foot measures four and a-half inches in length, and its greatest breadth and thickness are respectively three and a-quarter inches and three-quarters of an inch. That found in the fourth zone—the lowest yet reached—is the most elaborately finished implement of the series. It is lighter in color, and somewhat smaller than the preceding two, its dimensions being three and a-half inches long, two and a-half broad, and three-quarters in thickness.

Without intending at present to enter on the consideration of all the bearings of the entire evidence produced, the Committee feel at liberty to express their conviction that it is totally impossible to doubt either the human origin of the implements, or their inosculation, in undisturbed soil, with the remains of the mammoth, the cave bear, and their extinct contemporaries.

Nor are these the only indications of human existence found in the cave earth. Several small pieces of burnt bone have been met with in the red loam, some of them loose and detached, others of smaller size, and incorporated in the breccia, composed of loam, stones, and comminuted bone.

Mention has been made already of the occurrence, in the cave earth, of rounded stones not derivable from the limestone hill in which the cavern is situated. It seems probable that at least some of them were selected and taken there by man, though it may not be easy, perhaps, to determine, in all cases, for what purpose. But waiving this point, there are two stones which must not be hastily dismissed. The first of them is four and three-quarter inches long, and something less than an inch square in the section. It is a mass of hard purplish gray grit, and is undoubtedly a whetstone or rather a portion of one. It was found in the first level of the cave earth in a small recess or cavity in the northern wall of the chamber, immediately beneath a projecting stratum of limestone *in situ*. In this cavity the stone stood with its longest axis vertical. The superintendents were inclined to the opinion that it had slipped through a hole into the cavity at a comparatively recent date, and they diligently set to work to find the means of the ingress. Here, however, they were completely foiled. There was no hole or passage, vertical or lateral, by which the cavity could have been entered. Not only, as has been said, was there a thick stratum of limestone *in situ* immediately over the recess, but over this again, as well as over the red loam there was a thick compact mass of stalagamitic breccia, consisting of large and small pieces of limestone firmly cemented, and having a height of fully eight feet, the whole of which was removed before the cavity was disclosed or suspected.

The second stone is a rude flattened spheroid, formed from a pebble of coarse, hard, red sandstone, and apparently used for breaking or crushing. Its diameters measure two and three-quarters and one and three-quarter inches. It was found in the second level of the red cave earth, over which lay an enormous block of limestone, but no stalagmite. * * *

THE SUCCESSIVE PALÆOZOIC FLORAS IN EASTERN NORTH AMERICA.

BY J. W. DAWSON, F.R.S.

The Palæozoic formations of eastern North America may be grouped in four great ages, each characterized by a distinct Fauna and Flora, and a corresponding series of physical conditions. These are the Lower Silurian, the Upper Silurian, the Devonian and the Carboniferous, each of which constitutes a great cycle of Palæozoic time. The rocks supposed to be Cambrian are imperfectly known, and have afforded no fossils. The Permian group has not been recognized. 1. The Carboniferous Flora may be arranged in three subordinate groups: (1.) That of the Upper Coal Formation, consisting of a few of the more widely-distributed species of the preceding Middle Coal Formation. (2.) That of the Middle Coal Formation, the head-quarters of the peculiar Carboniferous Flora, and of the productive beds of coal. (3.) That of the Lower Carboniferous Coal Measures, consisting of a few peculiar species, several of which are not found in the overlying parts of the system. These plants have been widely recognized at this period in Eastern America, and a similar group seems to have existed at the same time in Great Britain. The whole Coal Flora in British North America may be estimated at about 150 good species, of which the greater number are common to America and Europe.—2. The Devonian rocks in Eastern America have afforded eighty-one species of land plants, of which only about ten are common to this and the Carboniferous period. They occur principally in the Upper Devonian, but some extend to the bottom of the system. Though fewer in species, the Devonian Flora is not lower in grade than that of the Carboniferous period. The earliest known species were allied to Lycopodiaceæ. The Devonian Flora has been recognized in Pennsylvania, New York, Ohio, Canada, Maine, and New Brunswick. The number of species common to the Devonian of Europe and America is not so great as in the case of the Carboniferous. 3. The Upper Silurian has afforded land plants only in its upper beds, and only at Gaspé, in Lower Canada. The only well-characterized species is *Psilophyton princeps*, which is also one of the most common plants in the Devonian. The first known appearance of land plants in America is thus at the same geological period with their first known appearance in Europe. 4. The Lower Silurian has as yet afforded no land plants. It abounds in objects called fucoids, but the greater part of them are trails of worms, crustaceans, and mollusks, rill-marks, shrinkage-cracks, &c. Those that show carbonaceous matter or structure seem to be allied to modern Algæ. The extent of shallow-water deposits of the Lower Silurian explored in Eastern America without any discovery of land plants, would seem to afford at least a presumption against their abundance at that period. The author anticipates that the Laurentian will yet afford evidence of at least the existence of Algæ before the Palæozoic period. He has prepared for communication to the Geological Society a detailed account of that part of the above succession which relates to the Carboniferous of British America.

REPORT ON LUMINOUS METEORS.

BY JAMES GLAISHER, F.R.S.

