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NEW SERIES. VOL. VIII.—No. 1.

THE

CANADIAN NATURALIST

AND

Quarterly Journal of Science.

WITH THE

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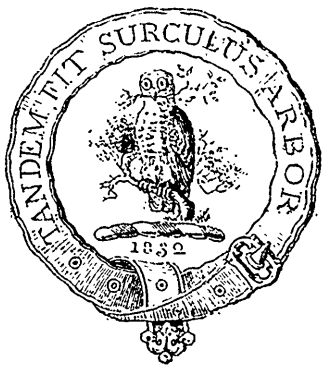

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CONTENTS OF No. 1, Vol. VIII.

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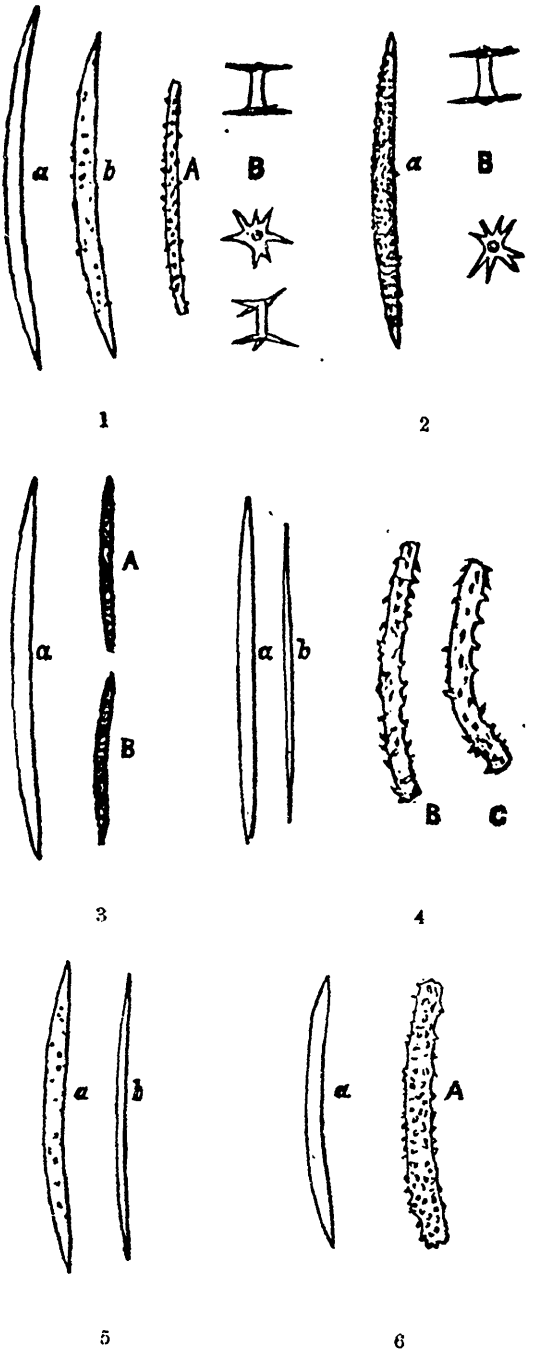

Figs. 1 & 5. *Spongilla stagnalis.*
" 2. " *asperrima.*
" 3. " *Dawsoni.*

Fig. 4. *Spongilla flexispina.*
" 5. " *Ottawaensis.*

THE

CANADIAN NATURALIST

AND

Quarterly Journal of Science.

ON SOME CANADIAN SPECIES OF SPONGILLÆ.

By George M. Dawson.

The *Spongillidæ* or fresh-water representatives of the marine sponges, though very widely distributed, are not yet known to be represented by a great number of species. It is probable that a systematic exploration of the great North American systems of lakes and rivers might bring many new forms to light. With the exception of *S. Lordii*, Bowerbank, from the sources of the Columbia River, the only Canadian spongilla which appears to have been described, is *S. Dawsoni*, of the same author, a form inhabiting the St. Lawrence River near Montreal, and other neighbouring waters.

Having become interested in the examination of a fine species from the Lake of the Woods, obtained in connection with the work of the British North American Boundary Commission, I have been induced, at the same time, to examine a number of other specimens in the collection of Principal Dawson. Among these, and including the Lake of the Woods form, I find four species which I believe to be undescribed. These are here defined, and though I have not the whole of the literature of the subject at hand, provisionally named.

The descriptions, from the poor state of some of the specimens, are necessarily not in all cases complete; but will, I believe, at least serve for the recognition of the species, with the aid of the figures.

The first spongillas studied—*S. fluviatilis* and *S. lacustris*—belong to two distinct types; and it has been found, on extend-

ing the knowledge of the genus, that all new forms fall naturally into one or other of these. To this rule the forms now under consideration offer no exception, though representing both groups; *S. stagnalis* and *S. asperrima*, belonging to the fluviatilis type, *S. flexispina* and *S. Ottawaensis*, to that of lacustris.

In the first series, are included those spongillas in which the gemmule, or reproductive capsule, is built up of birotulate spicula, placed side by side, and arranged with their axes radially. In the second, the capsules are more leathery, but covered, when mature, with straight or curved spicula, arranged at right angles to the radial lines.

For details concerning the classification and morphology of the *Spongillidæ*, reference should be made to Dr. Bowerbank's and Mr. Carter's Memoirs.

I append first Dr. Bowerbank's description of *S. Dawsoni*, as given in his monograph on the *Spongillidæ*.*

Spongilla Dawsoni, Bowerbank. "Sponge sessile?, branching; surface smooth, oscula and pores inconspicuous. Dermal and interstitial membranes abundantly spiculous; spicula fusiformi-acerate, entirely spined; spines numerous, short, and conical. Skeleton-spicula acerate or subfusiformi-acerate. Ovaria spherical: dermal spicula numerous, disposed in flat fasciculi, or groups of spicula parallel to each other; groups irregularly dispersed; spicula acerate or subcylindrical, entirely spined; spines numerous, obtuse, and ill-defined. Sarcode aspiculous. Colour, in the dried state, emerald-green."

Hab., River St. Lawrence, Montreal; a lake near Brockville.

Dr. Bowerbank further adds, with reference ro this species:

"The dermal and interstitial membranes abound with tension-spicula, and especially the dermal one, in which they seem to attain their fullest degree of development. Their normal form is fusiformi-acerate; but, from the abundant production of the spines at their terminations, they frequently appear to be cylindrical rather than acerate. They are disposed on these tissues rather unevenly, abounding in some spots, while they are comparatively scarce in others."

"The spicula of the skeleton are of about the same proportions as those of the European species. They are usually of the regular acerate form, but occasionally become subfusiform."

---

* Proc. Zool. Soc. London, Nov. 1863, and *Canadian Naturalist*, 1864.

The spongilla is sessile, and branches much, well-grown specimens much resembling fully developed examples of *S lacustris*.

Length of skeleton-spicula 0.013. Dermal and interstitial spicula, 0.0015 to 0.0017 inch.

Fig. 3.—*a*, ordinary skeleton-spiculum. A. and B., ordinary capsular and dermal spicula.

Spongilla stagnalis, sp. nov. Sponge encrusting, forming patches several inches in diameter, and from half an inch to an inch thick; greenish; lobular, somewhat hispid. Oscula simple, key-hole shaped, or double; large, 0.25 to 0.50 in. Scattered, sub-crateriform. Skeleton-spicula acerate and fusiformi-acerate, slightly arcuate, 0.011 to 0.013 in. long. Most of the stouter spicula medially spined, the apices always naked; spines small, sparsely distributed. Ovaria, sub-globose, diameter, 0.025 in. Rotulæ, about equal in size, flat, very deeply and irregularly dentate, diameter about equal to length of shaft of spiculum, or 0.0005 in.; the rays not acute. Shaft, thick, cylindrical, generally with a boss at each end.

Hab. North-west Angle Inlet, Lake of the Woods; River St. Lawrence near Montreal.

The two forms of skeleton spicula seem to pass into each other, and in specimens from both localities, are very irregular in size. The birotulate spicula—especially in the Lake of the Woods specimens—are very apt to be deformed. A number of small, entirely spined, straight, obtuse spicula, about one-third the length of the skeleton-spicula, were found with the others, after treatment with acid. They were searched for in all parts of the sponge, but finally found enclosed in some of the gemmules, and apparently in connection with the young sponge.

This species, which is nearest the European type *S. fluviatilis*, of Johnston, was found in great abundance at the first mentioned locality, in July, 1873. It was growing on floating logs and branches, and many specimens were filled with large gemmules. It is probably the species the existence of which was suspected by Dr. Bowerbank, who says, in the conclusion of his notice of *S. Dawsoni*:—"In the preparation of these spicula for examination, I found a few birotulate ones, having the rotulæ very deeply divided. These spicula were no part of the sponge in course of description, but were undoubtedly from the gemmules of another species inhabiting the St. Lawrence."

Fig. 1.—*a.* and *b.*, ordinary skeleton-spicula. B., birotulate spicula. The middle figure shows one end of a spiculum, of about the ordinary form; the lower figure, a type of deformed spiculum which is common. All the above drawn from Lake of the Woods specimens. Fig. 5. represents skeleton-spicula of a specimen from the St. Lawrence.

Spongilla Baileyi, Bowerbank. This species appears to be indicated by a single birotulate spiculum, in the Lake of the Woods collection. It was originally described by Dr. Bowerbank, from specimens obtained at West Point, N. Y.

Spongilla asperrima, sp. nov. Sponge sessile, encrusting, thin; surface slightly undulated; oscula rather large, scattered; skeleton-spicula, fusiformi-acerate, slightly arcuate, stout, densely spined, with the exception of the extreme apices; length, 0.01 to 0.009 in. These mixed with a few smooth and more slender. Spines minute, acute. Ovaria sub-globose, diameter nearly 0.02; spicula birotulate, short; rotulæ equal in size, flat, very deeply divided, about 0.0005 in., equal to, or greater than, the length of the shaft; radii not acute; shaft with a distinct boss at each end.

Hab., River St. Lawrence, near Montreal.

This species much resembles that from the Lake of the Woods, of which, it is possible, it may turn out to be a variety. It differs chiefly in its thicker, coarser and much more densely spinous skeleton-spicula, and in the external form of the sponge. Not possessing any intermediate forms, I have referred them, for the present at least, to different species. The spicula are not unlike *S. Parfitii*, as figured by Bowerbank,* but differ from them about as much as from those of the Lake of the Woods. Many of the skeleton-spicula are deformed, having crutch-like or bent ends.

Fig. 2., *a.*, ordinary skeleton-spiculum. B., one of the ordinary birotulate spicula.

Spongilla flexispina, sp. nov. Specimens not large enough to show the general form, or appearance of the surface. Skeleton-spicula acerate to subfusiformi-acerate, very slightly arcuate to nearly straight, smooth, not very acute, length about 0.0115 in. Dermal and interstitial spicula subcylindrical, irregularly and

* Brit. Spongiadæ, Vol. III., Plate LXXXVI.

often abruptly bent, entirely spined, length nearly 0.003 in.; spines scattered, rather large, conical, acute, generally retrorse near the ends of the spicula. Ovarian spicula scarcely distinguishable from the interstitial and dermal.

Hab., River St. Lawrence, near Montreal.

This species is of the type of the European *S. lacustris*, but differs sufficiently from that species. It also differs markedly from *S. Dawsoni* and *S. Ottawaensis*. Its ovarian and dermal spicula are intermediate in size between those of the last named species.

Fig. 4.—*a.*, ordinary skeleton-spiculum. *b.*, a second form of skeleton-spiculum, smaller and perhaps not fully developed. B., C., ovarian and dermal spicula.

Spongilla Ottawaensis, sp. nov. Specimens do not show the external form. Colour in the dried state, green. Skeleton-spicula acerate, slightly arcuate, often rather abruptly and bluntly pointed, smooth, length, 0.011 to 0.008 in. Ovaria sub-globose, rather irregular, large, diameter 0.04 in.; spicula cylindrical, stout, slightly and regularly arcuate, entirely and rather densely spined, length 0.0034; spines rather prominent, somewhat obtuse. Dermal and interstitial spicula like the ovarian, but slightly more delicate.

Hab., L'Orignal, on the Ottawa River.

The skeleton-spicula are shorter than those of *S. Dawsoni*; the ovarian etc. spicula much larger than those of that species, and larger also than those of *S. flexispina*. They somewhat resemble those of *S. lacustris*, but are distinctly truncate at the extremities. The specimens are small, but densely filled with large ovaria.

Fig. 6.—*a.*, ordinary skeleton-spicula. A., ovarian spicula.

NATURAL HISTORY SOCIETY.

PROCEEDINGS FOR THE SESSION 1874–75.

FIELD DAY.

A Field Day to Belœil Mountain was held on the 24th of May, which was very numerously attended. The spring being unusually late, the collections of plants, &c., were not so large as they otherwise might have been. From the summit of the mountain, addresses relating to the geology and history of the surrounding district were delivered by the President, A. R. C. Selwyn, F.R.S., by Principal Dawson and Rev. Dr. De Sola.

The following prizes were awarded during the afternoon:

1. For the best named collection in any department of Natural History.—Captain F. S. Barnjum.

2. For the largest number of species of Flowering Plants, unnamed.—Mr. Rankine Dawson.

3. For the second best ditto.—Miss Grace Lyman.

MONTHLY MEETINGS.

1st Monthly Meeting, held October 26th, 1874.

The Hon. Donald Smith, M. P., was elected a member of the Society.

Dr. J. Baker Edwards exhibited a sample box of materials for chemical experiments, prepared by Dr. May, of Toronto, for the use of schools, and commented on the cheapness of these portable cabinets, and their use to young students.

Mr. Whiteaves then read a paper on the Marine Fisheries and Oyster Beds of the Gulf of St. Lawrence. This will be found (condensed) on pages 336–349 of the last volume of this journal.

2d Monthly Meeting, held Dec. 7th, 1874.

Postponed from Nov. 30th, 1874, that being St. Andrews's Day.

Dr. W. Osler and Messrs. James Fletcher, Arthur Webster, W. Campbell and Thomas W. Evans were elected members of the Society.

Principal Dawson then read a communication on Indian Remains from Lake St. Francis and elsewhere.

A discussion ensued, in which the President, Mr. Leslie, Mr. Marler and Mr. E. E. Shelton took part.

3rd Monthly Meeting, held Feb. 1st, 1875. (This meeting was also adjourned from Jan. 25th, 1875.)

Mr. James Esplin was elected a member of the Society.

Mr. G. M. Dawson read a paper entitled: "On the Superficial Features and Geology of the Plains, from the Lake of the Woods to the Rocky Mountains."

Supplementary remarks on this topic were then made by Mr. Selwyn, Prof. Bell and Principal Dawson.

4th Monthly Meeting, held Feb. 22nd, 1875.

Dr. G. A. Baynes and Messrs G. W. Reed, J. G. Bowles and W. Cowie were elected resident members.

Principal Dawson made a communication on two Indian Skulls recently obtained by Mr. Richardson from the vicinity of Victoria, Vancouver Island.

At the request of the President, the Rev. J. B. Good, of British Columbia, made some remarks on this subject and on the distribution of the Indian Tribes on the N. W. Coast.

Dr. P. P. Carpenter gave an account of a collection of Sea Shells made by Mr. Richardson in the Gulf of Georgia.

Mr. Whiteaves also commented on other marines invertebrates from that region, which were exhibited at the meeting.

Remarks on Mr. Richardson's collection were also made by the President, by Principal Dawson and Mr. G. M. Dawson.

5th Monthly Meeting, held March 29th, 1875.

Dr. G. B. Shaw was elected a resident member.

Mr. Whiteaves read a paper on some Algæ, Marine Invertebrates and Cretaceous Fossils from British Columbia.

6th Monthly Meeting, held April 26th, 1875.

Messrs. R. Stanley Clark Bagg; David Aikman, J. Hedley, H. McLaren and G. Sumner were elected members.

Mr. F. B. Caulfield read a paper on Insect Life in the vicinity of Montreal.

Remarks on this topic were made by Messrs. Marler, Whiteaves and other members.

Mr. R. W. McLachlan also read a paper on Indian Stone Pipes.

Some discussion ensued, and the proceedings terminated by the passing of a vote of thanks to the lecturers.

SOMMERVILLE LECTURES.

The above course of free scientific lectures was duly delivered as follows:

1. March 4th, 1875. On Electricity, with experiments, by Dr. G. B. Shaw.
2. March 11th, " On the Adulteration of Food, by J. Baker Edwards, Ph. D., D.C.L., F.C.S.
3. March 25th, " The Grasshopper Plague of the North-West, by Prof. R. Bell, F.G.S., F.C.S.
4. April 1st, " The Transit of Venus, by Richard Johnson, M. A., F. R. A. S., Chief Astronomer at Kauai, Sandwich Islands, British Transit Expedition.
5. April 8th, " Matter out of place, by Dr. G. P. Girdwood.
6. April 15th, " The Nose, its Uses and Duties, by Dr. P. P. Carpenter.

ANNUAL MEETING.

The Annual Meeting was held on the 18th of May, 1875, Rev. Dr. De Sola in the Chair.