The principal points in this valuable Report were as follows: The number of meteors observed during the past year had been unusually small, partly owing to the cloudy state of the sky, and partly owing to the absence this year of certain acknowledged star-showers, namely, those of January, April, and August. The November shower, although concealed in England by clouds, was observed with considerable interest at Malta. If the sky be clear, the circumstances are altogether favorable for its re-appearance, in the present year and the next, on the morning of the 13th of November. Its greatest display is expected in 1866, but in the present year it is desirable to be prepared for its appearance. The British Association having printed maps for the use of the Committee (specimens of which were presented with the Report), every means will be provided to members willing to take part in the observations of this shower to enable them to record their observations with facility. A remarkable shower of meteors was observed on the 18th of October, coinciding with a date on which fire-balls have made their appearance in more than average numbers. The radiant point of this shower is perfectly well defined in Orion. There was a less conspicuous star-shower on the 28th of July, with a radiant equally distinct close to Fomalhaut, the most southerly star observed on our meridian. A number of other accurate observations of star showers are included in the Report. Of large meteors, the greater number took place in December. Two detonating meteors were also observed: the first in England, on the 20th of November; the second in Scotland, on 21st of February. Observations show that, on the first of these nights, shooting stars were extremely scarce, so that, at Weston-super-Mare and Hawkhurst, only one or two meteors could be counted in an hour. This fact illustrates, in a remarkable manner, the adventitious character of large meteors. A third detonating meteor, on the 30th of April, was doubly observed, at Manchester and Weston-super Mare, and its height well determined. The nearest approach to the earth was thirty-seven miles. Startling as are the accounts of detonations heard from such a height, it is yet more surprising that the report from such a distance should be brief and momentary. The sounds caused by meteors yet offer much which it is hoped will be explained by further observations. Interesting matter is given in the Report by Mr. Brayley and Mr. Sorby, "On the Origin of Meteorites, and on the Series of Physical Processes of which they are the Result." It appears, from microscopic examinations of their structure, that aërolites resemble, in their appearance, certain igneous terrestrial rocks; but characteristic peculiarities in their structure evince that this is far from being a complete account of their previous history. M. Brayley suggests that they originate in gaseous matter projected from the equator of the sun, and condensed to a solid form in its passage through interplanetary space. A gradual condensation from the vaporous state is said, by Mr. Sorby, to represent more nearly than any other the condition under which they must have been consolidated. In this view of the origin of meteorites, their source is considered to be unique, and they are traced to the energetic forces whose modes of action are considered in solar physics. The bodies thus arising are termed "meteoritic masses," to distinguish them emphatically from all other members of the solar system. In a "Memoir on Sporadic Shooting Stars," Mr. Newton, basing his conclusions upon a previous knowledge of their height, arrives at some interesting results regarding the number and distribution of these bodies in space. The average height of the centres of their visible tracks is sixty miles above the earth. Their number in the atmosphere daily is seven and a half millions, and if not intercepted in their flight, there would be found in the space occupied by the earth at any instant in its orbit, 13,000 of such bodies pursuing different orbits. Of shooting stars visible in telescopes, Mr. Newton calculates that the number is at least fifty times greater than the number of those visible to the naked eye. Indeed, there appears to be no limit to their minuteness or to their numbers. Their velocity is greater than that of the earth in its orbit, and Mr. Newton supposes they are grouped together according to some law, probably that of rings encompassing the sun, resembling, in their inclinations and dimensions, the orbits of the comets. Mr. Newton, in conclusion, supposes that these bodies, which he terms meteorites, are not fragments of a former world, but rather materials from which new worlds are forming. Meteorites and meteoritic masses, then, constitute two classes of bodies which have to be considered in meteoric astronomy. It is, however, reasonable to presume that the same forces which, in the phase of greatest concentration of the solar system, give rise to meteoritic masses might, in a phase of vastly greater antiquity and of greater extension of the solar orb, have given rise in a similar manner to rings of meteoroids. Continued observations directed to the phenomena of shooting stars will certainly remove doubt from this province of astronomy, and probably throw light on some of the most difficult questions in cosmical philosophy, such, for example, as the existence of organic matter (a kind of peat or humus) in the meteorites of Orgueil.

RESEARCHES IN THE LINGULA FLAGS IN SOUTH WALES.

BY MR. H. HICKS AND J. W. SALTER, F.G.S.

Mr. Henry Hicks, a resident of St. David's, having been entrusted with a grant to aid him in searching out the fossils of these strata, the results have been so important, as to lead to the discovery of an entirely new British formation, and the authors propose a new term for the group. The Cathedral City of St. David's was anciently called 'Minevia,' and hence, following the example of the best geologists, viz., first to ascertain the position, then the fossil contents of a group, and then to name it, the authors propose the term 'Minevian,' for the lowest division of the Lingula flag. Mr. Hicks described five sections on the coast north and South of St. David's—the coast affording admirable views of all the beds, from the central syenite through the olive gray, green and purple beds of the Lower Cambrians, in to the light-gray, black and grey shales of the Minevian group. Some of the sections show a passage from this group into the Ffestiniog group of Professor Sedgwick which forms the main mass of the Lingula flags proper, and in Whitesand Bay these are again overlaid by the Skiddaw group and the Llandeilo flags. Each of the sections has shown fossil traces after a long and persevering search. But the section at Porth Raw is not only the typical one, but contains all the principal fossil types—trilobites of six or seven genera, and about 15 species; brachiopod and pteropod shells, cystideæ, sponges of two or three different kinds. All of them are distinct not only as to species, but usually as to genera also from the overlying rocks of the