The minutes of the last Annual Meeting having been read by the Recording Secretary, Principal Dawson delivered the following address, the President being absent in British Columbia.

ANNUAL ADDRESS.

I propose to devote the greater part of this address to memories of a man whose death may almost be said to close an era in the history of geological progress, as the publication of his greatest work, the Principles of Geology, may be held to have begun an era in the study of that science, whose goal of to-day will ever be its starting point for to-morrow. Sir Charles Lyell, the greatest geological thinker of our time and nation, died on the 22nd of February, in his seventy-eighth year. He was born at Kinnordy in Forfarshire, on the 14th of November, 1797, and graduated at Oxford, in 1819. He studied for the Bar, and began the practice of his profession; but his mind was already occupied with inquiries as to the structure of the earth, stimulated apparently by Buckland's lectures, to which he had listened at Oxford. In 1824, he became an honorary secretary of the Geological Society of London, and for a time he was Professor of Geology in King's College, London. He was elected,

for the first time, President of the Geological Society in 1836.

Sir Charles received the honor of knighthood in 1848, and was raised to a baronetcy in 1864. He had the degree of D.C.L. from Oxford and that of LL.D. from Cambridge. He was thrice president of the Geological Society, and once of the British Association.

He married in 1832 the eldest daughter of Leonard Horner, himself a good geologist, and a friend and helper of Lyell in his earlier work; and his wife not only graced his home and sedulously attended to all the wants and interests of a man too devoted to his specialties to give much attention to the ordinary affairs of life, but shared the fatigues of his journeys, and gave no small help in many of his works, being herself well acquainted with natural history and an accomplished linguist. Her death, less than two years ago, deprived his old age of its chief earthly stay.

In January, 1830, the first volume of his Principles of Geology appeared, and was followed by the second in January, 1832, and by the third in the following year. This work has reached its eleventh edition; and with the Elements or Manual of Geology, which followed, it may be said to have done more than any other book to shape the geological science of the time. More especially the doctrine of reference to existing causes for the explanation of all geological phenomena, at once removed theoretical geology from a speculative to an inductive basis, and laid a stable foundation for a history of the earth. Though Lyell published many detached geological memoirs, and also gave to the world very instructive and interesting narratives of his travels in America, and latterly summed up the facts and conclusions at present reached with reference to the latest geological period, in his "Antiquity of Man," his great fame must rest on his Principles of Geology, and on the effect of this work in giving form to geological science.

While the name and fame of Lyell belong to the world, we in British America and our brother geologists of the United States have some special cause to revere his memory, because of his world-wide grasp of the subjects he studied, and because of his eminent services to our own local geology and geologists; and, as examples of these, I shall take the liberty of referring to some of them which came under my own personal observation.

The visits of Sir Charles Lyell to America were three in

number, though detailed narratives of two only were published. The first, in 1841, was made in pursuance of his determination to verify for himself, as far as possible, all geological facts to which he had occasion to refer—a determination justified not only by the love of truth, but by his own great powers of appreciating the nature and relations of phenomena, and of presenting them to the minds of others. He had, on this occasion, an invitation to lecture for the Lowell Institute of Boston, which kept him some time in that city; but he took time to travel very extensively both in Canada and the United States.

His second visit to America was made in 1845, and on this occasion, he merely called at Halifax, and did not travel in British North America. He devoted his whole time to the United States, and more especially to the South. In 1853, he was named one of the Commissioners to the Great Exhibition in New York, and on this third visit he landed in Halifax and spent some time in Nova Scotia and New Brunswick.

I had the pleasure of first meeting Sir Charles in 1841, when he spent a few weeks in the Maritime Provinces of British America. I had just returned from the University of Edinburgh and from the somewhat careful training in mineralogy and lithology of the veteran Jameson, and had already given some time and study to the Carboniferous rocks of my native province. In these circumstances, the visit of Lyell was most opportune for me; and from my local knowledge, I was able to give him some aid in unravelling those complexities of the Carboniferous beds, to which at the time his attention was earnestly directed. I accordingly accompanied him in the remainder of his tour in Nova Scotia, and after his departure, followed up his work in districts which he had been unable to reach. We have met many times since, both in England and in this country, and have regularly corresponded down to within a very short time of his death; and I have ever found him a warm friend, and intensely interested in all that concerned the growth of natural science in this country.

The benefits rendered by Sir Charles to American Geology in his several visits to this continent, it would not be easy to overestimate. At the time of his first visit, few English geologists had seen those great breadths of the older and of the more recent formations by which this continent is distinguished, or had the means of realizing for themselves the resemblances and

differences of the formations on the opposite sides of the Atlantic; and American and British workers in these subjects were little known to each other. The visits of Sir Charles did much to remedy all this. His own mind was filled with those grander aspects of geological phenomena which appear in America. He brought into correspondence with each other those workers in science, whom his intuitive tact perceived to be suited to give mutual aid. In British America, in particular, his agency in this way was very valuable in bringing together the widely-separated cultivators of science, and in linking them with the scientific movement of the mother country.

Nor were his visits barren of purely scientific results. He may have made few discoveries of new facts,—and he had not time to enter into detailed stratigraphical studies;—but in a thousand instances he cast new light on obscure facts, and gathered into a harmonious union detached fragments of evidence, and suggested new conclusions and interpretations. Of this character were his re-arrangement of the Carboniferous rocks of Nova Scotia and New Brunswick; and the clear conceptions which he formed of the nature and origin of our Post-pliocene formations, and which are still, I think, in advance of those currently taught on this side of the Atlantic.

Limited though his time for observation was, he always seized the salient and important points of any formation or locality; and I have often been struck with the truthfulness and completeness of the sketches which he gave of phenomena with reference to which his opportunities of collecting information were very imperfect.

In these American researches, the great gifts of the man were brought out in a light somewhat different from that in which they appear in his general works. The main distinction between Sir Charles and most of his contemporaries, was his eminence as a thinker, whether in inductive or deductive reasoning. Like most of the English geologists of his time, he had received less training in the characters of minerals and rocks than that which the more severe schools of science exacted, and his imperfect vision was a great hindrance in field work, and sometimes even a source of personal danger; but when facts, however complex, were once obtained, they grouped themselves in his mind in their natural relations, with an unfailing certainty, while their connections with all the other parts of his vast stores of know-

ledge and the general conclusions deducible from them, came out with a degree of clearness always beautiful, and often even startling.

Another quality of his mind was the fresh and vivid interest, almost childlike, which every new truth awakened in him. This feeling is more or less that of every true naturalist. It depends on the clear perception of what is presented to us, and on the keen realization of its relations to things previously known, and perhaps still more on the sudden breaking of those new relations upon the mind as if with a flash of divine light. I well remember how, after we had disinterred the bones of Dendrerpeton from the interior of a large fossil tree on the Joggins shore, his thoughts ran rapidly over all the strange circumstances of the burial of the animal, its geological age, and its possible relations to reptiles and other animals, and he enlarged enthusiastically on these points, till suddenly observing the astonishment of a man who accompanied us, he abruptly turned to me and whispered: "The man will think us mad if I run on in this way."

An allied feature of his mental character was the readiness with which he accepted new conclusions and relinquished without regret views which he might have long held, when he perceived them to be shaken or untenable. He seemed wholly free from that common failing of men of science which causes them to cling with such tenacity to opinions once formed, even in the face of the strongest evidence. This quality eminently fitted him to be the exposi'or of a rapidly advancing science, and also to be the patron and helper of younger and less eminent men, and was connected with that warm and earnest interest which he ever felt in the progress of knowledge, and with the deference with which he received new facts and suggestions from any quarter.

These qualities, apparent in his connections with American Geology, were equally valuable in his relations to science in its general aspect. A man so gifted, fortunate in his genius, his education, his outward circumstances, and in his appearance on the stage at a time when Geology had gathered in some of its greatest harvests of facts, and was waiting for a master mind to arrange them, had a great opportunity, which Lyell had the energy and ability to seize. He was thus able to become the guiding mind among his contemporaries in geological theory, and to

hold his pre-eminence down to the end of his life, and through all the great changes which occurred in the rapid development of the science. For nearly 45 years, his works have been the text-books of geologists, and though the great impetus which they primarily gave has thrown the study of the earth forward into an entirely new position:—the last editions of the Elements and Principles are still in the van of the science.

The position which he thus occupied is one to which he was in every way justly entitled. His large and judicial mind had always a clear perception of the true method of natural history. He saw that the foundations of our knowledge of geology were to be laid in extensive and accurate collections of facts, and in reasoning on these by severely inductive methods. This idea he carried out in his Elements of Geology. But in his Principles he opened up a new field, not as has been crudely conceived by some commentators on his work, one of the nature of deduction as distinguished from induction, but rather another inductive investigation, leading to general conclusions as to the changes now in progress, in order that by a fair use of analogy a key might be found to the interpretation of the facts and conclusions obtained by the study of the geological monuments of past ages. He has himself well stated this view of the case in the preface to the tenth edition of the Principles.

Viewed in this way, the Lyellian Geology rests on two inductive bases—the first relating to the facts discoverable in the earth's crust, and the second to the changes now in progress under our observation—and the connection of these by an analogy founded on identity of causes or conditions and identity of effects. This mode of treating the history of the earth was especially that of Lyell, and it was this that constituted his greatest contribution to the growth of modern geology.

Injustice has been done to the Lyellean method by two misconceptions, propagated perhaps by injudicious friends rather than by opponents, and which have arisen from a failure to enter into the grand comprehensive views of this great reasoner.

One of these is the representation that Lyell was thoroughly uniformitarian, in the sense of maintaining that similar changes had been taking place throughout all geological time. It is true that he objected to any explanation of geological changes by imaginary cataclysms not warranted by observation of similar facts; but no one was more ready than he to receive any

evidence of change, or physical or organic action, whether sudden or gradual, as a geological course, provided it could be shown to be or to have been a natural fact. Farther, no one was more fully impressed with the continual change and progress in nature, and with the necessity of taking into account the different conditions of different geological times, in applying any modern cause to account for ancient phenomena.

A second and still more mischievous misapprehension is that of regarding his method as similar to that style of analogical reasoning which Spencer and Darwin have made so current in our time. When Lyell strove to illustrate the conditions of the Coal period by those of the great Dismal Swamp, for example, his argument was one of analogy, but an analogy in which the main conditions could be proved to be identical. In both cases they were swamp conditions, though separated by a great lapse of time. He never would have reasoned, like Spencer, that the evolution of an egg explains the evolution of animals in geological time; because in this case the similarity of conditions which can alone give value to a natural analogy is wholly absent. Nor does the Lyellian philosophy properly admit the assumption, as a *vera causa* of past geological change, of processes supposed to be going on, but so slowly that human experience fails to obtain any measure of them, or even any certainty as to their reality. It is true that, in the later editions of the Principles, Sir Charles admits the force of Darwin's arguments for the transmutation of species, and devotes large space to their exposition; and he states, as his general conclusion, that Darwin, "without absolutely proving this, has made it appear in the highest degree probable;" but I do not find that he ever regarded these brilliant speculations as occupying the same stable ground with his own grand general conclusions as to the persistency of existing causes in geological time. Lyell, in short, while a uniformitarian rather than a cataclysmist, held to uniformity not of effects, but of the general laws of causation; and the analogies by which he sought to connect modern changes with those which had left their monuments on the earth's crust, had nothing in common with those on which theories of transmutation of species have been based.

It is always an interesting inquiry in the case of a great student of nature, to ask what position he took in regard to those higher problems which directly affect man in his mental, mora

and spiritual nature. There is nothing in the study of nature to withdraw a man from sympathy with his fellows; and men of science who have so shut themselves up in their specialties as to take no interest in the general welfare and progress of society, have necessarily failed to secure for themselves and their subjects the hearty interest of mankind. In these respects, Lyell was characterized by the same breadth which appears in his scientific investigations and reasonings. He was a warm personal friend, and full of sincere sympathy with all that concerned those he loved. He was active and earnest in promoting education and the diffusion of knowledge, and he took a lively interest in all movements for improving the social and political condition of mankind. He was quite free from that tendency to attack or sneer at everything that other men hold sacred, which characterizes some of the advanced writers of the day. He neither tormented himself with the gloomy idea that men looked askance upon him and desired to persecute him, nor did he desire to make any other man a martyr to his faith. In the earlier editions of the Principles, he closed the work with a few paragraphs of "Concluding Remarks," in which he repelled the imputation that his doctrine of modern causes was equivalent to the assumption that "there never was a beginning of the present order of things;" and he takes occasion to state his doctrine of the relation of natural science to religion in the following words, which, I find, remain unchanged in the last edition :—

"We aspire in vain to assign limits to the works of creation in space, whether we examine the starry heavens or that world of minute animalcules which is revealed to us by the microscope, we are prepared therefore to find that in time also the confines of the universe lie beyond the reach of mortal man. But in whatever direction we pursue our researches, whether in time or space, we discover everywhere the clear proofs of a Creative Intelligence, and of his foresight, wisdom and power. As geologists, we learn that it is not merely the present condition of the globe which is suited to the accommodation of myriads of living creatures, but that many former states also were adapted to the organization and habits of prior races of being. The disposition of the seas, continents and islands, and the climates have varied; the species likewise have been changed, and yet they have all been so modelled on types analogous to those of

existing plants and animals, as to indicate throughout a perfect harmony of design and unity of purpose. To assume that the evidence of the beginning and end of so vast a scheme lies within the reach of our speculations, appears to be inconsistent with a just estimate of the relations which subsist between the finite powers of man and the attributes of an Infinite and Eternal Being."

I have left but a little time to speak of the work of our own society in the past year. Six meetings for the reading of papers have been held during the winter. The subjects discussed at these might well afford some material for interesting remark; but, as the substance of them has been or will be published, this is scarcely necessary. In geology, our papers have related chiefly to the west. Mr. Whiteaves has described to us some of the Cretaceous marine fossils from British Columbia, which are found there associated with and underlying the remarkable coal fields of Cretaceous age containing remains of so many dicotyledonous trees. Mr. G. M. Dawson has given us some interesting expositions of the geographical features and superficial deposits of the little-known region along the 49th parallel, between the Red River and the Rocky Mountains, which are to be illustrated in his forthcoming Report on that region. In ethnology, we have had papers on Indian Remains from Lake St. Francis, and Mr. Richardson's Collections in British Columbia; and Mr. McLachlan has described some curious Indian Pipes. Dr. Carpenter, Mr. Whiteaves, Mr. Caulfield and others have directed our attention to a variety of zoological subjects connected with the natural history of the Dominion; and the economic aspects of natural history were well presented to us by the former gentleman in his memoir on our marine fisheries and oyster beds. It is to be regretted that our dredging operations could not be continued last summer; but it is to be hoped that something may be done this year, if not by government aid, at least by private enterprise. Should the arrangements to be referred to in the Report of the Council for the association of the Society with the Fraser Institute be carried into effect, it is to be hoped that they may give a new stimulus to our work; and may relieve the Society from much of the difficulty hitherto experienced in sustaining its library and museum, leaving it more free to pursue its work of scientific research and publication, and of popular education in science.

The report of the Chairman of Council was next read by Mr. G. L. Marler, as follows:

REPORT OF THE CHAIRMAN OF COUNCIL.

Your Council, at the end of their year of office, respectfully report as follows:

That the regular Monthly Meetings have been held, to the number of six, at which nine papers have been read. A list of these will be found in the Proceedings of the Society for the year just closed.

Your Council have also to report that negociations have been entered into between the "Fraser Institute," the "Royal Institution for the promotion of Learning," and this Society, with a view to the union of the latter with the Fraser Institute, in order to establish a Free Museum of Natural History and Archæology.

The President and Principal Dawson were appointed a Committee to confer with the Governors of the Fraser Institute, and a preliminary memorandum of the conditions of union has been prepared. Some progress in the matter has been made, the proposition for the said union being favorably entertained by the Governors of the Fraser Institute. Special application was also made by this Society to the Royal Institution for the advancement of Learning to obtain its consent to such amalgamation, subject to the same rights in the new museum as its professors and students now possess. Further action in the matter has been delayed, in consequence of the absence of the Honorable Mr. Abbott, one of the Trustees of the Fraser Institute, in England. On his return, these negociations will be resumed.

A Field Day was held on the 24th of May, 1874, at Belœil Mountain, and nothwithstanding the unfavourable state of the weather the excursion was a decided success. A large number of people took part in it, a very pleasant day was spent, and prizes were awarded for the best collections made. Your council would suggest to the incoming officers that these Field Days should be continued.

Your Council would further report that the operations of its Scientific Curator in Dredging in the Gulf of the St. Lawrence were discontinued this year, through the inability of the Minister of Marine and Fisheries to place one of the Government vessels at his disposal, as on former occasions.

The Lecture-Room was rented, during the winter, to the Montreal Branch of the Entomological Society of Ontario, also to Mr. W. Muir, and the proceeds of such rental—amounting to $202—will be found credited by the Treasurer in his accounts to be submitted this evening.

Your Council have also to report an addition of seventeen ordinary members, as having been elected during the past year.

The number of visitors to the Museum has increased somewhat there having been about 1200 in the session which closes this evening.

The Sommerville Course of Free Lectures has been duly delivered, a list of which, with the Lecturers' names, will be found in the Society's Proceedings.