Lingula flags. And as the history of discovery in the Palæozoic rocks has been that every group beneath the old red sandstone, containing a distinct fauna, has received a separate name, the authors hold it of prime importance not to confound this fauna with any of the overlying rocks of the Silurian or even upper Cambrian systems. If Llandeilo, Caradoc, Llandovey, and Wenlock imply distinct periods of creation, much more does the term Lingula flag, Ffestiniog group indicate a remote period, in which not even the genera of fossil animals common in the great Silurian deposits are to be found. All is distinct and anterior, lower in point of organization, more limited in point of numbers; the species even, with some exceptions, diminishing in size. We seem to be coming to the dawn of animal and vegetable life. As indicative of the value of a close observation of these old faunæ, it may be sufficient to say that by means of this Minevian group, we can tell the exact horizon of the gold-bearing rocks of Wales; we can identify accurately the oldest fossil-bearing strata of Bohemia and Sweden with those of our own country, and assign them their exact position in the Palæozoic series. The genus *Paradoxides* becomes in this way one of the medals of creation, and the index of a most remote age—so remote that only a few, and those the humbler members of the invertebrate classes, inhabited the sea. With regard to the distribution of the fossils themselves, the lowest beds, which actually lie under the uppermost coarse beds of the Cambrian grits, only distinguished from them by the want of purple color, contain a species of Paradoxides (*P. Aurora*), with which are associated some minute trilobites; *Agnostus Microdiscus*, &c. Further up we have Paradoxides again, but of a distinct species, and larger. The mass of the fossils then come in, both crustacea, shells, and sponges; and high up in the series a third Paradoxides, so large as to attract general notice; the well-known *P. Davidis*. Specimens of each of them were exhibited on the reporter's table. Mr. Hicks described beds of contemporaneous trap, and showed their origin and direction, and the faults of the region were touched upon, but could not be fully described.

Mr. J. W. Salter offered some remarks upon the fossils of the flags. He first gave a general section of the district. The central portion consists of a mass of altered Cambrian rocks, and also a nucleus of syenite. The central part is succeeded by black shales and other deposits. The middle lingula succeeds; and these are capped with the Llandeilo measures, with the representatives of the stiper stones coming in between. The fossils occur in the lower member of the lingula flags. Thirty-three species are now known from these measures, and, with the exception of two species, have all been discovered by Mr. Hicks. From this cause he proposed to term this group of rocks the Minevian division, a name derived from the ancient designation of St. David's. The largest form of trilobite yet found in Great Britain (sometimes twenty inches in length, and called Paradoxides) is characteristic of these beds, and the smallest known trilobite (Agnostus) is also peculiar to this formation. With the crustacea occur several forms of mollusca of a low order. A few species of Cystidea are found, also several species of sponges. The fauna of St. David's is represented in the neighborhood of Dolgelly. The series is doubtless the equivalent of well known beds in North America, Bohemia, Sweden, and Spain. The result of the recent exploration has been to carry down the lower forms of life only. As we descend, the higher forms of life successively disappear. When we reach the lower beds, only annelids remain.

The PRESIDENT said every geologist must feel infinitely indebted to Mr. Hicks for his discovery, and to Mr. Salter for his lucid explanations. With respect to the general position of these beds, it appeared to him that they formed the natural base of that great system of rocks, the Lower Silurian. In Sweden, in America, in Germany, and all over the world, this primordial zone was the natural base of the Silurian or great Lower Trilobitic system.

Principal DAWSON said it was very pleasant to find so close a parallelism between the Lower Silurian rocks of this country and of Canada and other parts of North America. As Mr. Salter had mentioned, the great Paradoxides was found in Newfoundland in rocks of probably the same age as the Lingula flags. The same rocks ran along Nova Scotia, being the gold-bearing rocks of that country, but the Paradoxides had not yet been found in them. There was a continuation of the same great zone in Massachusetts; and in Canada, there were the very remarkable rocks constituting the Quebec group, containing similar fossils, and being, as Sir William Logan believed, a deep-sea formation of Lower Silurian age; so that all this brought what was known in America into harmony with what was found in this country. The occurrence of sponges in these rocks had been mentioned by Mr. Salter. The same thing had been ascertained in Canada by Mr. Billings in rocks probably nearly as old.

A FEW NOTES ON THE STRUCTURE OF THE MATTERHORN.

BY E. WHYMPER.

When one observes the great peak of the Matterhorn at a short distance, it is seen that its rocks are separated into three great divisions, of which the middle mass is the largest, and grey in color, while the upper and lower sections are apparently of a dull red. On ascending the mountain, these divisions are so clearly apparent, and the junctions of the sections are so marked, that it is almost possible to see the lines of separation. The rócks on the upper and lower divisions, however, it is found, are by no means uniformly red in color, but are interspersed with others of a green and of an iron grey. It is from the red rocks being so much more positive in tone that they present a uniform tint when seen at a distance. The specimens collected comprise fragments from each of these divisions. Those taken from the summit were detached when collected, but others were broken from the living rock. After exhibiting specimens of the rock, the writer went on to say: The summit of the Matterhorn is a roughly-lined ridge of 350 feet to 400 feet in length. It is extremely precipitous on one side; but on the side which descends towards the glaciers of Zmutt the inclination is moderate, and it can be traversed with great facility. There are several little points on this side, and the highest of them is usually covered by a small cone of snow. The whole of the summit is covered with disintegrated fragments, and the living rock is not anywhere visible. It was observed by De Saussure that the beds of the Matterhorn rise towards the N. E. at an angle of 45°. This is scarcely exact, although correct on the whole. They dip towards the south and west; but the inclination towards the west is three times as great as it is to the south. In consequence of these dips, the plane surface of the beds presents a surface sloping downwards on the western and southern sides of the mountain, and the fractured edges overhang each other. It is mainly from this cause that so much difficulty has been experienced in all previous endeavors to ascend the mountain; and it was from observing this fact that I formed the resolution to attempt the ascent by the north-western face; for although it appeared smooth and unbroken, yet I argued that the fractures would fall in exactly the reverse manner to that which I have described, and this would render the ascent easy, even although the hold they might afford should be but small. The theory was correct, and the whole of the north-eastern face was found to be in, fact, a long staircase, with the steps shelving inwards. It is also in consequence of these steps that stones do not fall to any distance on the north-eastern side; for it is evident that if any disintegrated fragments do break away, they must sooner or later be arrested on a ledge, and, indeed, I did not see any fall during the two days which I passed on the mountain. On the other side, on the contrary, the Matterhorn rains down showers, nay, torrents and avalanches of stones, both by day and night. Thus these dips become on one side a source of safety, but on all others a source of great danger. We are enabled by a knowledge of these facts to account for the enormous moraine of the Zmutt glacier, which has attracted the attention and the curiosity of all observers; for the Zmutt and its tributary, the Tiefenmatter, sweep round the two faces of the Matterhorn on which we should expect the greatest masses of rock would fall. We find, moreover, that the Furgee glacier, which is below the N. E. face, has scarcely any moraine. The consideration of these facts also suggests naturally that we see nearly the primal form of the Matterhorn on its N. E. side, but that great changes have taken place on the others. We are sure, indeed, of this, for we see the fallen fragments below. We can go a step further. The fallen masses are chiefly of the red rocks, and they must have either come from the upper or the lower of the three divisions. On the side of the Zmutt and the Tiefenmatter glaciers, however, the lower division is almost entirely covered by snow and glaciers. We are forced, therefore, to the conclusion that they came from the upper; and it is doing no violence to the imagination to suppose that at some early period the now isolated obelisk of the Matterhorn was only the termination and the culminating point of the ridge of which the Dent d'Erin and the mountains to the south of it formed also a part.