The annual grant of $750 from the Legislature of the Province of Quebec has also been duly received.

Your Council recommend that application be again made to the Local Government for an increase of this grant to $1000.

Finally, your Council would again urge on the incoming Officers the desirability of trying to make the Library, which is now incomplete, more useful to its members, and to the students of Natural History generally.

The subjoined report of the Scientific Curator and Rec. Secretary was then read by Mr. Whiteaves:

REPORT OF THE SCIENTIFIC CURATOR.

Since the last annual meeting, considerable time has been devoted to the study of some of the most difficult marine animals obtained in four late dredging expeditions to the Gulf of St. Lawrence. So many specimens were collected on these occasions, that it will be probably some years before the whole of them are correctly determined.

The Foraminifera have been exhaustively examined, and some of the more critical forms have been sent to Dr. Parker. With the exception of a solitary species, the entire series has been now identified. The microscopic crustacea, such as the entomostraca and copepods, have been forwarded to Messrs. Robertson and Brady, who have kindly named all but a few still doubtful forms, which are believed to be new to science.

All the amphipods of the Gulf have been submitted to Prof. S. J. Smith, of Yale College, New Haven, the only authority on this subject in the United States, who has just communicated to me the results of his latest studies on these difficult crustacea.

Many of the polyzoa have also been examined microscopically, and some of the most doubtful species have been sent to the Rev. A. M Norman, who is one of the best European authorities on this group. About twenty of these molluscoids, whose specific relations were doubtful, have been now determined satisfactorily. Some of the St. Lawrence polyzoa have also been sent, by request, to Prof. A. E. Verrill, who is engaged on a new work on the invertebrata of Northern New England.

The Dominion Government has decided, for the present, to discontinue the dredging explorations, a determination which, it is hoped, will soon be reconsidered.

Through the zeal of Mr. Richardson and the liberality of the Director of the Geological Survey, the Society has recently received a valuable collection of natural history specimens and ethnological objects, from various parts of British Columbia. Among these are a collection of flowering plants of great interest, a large series of marine animals, some Indian skulls and other miscellaneous objects. The plants have been carefully determined by Mr. Barnston, end the marine shells by Dr. P. P. Carpenter. The land and fresh-water shells and the crustacea have also been examined and named, and the alcyonaria, echinodermata, polyzoa and cephalopoda have also been partially studied. As soon as the specific relations of these and the hydroids have been properly ascertained, my intention is to contribute an article on these interesting specimens to the Society's Journal. The Society is indebted to Mr. S. I. Smith, of Yale College, for the names of several crustaceans described in Dana's and Brandt's elaborate monographs, works which are entirely inaccessible in Canada.

By Mr. Selwyn's request, a specimen of the rare Pennatulid from Burrard's Inlet has been presented to the Museum of McGill University, and a second one will be shortly forwarded to the British Museum.

The Cabinet of Insects belonging to the Society has been partly re-organized during the past summer. All the old and dilapidated specimens have been removed and destroyed, and their place filled, as far as possible, with new and better ones. In every order, the insects obtained on the Island of Montreal, have been kept separate. Large collections have made in the field, during the summer, and the specimens obtained have been properly mounted. Special attention has been paid to the cole-

optera, especially to the aquatic species, and the list of the Montreal beetles has been largely added to. Mr. F. B. Caulfield has also kindly presented us with an extensive series of local species which were previously wanting in our cabinet. Mr. Passmore and myself have also endeavoured to collect as many specimens as possible of the diptera, hymenoptera, hemiptera and orthoptera of the Island of Montreal, and our efforts have been liberally supplemented by Mr. Caulfield and other friends. When a reasonable collection has been obtained, we propose to send the diptera to Baron Osten Sacken, and the hymenoptera to Mr. Cresson, unless Mr. Bowles can find time to work them up here. The orthoptera we hope to study ourselves, and indeed have already examined and identified all those that have been collected so far. One half of the Cabinet has been rearranged, but the coleoptera and lepidoptera remain to be finished. Materials for doing this have been accumulated, and it is hoped that the work will be completed, at least to a certain extent, during the summer. For some time attention has been directed to the collection of those insects which are parasitic on our native mammals and birds. A tolerably complete series of these has been obtained. Mr. Denny's monograph on the anoplura has been purchased, so that, when time will permit, it is hoped that some novel information may be obtained about these so far neglected but very curious insects.

Our local entomologists seem to have devoted most of their energies to the collection and study of the butterflies and moths only, while other orders have received hardly any share of their attention. Almost nothing is known about the two-winged flies of the Island of Montreal, or the bees, wasps, ichneumons, etc., the grasshoppers and the order to which they belong, or the hemiptera or spiders of the same district. Considerable difficulty has been met with in the attempt to preserve the neuroptera and orthoptera, as it was found that the larvæ of dermestes make great havoc among dried specimens in our Cabinet. An alcoholic series of the orthoptera has accordingly been attempted, with fair results, but the preservation of the larger dragon flies has yet to be accomplished.

The remainder of my own private collection of shells and fossils has been imported from England, and some progress has been made in the arrangement and naming of the same. A want of proper cabinets, however, has long delayed the final classification and exhibition of this collection in the Museum.

The number of new specimens of birds or mammals obtained or presented during the past year has been unusually small.

The collection of North American birds' eggs has, however, been largely increased by a donation from J. J. Frothingham, Esq., and by exchanges with Mr. Lechevalier.

Marine invertebrates from the coast of Northern New England have been received, in exchange from Prof. Verrill; and negociations are pending with Mr. Dall, from whom we may expect ultimately to receive some of the products of the seas off Alaska.

In accordance with a vote of the Society to that effect, a report has been published on the Cretaceous Fossils collected by Mr. Richardson in British Columbia, during the season of 1873, and progress has been made with a monograph on some of the Fossils of the Coal-bearing Rocks of the Queen Charlotte Islands.

Two original articles have been contributed to the *Canadian Naturalist*, and two have been read at monthly meetings of the Society, as already stated by the President.

The following financial statement was submitted by the Treasurer, E. E. Shelton:

Dr. THE NATURAL HISTORY SOCIETY in account with E. E. SHELTON, Treasurer. Dr.

1874-75.	
To cash paid J. F. Whiteaves, salary	$400.00
" " S. W. Passmore, "	200.00
" " Foote, commission	29.30
" " for Coal and wood	178.22
" " " Gas	58.94
" " " Water	34.95
" " " City Taxes	59.90
" " " Insurance	42.50
" " " Repairs and petty expenses	100.98
" " " Naturalist, Dawson Bros.' acct	191.00
" " " Printing and advertising	43 83
" " " Furnace	76.50
" " Interest to Royal Institution	80.00
Balance in Treasurer's hands	509.57
	$2005.69

LIABILITY.

Royal Institution, Balance on Mortgage $1000.00

1874—May 30th.	
By Balance from late Treasurer	$255.94
1874-75.	
By Government grant	750.00
" Cash, Members' Yearly Subscriptions	598.00
" " Museum Entrance Fees	50.50
" " Rent of Lecture Room	209.00
" " realized from Excursion to Belœil	142.25
	$2005.69

Errors and omissions excepted.

[Signed] E. E. SHELTON, *Treasurer.*

Montreal, May 18th, 1875. G. L. Marler, J. H. Joseph, } *Auditors.*

On motion of Prof. R. Bell, seconded by Dr. B. J. Harrington, it was unanimously resolved:

"That the foregoing reports be received, adopted, and printed for distribution among the members."

The thanks of the Society were also voted to the Officers of the past Session.

Principal Dawson moved, seconded by G. L. Marler:

"That the bye-law relating to the election of officers by ballot be suspended, and that A. R. C. Selwyn, F.R.S., &c., be re-elected President."

The motion was carried by acclamation.

Dr. B. J. Harrington and Prof. P. J. Darey having been appointed scrutineers. the following gentlemen were elected Vice-Presidents by ballot:

Vice-Presidents,—Sir W. E. Logan, LL.D., F.R.S.; Rev. A. De Sola, LL.D.; G. Barnston; E. Billings, F.G.S.; Principal Dawson, LL.D., F.R.S.; His Lordship the Metropolitan; C. Robb.

On motion of Mr. Marler, seconded by C. Robb, it was resolved:

"That the formality of balloting be dispensed with, and that the following three officers be re-elected:

Treasurer,—E. E. Shelton.

Corresponding Secretary,—Prof. P. J. Darey, M.A., B.C.L.

Scientific Curator and Recording Secretary,—J. F. Whiteaves, F.G.S.

The Scrutineers then declared the following gentlemen duly elected:

Council,—Prof. R. Bell, Dr. B. J. Harrington, G. L. Marler, J. H. Joseph, Dr. J. B. Edwards, D. A. P. Watt, Rev. Canon Baldwin, D. R. McCord, and James Ferrier, jun.

On motion of Principal Dawson, seconded by Mr. G. L. Marler, it was resolved:

"That Messrs. A. R. C. Selwyn, Dr. B. J. Harrington, R. McLachlan, M. H. Brisette, and Dr. W. Osler be elected a Library and Membership Committee."

DONATIONS TO MUSEUM AND LIBRARY—SESSION 1874-75.

From	TO THE MUSEUM.
Mons. A. Lechevallier.	A series of Bird's Eggs from Florida and California.
E. Murphy, Esq.	A Horned Frog. Phrynosoma cornutum?
Scott Barlow, Esq.	Fine specimen of Amblystoma punctata, Baird, from Spring Hill, Nova Scotia.
Prof. A. E. Verrill.	Two specimens of Cancer borealis from the Coast of Maine.
Miss Cordner.	A young Alligator from Jacksonville, Flor.
Mr. S. W. Passmore.	Water Snake (Nerodia sipedon), Toronto.
	Green Snake (Chlorosoma vernalis) "
Dr. G. P. Girdwood.	Specimens of the Tell-tale Tatler and the Pied Billed Grebe.
J. J. Frothingham, Esq.	A small collection of Canadian bird's eggs, including an egg of the Goshawk from Montreal mountain, and two eggs of the Wild Turkey from Western Canada.
F. B. Caulfield, Esq.	An extensive series of the coleoptera, diptera, hymenoptera, and lepidoptera of the Island of Montreal.
E. J. Major, Esq.	5 Chinese Arrows. 3 Persian do.
	1 Abyssinian Shotel.
	1 Metal Celt, locality unknown.
	Indian Pipe, of Catlinite, brought from the Red River district.
	Indian Stone Pipe, probably from the Plains of the Saskatchewan.
The Geological Survey. per A. R. C. Selwyn, F.R.S. (Director.)	A collection of dried plants from various parts of British Columbia, made by Mr. James Richardson in 1874.
	A valuable series of marine invertebrates from the same region, including, besides about 60 species of shells, fine examples of the great sea pen of Burrard's Inlet (Verrillia Blakei Stearns) in alcohol, also good alcoholic examples of Octopus punctatus Dall, Echidnoceros cibarius White, &c., &c.
	NOTE.—A detailed catalogue of these specimens will be published in an early number of this Journal.

From	TO THE LIBRARY.
John Harris, Esq.	The Circle and the Straight Line, 4 vols. 8vo. cloth.
	Centrifugal Force and Gravitation, 7 vols. 8vo.
	The Science of Ideal Theology as taught by the Bible
The Trustees of the British Museum.	Catalogue of Birds, vol. 1.
	Hand List of Seals.
	Guide to Exhibition Room.
The Society.	Report of the Entomological Society for the Province of Ontario for 1874.
The Geological Survey.	Report of Progress for 1873.
	Palæozoic Fossils, Vol. 2, Part 1.
The Author.	Manual of Artillery, by General de Peyster.

LIST OF DIURNAL LEPIDOPTERA OF THE ISLAND OF MONTREAL.

By F. B. Caufield.

PAPILIONIDÆ.

1. Papilio asterias Drury.—Not common in the vicinity of the city; more abundant inthe open country. May to end of August.

2. Papilio turnus Linn.—Generally common; end of May to middle of July.

PIERIDÆ.

3. Pieris oleracea Harris.—Not common; May and June. I have not seen an August brood.

4. Pieris rapæ Linn.—Very common, although not so abundant as a few years ago, owing to the attacks of *Pteromalus puparum*. May to end of September. Var. novanglia Scudd., not common, but appear throughout the season.

5. Colias eurytheme Boisd.—Very rare; a male in fine condition, taken last season (1874)by Mr. C. W. Pearson.

6. Colias philodice Godart.—Generally abundant; last season very scarce; June to October; white females very rare; August.

DANAIDÆ.

7. Danais archippus Cram.—Generally common; some years very scarce; May to end of September.

NYMPHALIDÆ.

8. Argynnis cybele Fabr.—Common; end of June to middle of August.

9. Argynnis aphrodite Fabr.—Not so common as the last species; end of June to middle of August.

10. Argynnis atlantis Edwards.—Very rare; I took one example in 1872.

11. Argynnis myrina Cram.—Very common in damp meadows; May, June and August.

12. Melitea phaeton Drury.—Rare; June.

13. Phyciodes Harrisii Scud.—Very rare; taken by Mr. P. Kuetzing.

14. Phyciodes nycteis Doubled.—Rare; July.

15. Phyciodes tharos Boisd. & Lec.—Very common; June to middle of August.

16. Grapta interrogationis Fabr.—Rare; May (hybernated), July to October.

17. Grapta comma Harris.—Common; May (hybernated), end of June to October; var. dryas Edwards, not so common.

18. Grapta faunus Edwards.—Generally scarce; last season (1874) very abundant. May (hybernated), July to October.

19. Grapta progne Cram.—Common; May (hybernated), July to October.

20. Vanessa antiopa Linn.—Very common; end of April and May (hybernated), July to October. Var. Lintnerii, bred by Mr. Pearson, last season.

21. Vanessa milberti Godart.—Not common, being greatly checked by parasites in this locality. I collected over thirty larvæ last season (1874), but only got four butterflies, the remainder being full of small ichneumons. May (hybernated), August and September.

22. Vanessa J. Album Boisd. & Lec.—Not common; end of April and May (hybernated), July to October.

23. Pyrameis huntera Drury.—Generally scarce; August and September. I have not seen hybernated specimens.

24. Pyrameis cardui Linn.—Some years scarce, others common; very abundant last season (1874). May and June (hybernated), August and September.

25. Pyrameis atalanta Linn.—Not common; May (hybernated), end of July to October.

26. Limenitis arthemis Drury.—Not abundant; July and beginning of August.

27. Limenitis disippus Godart.—Common; June to end of August.

SATYRIDÆ.

28. Euptychia eurytus Fabr.—Common in open woods; June.

29. Satyrus nephele Kirby.—Not common; open fields; July and August.

30. Lethe portlandia Fabr.—Not common; July.

31. Pararge Boisduvallii Harris.—Abundant in open grassy swamps; end of June to middle of August.

32. Thecla calanus Hübn.—Generally rare; abundant last season (1874) on blossoms of Asclepias and Sumach; July and August.

33. Thecla mopsus Hübn.—Rare; July and August.

34. Thecla niphon Hübn.—Very rare; taken by Mr. P. Kuetzing.

35. Chrysophanus Americanus Harris.—Generally common; May, June, August and September.

36. Chrysophanus hyllus Cram. (= C. *Thoe* Boisd.) very rare. I took three specimens at Lachine, in August, 1872, and have not met with it since.

37. Lycaena comyntas Godart.—Rare; June, July and Aug.

38. Lycaena lucia Kirby.—Very common; May and June.

HESPERIDÆ.

39. Epargyreus tityrus Fabr.—Common; June and July.

40. Thorybes pylades Scudder. (= T. *Bathyllus* Harris) common; end of May, June and July.

41. Nisoniades brizo Boisd.—Rare; June.

42. Atrytone Zabulon Boisd. (= A. *hobomok* Harris) very common; June. ♀ var. Pocahontas Scudder not common.

43. Anthomaster Leonardus Harris.—Very rare; one specimen taken in 1872.

44. Polites peckius Kirby. (= P. *Wamsutta* Harris) not common; July.

45. Hedone orono Scudder.—Not common; July.

46. Limochores mystic Scudder.—Not common; July.

47. Limochores taumas Fabr. (= L. *Ahaton* Harris) very common; end of June and July.

These are all the species that I have seen from this locality. *Pieris Protodice* was taken at Lachine, some years ago, by Dr. Barnston. *Argynnis bellona* was taken, last season (1874), by Mr. Jack, on the south shore of the St. Lawrence opposite Lachine, and will probably yet be found on the Island of Montreal; and I think additions will be made to the Lycænidæ and Hesperidæ when these groups have been properly worked up.

I have, with two or three exceptions, followed Mr. W. H. Edwards's synopsis in this list, both in classification and nomenclature.

I hope to soon give lists of the remaining families, and would here gratefully acknowledge the assistance given me by those friends who kindly allowed me to study and refer to their material, amongst whom I would especially mention Messrs. Wm. Couper, P. Kutzing, C. W. and G. B. Pearson.—*The Canadian Entomologist.*

A SUMMER STROLL IN ENGLAND.

By G. E. Bulger, F. L. S.