ENTOMOLOGICAL SOCIETY OF CANADA.

DESCRIPTION OF ALYPIA LANGTONII.

BY WM. COUPER, QUEBEC.

The male of the above species* was unknown to me, when I described and figured the female in the February number of this Journal (p. 64). The former is so different in color and markings, that a description is necessary.

The upper surface of the wings is not so dark as in the other

* Exhibited before Quebec Branch, Ent. Soc. of Can., July 5th, 1865.

sex; the color is brown, covered with a beautiful purple gloss. The spots on the anterior wings are in shape and color the same as in the female. There are two white spots on each of the posterior wings, one on the medial cell, opposite the limbus, as in the female, and the other, twice the size of the latter, occupies the subdorsal region. This spot is much larger on the under surface extending on the margo interior, and it is the distinctive mark between th' sexes. Dorsal part of the body tufted with white hairs. Length 1$\frac{3}{20}$ inch.

On the 29th June, I captured both sexes of this species in the Gomin swamp, near Quebec. *Alypia* resembles the *Hesperidæ* in flight, but when at rest, they do not erect their wings like the species of the latter family. It is very difficult to capture *Alypia*; three or four specimens may be considered a good day's work.

The following note relating to this species, was received in September last, from Aug. R. Grote, Esq., of New York:—"Your note and specimen of *Alypia Langtonii*, Couper duly handed to me. I thank you very much for the specimen. This species is very closely allied to *Alypia 8-maculata*, with which you should compare it rather than with *A. MacCullochii*, Kirby, to which latter *A. Ridingsii* Grote, is nearer allied. *A. Langtonii* ♀ differs from *A. 8-maculata* ♀ merely by the slightly more prominent palpi, and the presence of but one larger external spot on the secondaries. Kirby's species should be turned up by some of your entomologists. The ♂ of *Alypia 8-maculata* differs from the ♀, principally in that the inner larger spot on the secondaries is extended to internal margin and base of the wing."

CANADIAN INSECT ARCHITECTURE.

BY WILLIAM COUPER, QUEBEC.

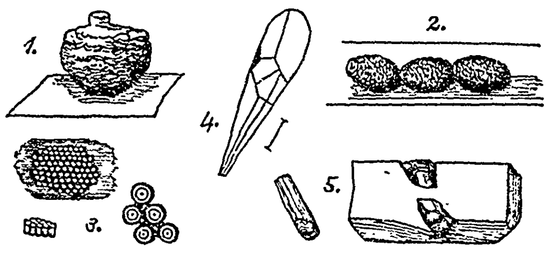

Fig. 1.—I found this pretty specimen on the 11th April. It was attached to the bark of a birch stump in Mr. Montizambert's woods, near Quebec. It is the work of a solitary hymenopter, probably belonging to the European family EUMENIDÆ, but whether the Canadian insect is the same as 6, fig. 87, vol. ii, of Westwood's Introduction to the Modern Classification of Insects, remains to be determined. The following extract from the above book will suffice to throw some light on this insect architecture:

"Geoffroy (Hist. Ins. Paris, tom. ii, p. 378, pl. 16, fig. 2) has described a species of EUMENES (*V. coarctata* Linn.) which differs somewhat in its habits from the rest of this family. This species constructs upon the stems of plants, especially heath, small spherical nests formed of fine earth. At first a hole is left at the top, through which the parent fills the cell with honey, undergoes the metamorphosis, and makes its escape through a hole which it forms in the side of the cell which contains but a single insect."

Westwood's illustration (7, fig. 87) and the above description corresponds with the Canadian architecture; but, as Mr. Cresson, of Philadelphia, does not include *V. coarctata* in his list of North America EUMENIDÆ in Proceed. Ent. Soc. Philad., vol. i, p. 327, I infer that the insect and its architecture have not been heretofore described as occurring on this side of the Atlantic. I found at Toronto a similar specimen of the work of a solitary wasp, but failed to obtain the insect from it, and I have been equally unfortunate with the one found at Quebec. The insect, not making its appearance up to the middle of June, I made a hole in the side of the nest, with a sharp-pointed instrument, which wounded and destroyed the larva. The inside of the nest is lined with a strong silky substance. Should I hereafter obtain the builder of this form of insect architecture, and recognize it as identical with the one mentioned by Westwood, it will not only sustain the supposition that at one time a land connection existed between Europe and America, but will also be an additional species in evidence of Mr. B. D. Walsh's argument (Proceed. Ent. Soc. Philad., vol. iii, p. 213) against statements of some American naturalists that separate insect creations have occurred on this continent.

I found another beautiful specimen of fig. 1, on the 25th July, attached to a fence on the St. Louis Road, not half a mile from the locality, where the figured specimen was discovered. The structure stood out from the fence—indeed, I would have passed it, had not the button-form on the top attracted my notice. Its foundation is different from the figured one; instead of being spherical, the form is dome-shaped, the fence having been the base of the structure, therefore, its contents were exposed when it was detached from its position. It contained the larva of the hymenopter and two fresh looking caterpillars, which it devoured together with a common fly that I gave it on the following day. The larva is about half an inch long, flesh-colored, smooth and glossy, having about thirteen rings. It has since lined the interior of its nest with a coating of fine white silken threads. It is difficult to explain the use of the button-like form which is always on the top of the nest of this wasp. When I found the nest, it contained two small caterpillars which only served the larva one day, and it afterwards devoured common houseflies. Can it be that the button or top is removed by the parent insect in order to supply its progeny with additional food? When the architecture of this wasp is newly formed, the top has a regular concavity, and the edges are well rounded and sharp, which is the case with the specimen found on the 25th July. The top of specimens found early in spring, and which were exposed during winter, are not so perfect, and after making allowance for exposure to the weather, I am led to think that the parent insect opens the top of the nest to supply the larva with additional food, reconstructing it with less regularity than the original form: the top is evidently the last part of the structure finished. There is no other substance but clay or mud and sand used by the parent insect, and it is not until the larva had finished feeding, and devours the material supplied to it, that it lines the walls of its cell. The economy of this insect is not yet thoroughly investigated. I may have another opportunity of doing so.

Fig. 2.—The three nests above figured were found attached to the bark of a stump in the same locality where the former specimen was found. They belong to a different genus, and the architecture corresponds with that of the genus Osmia, an European mason-bee, the cells of which are figured in Rennie's Insect Architecture, p. 41, fig. 2. The nests of this insect are made of clay and sand, but they are smaller than those of *Osmia bicornis* of Europe. There are three series of cells illustrated in this work, two of which produced the last-named insect, and from the third came *Megachile muraria*, and a dipterous parasite. The author is evidently at fault, as the similarity of structure represented by the illustrations are alone sufficient to show the work of one species. *M. muraria* Linn., is a sand-burrowing bee, and I am not aware that it is a parasite on any species of its own family. The Quebec cells had no winter protection; they were found in a position exposed to a low temperature during winter. I have not detected either of these species constructing their nests, and whether they are filled with honey, pollen, insects on their larvæ, as stated by Westwood, p. 241, I cannot state positively, but I am led to believe that the interior of fig. 1 is filled either with honey or pollen by the parent insect. Neither of the cells, fig. 2, produced an insect. Probably the low temperature destroyed the larva.

Fig. 3 illustrates a mass of what, at first I took to be the cocoons of a species of microgaster similar to 17, fig. 76, Westwood's Int. to Mod. Class. of Ins., vol. ii. They were found attached to a paling on St. Foy's road by Mr. Geo. J. Bowles, of Quebec. I have since discovered that they are the eggs of a species of geometer, probably the canker-worm figured in Harris's Insects Injurious to Vegetation, p. 463.

Fig. 4 is the anterior right wing of a hymenopter, belonging to the family Crabonidæ, the genus and species of which are unknown to me. The insect is completely black. Head wide; eyes reniform; antennæ inserted in front, thickened at their tips; face above the mandibles silvery; wings iridescent, anterior wings composed of eight, posterior, of seven cells; posterior legs about twice the length of anterior; length from the base of antennæ to tip of abdomen five-twentieths of an inch.

Fig. 5 represents the piece of a maple stump containing the cell of the last described solitary wasp. It appears to be allied to that of fig. 2 in its mode of mason-work. Instead of forming an exposed oval cell made entirely of clay and sand, the parent insect selected an old coleopterous larva hole which runs obliquely upwards in the stump, and the cell of the hymenopter is near its exterior, as seen in the figure, about seven-twentieths of an inch long, having an interior as well as an exterior barrier of clay, represented by the dots in the wood-cut. The intervening space is occupied by an oblong thin cocoon, similar to a quill membrane. One species, the *Trypoxylon figulus* of Europe, makes use of the holes of other insects commenced in woodwork, by first enlarging and then plastering them with a covering of fine sand; and I have noticed that when the American mason-wasp finds a suitable hole terminating at a short distance from the entrance, that the clay used by it is what closes the mouth of the cell, one of the wasps keeping guard while the other is away procuring material for the work.

I am indebted to my fellow-laborer in entomology, Mr. Geo. Jno. Bowles, for the illustrations accompanying this paper.

Read before the Quebec Branch, 7th Sept., 1865.

OBITUARY NOTICES.

SIR W. J. HOOKER.

The brief announcement in our last number of the death of Sir William Hooker will have been perused with feelings of regret by all our readers, and by a very large circle with the deepest personal sorrow. During his long career he had succeeded in attaching to himself the affectionate regard of a long series of friends, pupils and correspondents; and there is no corner of the earth where his loss will not be mourned with heartfelt grief, by some one to whom his uniform kindness lent a helping hand. For more than fifty years he has occupied a distinguished place as a man of science; and throughout that long period, first as a successful teacher, and later as the head of our great national establishment, with the rise and progress of which he is identified, he has been conspicuous for his singleness of purpose, his forgetfulness of self, his zeal in the discharge of his duties, his sagacity in forming plans, and the success with which he carried them out. The death of such a man is no common loss to the world, and we have therefore spared no pains in getting together authentic particulars of his life.