Happening to spend the whole of May and the greater portion of June, last year, at Upnor, in Kent, I enjoyed many a pleasant ramble through the sweet, green lanes and picturesque country-roads of the vicinity—especially in the neighbourhood of Chattenden, where new barracks are in course of construction, almost in the midst of the ordnance plantations—young, tender woodlands, full of delicious, shady nooks, and be-gemmed with thousands of lovely wild flowers.

The portion of Kent I allude to is said to be famous for its primroses and its nightingales—the blossoms of the former appearing in countless myriads very early in the season, and the latter congregating, about the beginning of June, in such number, and singing so lavishly, as to render the spring and summer nights absolutely vocal with their sweet and rapturous strains. The primroses had all but gone before my arrival; but the nightingales were in the full heyday of their happiness, and, during the whole of my stay, they serenaded me nightly with such continuous and wondrous bursts of melody, that it almost seemed to me as if the little birds could never tire, or that their sole mission upon earth was to sing until they died.

One bright and glorious day, early in June, I wandered out in the direction of Chattenden, along a lovely and secluded road, almost hidden between luxuriant hedgerows, in which the bloom and fragrance of the hawthorn had but recently given place to the frail, soft beauty of the delicate, wild rose; though, ever and anon, an elder-bush flaunted its broad corymbs of white flowers amidst the sweeter and more attractive, though less conspicuous, blossoms of its modest and blushing neighbour.

On either side of this charming pathway, the country presented a succession of smiling meadows and picturesque woodlands—typical of that fair and gentle pastoral beauty which seems to be the especial attribute of sweet, yet rich and peerless England: the former intensely green with the bright verdure of early summer, and spangled with millions of gay flowers, amongst which the white stars of the great moon-daisy (*Chrysanthemum leucanthemum*) were conspicuously abundant.

Hedge-plants did not seem to be generally in bloom, though, here and there, the pale petals of the blackberry showed themselves amidst the tangled bushes, and purple vetches (*Vicia cracca et sativa*), the wild chervil (*Chærophyllum sylvestre*), crucifers of several genera, with buttercups of at fewest two species (*Ranunculus bulbosus et acris*), and the purple flowers of the common mallow (*malva sylvestris*) peeped out from the long grass and lower herbage: while, at the edges of the fields, close to the road, I found blossoms of the common gromwell (*Lithospermum officinale*), the dogwood (*Cornus sanguinea*), a pale lilac variety of the large bittercress (*Cardamine amara*), the lesser stitchwort (*Stellaria graminea*), the common agrimony (*Agrimonia eupatoria*), and the great, rank goutweed (*Ægopodium podagraria*); as well as, much to my surprise, the already developed seed-balls of the yellow goat's beard (*Tragopogon pratense*).

Of birds, I met with few. The modest and confiding hedge sparrow (*Accentor modularis*), harmless, unobtrusive little dweller by the road-side, crept out now and then from the shelter of his leafy home to look about him; a few stray robins and thrushes piped their sweet songs occasionally from the trees and copses close by; but the woods and meadows were, for the most part, silent, and even the joyous skylark seemed to have gone to rest for a time. Later in the day, however, I heard several cuckoos, saw a flock of starlings, and disturbed a magpie from a thicket, out of which he darted with a precipitancy that looked very like conscious guilt, and suggested the idea of a culprit endeavouring to escape from the consequences of some recently committed crime.

Insects did not strike me as being abundant, though the orange-tip butterfly (*Euchloe cardamine*) seemed common enough wherever I went, as well as the small cabbage-white (*Pieris rapæ*); and bees and wasps of several species were humming and buzzing about amongst the flowers, while numbers of the ethereal-looking, but ferocious, blue dragon-flies, were continually darting through the air in pursuit of the unhappy little creatures on which they prey. I found one brown, hairy caterpillar, with black rings at the joining of the segments, which appeared to me to resemble very much the larva of the moth (*Lasiocampa rubi*); but, on this point, I can give no reliable opinion.

. . . . . .

Returning to Upnor, about four o'clock, I found the sun so powerful that I was really glad to get under shelter of the woods, which were fresh and pleasant, as usual, and gay with wild flowers. Amongst these, the showy blossoms of the red lychnis (*Lychnis diurna*) were very conspicuous—some pale rose in colour, and others of a rich carmine; but, here and there, their glory was eclipsed by the effulgence of the field poppy (*Papaver rhœas*), which was then beginning to bloom abundantly. The strange and beautiful luminous glow which surrounds these brilliant flowers under certain conditions, did not present itself to my senses on the occasion I refer to, though the vivid hue of the scarlet corollas was very striking, and stood out from the green gloom of the woods in strong relief. I found both the common and black bryonies (*Bryonia dioica et Tamus communis*) in blossom; also *Sherardia arvensis*, the stink mayweed (*Anthemis cotula*), *Ranunculus repens et arvensis*, *Fumaria officinalis* sparingly; *Veronica chamædrys*, *Myosotis arvensis*, *Polygonum maritimum*, *Stachys sylvatica*, *Convolvulus arvensis*, *Geranium dissectum*, and other common plants; as well as several grasses, which, although very lovely to the eye, have a most unpleasant influence, in summer time, upon those who suffer, as I do, from hay asthma.

Ever and anon, I heard the cuckoo during my ramble homewards, and the soft, mournful notes of the wood-pigeon (*Columba palumbus*) came bubbling up at intervals from the leafy recesses of the neighbouring groves, while the beautiful, little yellow-hammer (*Emberiza citrinella*) constantly obtruded himself and his pleasant whistle upon my notice, as I lingered amongst the many attractions of the sweet, young woods.

Sincerely
W. E. Logan

SIR WILLIAM EDMOND LOGAN.*

On the 22nd of June, at Castle Malgwyn, Llechryd, South Wales, Canada's veteran geologist passed from his labours. For several years his health had been failing, and he felt more and more the need of rest and change of climate. Accordingly, in August, 1874, he crossed to the mother country, intending to pass the winter there, and then to return to his work in the spring. But rest and a more genial clime were unavailing, and now—kindest of friends, most indefatigable of workers for science and for his country—he is no more! We shall never again hear the ring of his hammer; but time cannot efface its marks, and deep-chiselled in the face of Cape Eternity, the generations of the future shall read the names—LOGAN and LAURENTIAN.

William Edmond Logan was born at Montreal, in 1798. He was of Scottish parentage, and his father, after a residence of many years in Canada, returned to Scotland, and purchased an estate near Stirling, known as Clarkstone. His education was begun at Mr. Skakel's school, in this city, and completed at the High School and University of Edingburgh.

On leaving college he betook himself to mercantile pursuits, and we find that in 1818 he entered the counting-house of his uncle, Mr. Hart Logan, of London. Here he remained for about ten years, and here, it is said, he first became fond of geology, making geological excursions into the country whenever opportunity afforded.

In 1829, he paid a visit to Canada; but, returning the same year, took up his residence at Swansea, in South Wales, where he was appointed manager of a copper-smelting establishment, and of coal mines, in which an uncle of his was interested. In 1834, he made a tour through France and Spain, visiting many of the mines in the latter country, and making many observations on the geology of the regions through which he passed. In 1838, his uncle dying, Mr. Logan resigned his position at Swansea. But the nine years he spent here were well-spent years; for not only had he gained a practical knowledge of

* Obituary notice read before the Natural History Society, October 25th, 1875.

mining and metallurgy, which afterwards proved of the greatest value to him, but had done a large amount of very excellent geological work—work which caused Dr. Buckland, of Oxford, to say of him, "He is the most skilful geological surveyor of a coal-field I have ever known." During his stay at Swansea, he was an active worker for the interests of the Royal Institution of South Wales. He was Honorary Secretary and Curator of the geological department, and the Institution is indebted to him for valuable collections of minerals and metallurgical products, besides books, drawings and laboratory apparatus. The whole of his geological work in South Wales he placed gratuitously at the disposal of the Ordnance Geological Survey of Great Britain, and it was not only gladly accepted, but published "without alteration," and made the basis of future work in that region. Concerning it, Sir H. T. De la Beche afterwards wrote as follows:

"Prior to the appearance of the Geological Survey in that part of the country, Mr. W. E. Logan had carefully investigated it, and at the meeting of the British Association for the Advancement of Science, held at Liverpool in 1837, he exhibited a beautifully executed map of it.

"The work on this District being of an order so greatly superior to that usual with geologists, and corresponding in the minuteness and accuracy of its detail, with the maps and sections executed by the Ordnance Geological Survey, we felt desirous of availing ourselves of it, when Mr. Logan most handsomely placed it at our disposal. Having verified this work with great care, we find it so excellent that we shall adopt it for that part of the country to which it relates, considering it but fair and proper that Mr. Logan should obtain that credit to which his labours so justly entitle him.