Sir W. J. Hooker was born in 1785; his father, who was in business at Norwich, being a man who devoted all his leisure to reading, especially travels and German literature, and to the cultivation of curious plants, by which, doubtless, was laid the foundation of that love of Natural History for which his son was so distinguished. Sir William's education was received at the High School of Norwich. Having at an early age inherited an ample competency from his godfather, William Jackson, Esq., he formed the design of devoting his life to travelling and natural history. Ornithology and entomology first attracted his attention; but, being happily the discoverer of a rare moss, which he took to Sir J. E. Smith, he received from that eminent botanist the bias which determined his future career. Henceforth, botany was his sole aim; and with the view of collecting plants, he made expeditions to Scotland and its islands, France, Switzerland and Iceland, and made extensive preparations for a prolonged exploration of Ceylon, which plan was, however, frustrated by the disturbances which broke out in that island.

During this period, 1806—14, he formed the acquaintance of all the principal scientific men in England and on the Continent, and commenced that intercourse and correspondence which never ceased till the day of his death. In 1815 he married the daughter of Dawson Turner, of Yarmouth, himself well known as a good botanist, and settled at Halesworth, in Suffolk. Here was laid the foundation of his now magnificent herbarium, and here commenced a long series of valuable botanical works, which followed each other at short intervals up to the present time. An increasing family and a decreasing income induced him, in 1820, to accept the Regius Professorship of Botany in Glasgow, at which place the next twenty years of his life were passed, and where his popularity as a lecturer, his admirable method of training his students, and his genial and attractive manners, soon made his house a rendezvous for all scientific men who visited Scotland—we might almost say England. Gradually his correspondence and his herbarium alike increased; the latter receiving large contributions from his numerous pupils, who, in foreign countries, remembered with gratitude the teacher who had placed science before them in so attractive a form.

In 1836 he received the honor of knighthood from William the Fourth, in acknowledgment of his distinguished botanical career, and the services he had rendered to science; and in 1841 his connexion with Scotland terminated, and a new era of his life began with his appointment to Kew. To be Director of Kew Gardens had long been the ambition of Sir William Hooker's mind; and throughout his long residence in Glasgow he never abandoned the possibility of eventually being placed in that position. He was encouraged in these views by a nobleman well known for his distinguished patronage of literature and science, and himself a keen horticulturist and no mean botanist. We allude to the late John, Duke of Bedford, who, through the influence of his son, Lord John Russell, a statesman then rapidly rising into power, exerted a silent but most powerful influence with the Government and officers of the Queen's Household, in effecting the transference of the Gardens to the public. Sir William's appointment was indeed drawn up by Earl Russell; it gave him a salary of £300 a year, with £200 to hire a dwelling-house for himself, which should be large enough to contain his library and herbarium, the latter requiring no fewer than twelve ordinary sized rooms for their accommodation. This was afterwards increased to £800 a year, with an official house in the Gardens, and accommodation for his herbarium in the residence of the late King of Hanover, where it forms the principal part of the great Herbarium of Kew. The noble Earl is fond of stating that on taking Sir William's appointment for signature to a brother Lord of the Treasury, the latter remarked, "Well, we have done a job at last!"

The history of his career as Director of the Royal Gardens is so well and so widely known, that it need not detain us long. From a garden of eleven acres, without herbarium, library, or museum, and characterized by the stinginess of its administration, under his sole management it has risen to an establishment comprising 270 acres, laid out with wonderful skill and judgment;—including an arboretum of all such trees and shrubs as will stand the open air in this country, magnificent ranges of hot-houses and conservatories, such as no three establishments on the Continent put together can rival;—three museums, each an original conception of itself, containing many thousand square feet of glass, and filled with objects of interest in the vegetable kingdom from all parts of the globe, a herbarium unrivalled for extent, arrangement, accuracy of nomenclature, and beauty of keep, and excellent botanical libraries, including small ones for the use of the gardeners and museums.

To the accumulation of these treasures he not only brought all the powers of his Glasgow correspondence, but by means of his friendly relations with the Admiralty, Colonial and Foreign Offices, India Office, and many private companies, not only enlarged the bounds of his intercourse in all directions, but at a comparatively trifling cost procured specimens from countries the most distant and difficult of access.

To him is due the formation of many of our colonial Gardens, and the resuscitation of the rest; his example has stimulated national gardens on the Continent to a degree they never felt before; whilst the amount of information on all branches of economic botany which he has diffused among the laboring and manufacturing classes can hardly be over-estimated.

In conclusion, it is only right to state, that though these more public duties have naturally attracted the most attention, his scientific labors not only did not cease on his coming to Kew, but were literally doubled. Rising early and going to bed late, and rarely going into society, the whole of his mornings and evenings were devoted to scientific botany. The species Filicum, prepared wholly at Kew, is of itself a sufficient monument of one man's industry; and when to this we add that he published from his own pen upwards of fifty volumes of descriptive botany, all of them of merit and standard authority, it must be confessed that his public career has in no way interfered with his scientific one. Indeed, up to the day of his death his publications were progressing as busily as ever, and the first part had appeared of a new work, the 'Synopsis Filicum,' for the continuation of which extensive preparations had been made.

Not content with publishing himself, he was always forward in obtaining for others remunerative botanical employment. Besides numberless appointments given to young and rising gardeners and botanists, he procured the publication of the results of many scientific expeditions and missions, and latterly, after many years' strenuous exertion, he induced almost all our Indian and Colonial Governments to employ botanists upon the publication of their Floras.

In person Sir William Hooker was tall and good-looking, with a peculiarly erect and agile gait, which he retained to the end of his life. His address and bearing were singularly genial and urbane, and he was as remarkable for the liberality and uprightness of his disposition, as for the simplicity of his manners and the attractive style of his conversation.

He died at Kew, of a disease of the throat, then epidemic at that place, on the 12th of August, having just completed his eightieth year. His widow survives him, a lady whose varied accomplishments were of invaluable assistance to him in his scientific labors throughout his married life; and he leaves one son, the present Assistant-Director of the Royal Gardens, and two married daughters.—*London Athenæum.*

DR. LINDLEY.

Science has just sustained a heavy loss by the death of Dr. John Lindley, one of the most hard-working and celebrated botanists England has ever produced. Dr. Lindley was born at Catton, Norfolk, in 1799, and at an early age turned his attention to the study of the Vegetable Kingdom. When he first entered scientific life, botany was just emancipating itself from the deadening influence of the artificial system, in this country upheld by a narrow-minded party. Whoever ventured to write or say anything against these sages was at once a marked man. The treatment which Dr. Gray received for daring to publish the first British Flora, arranged according to the Natural system, is no isolated case. Dr. Lindley's history, and that of several other men of genius, furnish additional examples. * * * * Dr. Lindley's rise, in the estimation of his contemporaries, was rapid, and for more than thirty years he was the centre to which botanists turned for advice and help, and around which botanical science in this country moved; Robert Brown, his equal—or let us rather say superior—in intellectual grasp, being of too retiring a disposition to serve that purpose.

Dr. Lindley's external history is briefly told. He was for many years Secretary to, not to say the life and soul of, the Horticultural Society during its palmiest days, when botanical collectors such as Douglas and Hartweg were sent out to remote parts of the world, when Knight and Sabine published the result of their investigations, and new methods of cultivation were practically and successfully demonstrated at Chiswick. To his connexion with this body of enlightened men is owing his conception of his 'Theory of Horticulture,' a work which has done more to put gardening on its proper footing than any other, and which in this country went through several editions, and has been translated into many European languages by men of real eminence. This same connection also led him to feel acutely the want of a good weekly gardening newspaper, such as Fred. Otto had established in Berlin some years previously, and the 'Gardener's Chronicle' was the result. Dr. Lindley became the editor of the paper, and held that office till the day of his death. It offered him a ready field for expressing his opinions, freely criticising all that was unsound and shallow, and holding out that helping hand to rising talent so shamefully withheld from him on his first entry into scientific life. The 'Botanical Register' offered another opportunity of advancing his favorite science, by figuring and describing the most remarkable new plants that came to this country. Many of our garden pets, the names of which have become household words, such as Fuchsias, Verbenas, and Calceolarias, were first made known in the pages of that periodical. Dr. Lindley's particular favorites, however, were none of the plants just mentioned, but those most singular of all vegetable forms the Orchids; and it may be said that he brought them into fashion. For many years he labored incessantly to describe their numerous representatives, and interpret their singular structure. It took him ten years to work out 'The Genera and Species of Orchidaceous Plants,' and another ten years to complete various memoirs on these plants, which he published under the name of 'Folia Orchidacea.'

The writings of Dr. Lindley form quite a library by themselves. There are amongst them both elementary books, and works intended merely for leading men of science. His 'Fossil Flora of Great Britain' has endeared him to geologists, and his various works on gardening to horticulturists. Perhaps the most widely known of all his works is 'The Vegetable Kingdom,' which appeared in 1846, and gives a condensed account of the structure, geographical distribution and uses of plants, arranged according to the Natural system as understood by him. It was an amplification of his earlier attempts in the same direction, and has been found extremely useful. Notwithstanding that its general arrangement of the Natural Orders has never been followed by any botanist, it would be difficult to name a work which has more advanced the cause Dr. Lindley had so much at heart, than this book. When it first appeared, it was stereotyped, and the new editions are merely the old matter with some cancels and supplementary pages. "I can do nothing more with it," we heard him say a few years ago; "I am getting too old to be able to sit up half of the nights as I used to do formerly; and I must leave it to younger men to finish what I have begun." He was right; he was no longer able to sit up half the night deeply engaged in study. As it was, he had worked too hard, and overstrained his brain. His memory, which had always been most retentive, began to fail; and he suddenly found that he must give up all mental labor at least for a time. There was a slight improvement after he had enjoyed some months of undisturbed rest, but it soon became painfully evident to all that the strength of this mental giant was broken, that Lindley had laid down his powerful pen, never to take it up again. He had to give up his connection with the Horticultural Society altogether, and resign the Professorship of Botany at University College, which he had filled for many years. He died of apoplexy on Wednesday, the 1st inst., at his residence on Acton Green, deeply regretted by a large circle of friends.

Dr. Lindley was a member of most scientific societies in all parts of the world, and his name is held dear wherever science is cultivated and true genius appreciated.—*London Athenæum.*

REVIEWS.

ILLUSTRATED CATALOGUE OF THE MUSEUM OF COMPARATIVE ZOÖLOGY, AT HARVARD COLLEGE. No. 1. OPHIURIDÆ, &c. By Theodore Lyman.

To a working naturalist, no publication is more acceptable than an illustrated descriptive catalogue of an extensive collection; and no work requires more care and patient application. Good museum catalogues, owing to the labor and expense they involve, are of rare occurrence; and the thanks of all naturalists are due to the director of the Cambridge Museum, Professor Agassiz, for this excellent beginning of a work which it is to be hoped will be continued in many successive numbers. The work of this catalogue is exceedingly well done, both in regard to scientific accuracy and mechanical and artistic execution. We could have wished, however, that the authors' names had not been changed in cases where a species is referred to a new genus. This not only deprives the original describer of due credit, but interferes with the facility of reference. The difficulty would be better met by giving the original author of the specific name with the letters Sp. following. In the present work the mode followed causes a large number of old familiar species to be referred to the author of this catalogue, who has merely changed the genus. In making this remark, however, we do not wish in the least to detract from the merits of this very excellent catalogue, or more properly descriptive monograph. The objects sought to be attained by its publication are thus stated by Prof. Agassiz:—

"The publication of the Illustrated Catalogue of the Museum of Comparative Zoölogy has been undertaken with a threefold object. In the first place, like the catalogues of most institutions of a similar character, it is intended to make the contents of our Museum generally known, and to facilitate our exchanges. In the second place, to be the medium of publication of the novelties received at the Museum, which require to be described and illustrated by diagrams or wood-cuts, or more elaborate plates. Finally, it is hoped that it may be the basis of a systematic revision of such natural groups of the animal kingdom as are most fully represented in our collections, and that it may, as far as possible, present to the scientific world the results of the investigations carried on in the Museum with a view of ascertaining the natural limits of the Faunæ at the present time and in past ages, and the genetic relations which may exist between the order of succession of organized beings upon the earth, their mode of growth, and their metamorphoses during their embryonic life, and the plan and complication of their structure in their adult condition.

" The means for publishing this work have been most liberally granted by the Legislature, at a time when, in a less enlightened assembly, the material cares of the community would have engaged their exclusive attention." J. W. D.

EMBRYOLOGY OF THE STARFISH. By Alexander Agassiz.
SEASIDE STUDIES IN NATURAL HISTORY. By Elizabeth C. and A. Agassiz.

These are new products of the teeming workshop of Zoology established under Professor Agassiz at Cambridge. While the great zoologist is himself exploring in Brazil, these works have been issued by his son and by Mrs. Agassiz. The first mentioned is an elaborate account of the remarkable changes through which two of our commonest American star fishes, *Asteracanthion pallidus* Ag., and *A. berylinus* Ag., pass in their progress to maturity. In some respects it forms a supplement to the investigations of Müller and other European naturalists on the Embryology of Echinoderms; but it elucidates several points which had been left in obscurity; and it fully vindicates the claim of the echinoderms to be placed in the great Cuvierian group of radiates, in opposition to the preposterous attempt to place them with the worms, which has lately gained currency in some quarters. Every one interested in these questions should carefully study this work, which will constitute a part of the forthcoming volume fifth of Agassiz's " contributions."

The second work above named is a popular sea side book, giving an excellent and very interesting summary of the marine radiates of Massachusetts Bay. Most of the species referred to are found also on the shore of Maine and in the Gulf of St. Lawrence, so that the work will form a good companion and guide for visitors to those coasts as well as to Massachusetts. The book is well illustrated, and is at once thoroughly popular and accurate in a scientific point of view. J. W. D.

MISCELLANEOUS.

Preservation of Starfishes with natural colors; by A. E. Verrill.—Starfishes may be dried, so as to retain their natural colors almost unimpaired, by immersing them in alcohol of moderate strength for about a minute, or just long enough to destroy the life, and produce contraction of the tissues, and afterward drying them rapidly by artificial heat. The drying is best effected by placing them upon an open cloth stretched tightly upon a frame and supported a few feet above a stove. Care should be taken not to raise the heat too high, as the green shades change to red at a temperature near that of boiling water. By this process I have succeeded in preserving the delicate shades of red, purple and orange of the species found on the coast of New England, including *Solaster papposus*, *S. endeca*, *Cribella*, *Asteracanthion pallida*, *A. littoralis*, and various other species, specimens of which are in the Museum of Yale College. The same process is equally applicable to Echini and Crustacea.—*Silliman's Journal.*

Harvard University Herbarium.—This establishment is noticed in the Annual Report of the President of the University to the Board of Overseers, made in January last, as follows:—

"Dr. Asa Gray has presented to the University his invaluable Herbarium and his Botanical Library; which have been safely transferred to the fire-proof building furnished, at a cost of over twelve thousand dollars, by the generosity of Nathaniel Thayer, Esq., of Boston. A fund has also been raised by subscription, for the support and increase of the collection......The gift of Dr. Gray cannot be estimated in money, but it embraces the results of many years' labor faithfully given by that distinguished botanist, aided by the generosity of his collaborators and correspondents in various parts of the world."

The collections were formally presented by the following letter:—

Botanic Garden, Cambridge, November 30, 1864.

"To Rev. Dr. Hill, President of Harvard University,

"*My Dear Sir*:—I have the pleasure to inform you that the Herbarium and Botanical Library, which a year ago I offered to present to the University, are now safely deposited in the building erected for their reception by Mr. Thayer. I have regarded them as belonging to the University from the beginning of the present year; but I wish more formally to make them over to the President and Fellows, as the foundation of the Harvard University Herbarium.

"The Herbarium is estimated to contain at least 200,000 specimens, and is constantly increasing. From the very large number of typical specimens it comprises, its safe preservation is very important.

"The Library, from the rough catalogue which has been made out, contains about 2200 botanical works—perhaps 1600 volumes, and nearly as many separate memoirs, tracts, &c.

"The current expenses of the establishment for the first half of the year now drawing to a close have been defrayed by Dr. Jacob Bigelow, who placed in my hands a special donation of two hundred dollars for this purpose.

"I had stated that the income of a capital sum of $10,000 would be required to defray the current expenses of the Herbarium, *i. e.*, for the purchase of certain collections and books not obtainable by exchange, for freights and charges, paper, alcohol, fuel, &c. I am informed that this sum, which Mr. George B. Emerson undertook to raise by subscription, is substantially secured. It is desirable, but probably not at this time practicable, that this endowment should be so far extended as to provide for the services of a Curator, so that I could myself devote valuable time to the prosecution of important botanical works for which I am prepared, and to which I am pledged.

"I have the honor to be, with great respect, very truly yours,

ASA GRAY."

Published, Montreal, Feb. 19, 1866.

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