"His sections are all levelled and measured carefully with proper instruments, and his maps are executed with a precision only as yet employed, except in his case, on the Ordnance Geological Survey; it being considered essential on that survey, for the right progress of geology, and the applications to the useful purposes of life, that this accuracy and precision should be attained."

In 1840, Logan read a paper before the Geological Society of London, in which he explained, for the first time, the true relation of the *Stigmaria* underclays to the overlying beds of coal,

shewing that the underclay was the soil in which the plants grew which were afterwards converted into coal. Of the 100 thick and thin coal-seams in the South Wales coal-field, he found that not a single one was without an underclay, and the inference appeared to be that there was some essential connection between the production of the one and the existence of the other. "To account," said he, "for the unfailing combination by drift, seems an unsatisfactory hypothesis; but whatever may be the mutual dependance of the phenomena, they give us reasonable grounds to suppose that in the *Stigmaria ficoides* we have the plant to which the earth is mainly indebted for those vast stores of fossil fuel which are now so indispensable to the comfort and prosperity of its inhabitants."

So much did he become interested in this subject that in the following year (1841) he crossed to America, and visited the coal-fields of Pennsylvania and Nova Scotia, in order to ascertain whether the same conditions existed there. Such he found to be the case; and in the following Spring he read an interesting paper before the Geological Society, the object of which, to use his own words, "was to state the occurrence immediately below the coal-seams of America of the same *Stigmaria* beds as had been observed below those of South Wales, and to shew the importance of this prevailing fact." Shortly after his return from America, he also visited coal-seams in the neighbourhood of Falkirk, Scotland, there too finding the *Stigmaria* clays beneath the coal.

It was during his visit to Nova Scotia, in 1841, that he discovered in the Lower Coal measusures of Horton Bluff the footprints of a reptilian animal—a discovery which perhaps failed to attract as much attention as it deserved, although it was the first instance in which any trace of reptiles had been detected as low down in the geological scale as the Carboniferous. The winter of 1841–42 was also spent in Canada, and the facts obtained for a paper on the packing of ice in the St. Lawrence, which was subsequently read before the Geological Society of London.

Such, briefly, was the career of Logan previous to his appointment as Director of the Geological Survey of Canada. Already he had acquired a reputation in Britain as a geologist, and had given himself the best of trainings for the work upon which he was about to enter on this side of the Atlantic. But what was meantime passing in Canada?

"In January, 1832, a petition from Dr. Rae, praying for pecuniary assistance in prosecution of a geological and statistical survey of the province, was sent down by message to the Legislative Assembly, with a favourable recommendation from his Excellency Sir John Colborne, Lt. Gov. of Upper Canada. It was read and referred to the committee of supply, but not considered.

"In February, 1836, on the motion of Mr. W. L. Mackenzie, seconded by Mr. Durand, Messrs. R. G. Dunlop, Gibson and C. Duncombe were named a select committee to consider and report on a plan for a geological survey of the Province. Three hundred copies of this report were ordered to be printed, and it was referred to the committee of supply, but was not considered.

In November, 1836, on the motion of Mr. R. G. Dunlop, seconded by Col. Prince, the house went into a committee of the whole to consider the expediency of a geological survey, and, on their report being received, it was resolved that an address should be presented to His Excellency the Lieut. Governor (Sir F. B. Head), to ascertain whether there were any means at his disposal to effect a geological survey of the Province. The address was ordered to be drafted, but was not reported.

"In December, 1836, Mr. R. G. Dunlop gave notice that he would move an address to His Majesty for a grant of wild lands to defray the expense of a geological survey of the Province, but no address was presented.

"To Lord Sydenham, who well appreciated the importance of an examination into the mineral resources of Canada, the country is indebted for the commencement of the geological survey which has been instituted.

"In July, 1841, in the first United Parliament, a petition from the Natural History Society of Montreal, praying for aid to carry out a systematic geological survey of the Province, was presented by Mr. B. Holmes. It was referred to a select committee consisting of Messrs. Holmes, Neilson, Quesnel, Merrit, and the Hon. Mr. Killaly, but it was not reported on. A similar petition was presented by Mr. Black, from the Literary and Historical Society of Quebec, which was read. The government took up the matter, and on the motion of the Hon. B. Harrison, the sum of £1500 sterling for the purposes of a survey was introduced into the estimates."*

* From Scobie's Canadian Almanac for 1851.

Lord Sydenham dying in 1841, it fell to his successor, Sir Charles Bagot, to appoint a Provincial Geologist. Sir Charles referred the matter to Lord Stanley, Secretary of State for the Colonies, and His Lordship, on recommendation of Murchison, De la Beche, Sedgwick, and Buckland, offered the position to Mr. Logan in the spring of 1842.

Logan was now thoroughly in love with geology, and seeing in Canada the grandest of fields for original research, at once accepted. Still he well understood the difficulties which lay before him, and shortly afterwards addressed the following words to De la Beche: "You are aware that I have been appointed by the Provincial Government of Canada to make a Geological Survey of that Colony. The extent and nature of the territory will render the task a most laborious one; but I am fully prepared to spare no exertion of which I am capable to render the work, when it is completed, satisfactory to those who have instituted the examination and creditable to myself ..... No one knows better than yourself how difficult it would be for one person to work with effect in all the branches of so extensive a subject. To carry out the field-work with vigour, to reduce all the sections with the requisite degree of accuracy, and map the geographical distribution of the rocks, to collect minerals and fossils, and to analyze the one, and by laborious and extensive comparisons, to determine the geological age of the other, is quite impossible without a proper division of labour..... In Canada, all the expensive means of palæontological comparison have yet to be brought together. There is no arranged collection of fossils, and no such thing as a geological library to refer to."

Arriving in Canada late in August, 1842, Logan devoted several months to making a preliminary examination of the country, and to collecting information with regard to the topographical work which had been accomplished. This was done entirely at his own expense. In December, he returned to England to fulfil engagements there, but came out again in the following spring, During his visit to the old country, he was so fortunate as to secure the services of Mr. Alexander Murray, a gentleman who afterwards proved himself an invaluable assistant and friend, and who has contributed largely to our knowledge of the geology of Canada, and, more recently, to that of Newfoundland.

Reaching Halifax on the 20th of May, Logan spent several weeks in examining portions of the coal-fields of Nova Scotia and New Brunswick, and it was at this time that he made his section of the Coal Measures at the South Joggins, which, as has been truly said, is "a remarkable monument of his industry and powers of observation." It gives details of nearly the whole thickness of the Coal formation of Nova Scotia, or 14,570 feet, including 76 beds of coal and 90 distinct *Stigmaria* underclays. Shortly after his visit to the Joggins, he wrote to a friend as follows: "I never before saw such a magnificent section as is there dispayed. The rocks along the coast are laid bare for thirty miles, and every stratum can be touched and examined in nearly the whole distance. A considerable portion has a high angle of inclination, and the geological thickness thus brought to view is very great. I measured and registered every bed occurring in a horizontal distance of ten miles, taking the angle of dip all the way along." And again, in a letter to De la Beche written in the spring of 1844, referring to the Joggins section, he says: "Since my return from field-work, I have reduced all the measurements and made out a vertical column. It occupies fifty-four pages of foolscap, closely written, and you will be astonished at the details in it."

Reaching Gaspé early in July, the summer and autumn were spent in making an examination of the coast, while Mr. Murray was at work in the Upper Province, examining the country between Lakes Huron and Erie, The Gaspé peninsula had been selected by Mr. Logan as the field for his first operations, as it was thought that outlying patches of the Carboniferous might be found to exist there, and the government was especially anxious to ascertain whether there was any truth in the reported occurrence of coal.

The following season, the work in Gaspé was continued, the Director being this time accompanied by Mr. Murray, who, in 1845, again carried on the work, while Mr. Logan was engaged in explorations on the Upper Ottawa and Mattawan. Altogether, during the three seasons, 800 miles of the Gaspé coast were examined, and several sections made across the peninsula, from the St. Lawrence to Bay Chaleur. No coal was found, but many geological facts of importance were accumulated, and a large amount of topographical work accomplished in what was previously almost a *terra incognita*.

"Living the life of a savage, sleeping on the beach in a blanket sack with my feet to the fire, seldom taking my clothes off, eating salt pork and ship's biscuit, occasionally tormented by mosquitoes,"—such is the record which Logan has left us of his Gaspé life, the foretaste of what was to be endured for many years. From early dawn till dusk he paced or paddled, and yet his work was not finished, for while his Indians—often his sole companions—smoked their pipes round the evening fire, he wrote his notes and plotted the day's measurements.

To give details of his work during the many remaining years of his life would be to write a book; and all that we can do here is to trace briefly what his movements were, at the same time calling special attention to those of his labours which have given him a world-wide fame.

The summer of 1846 found him studying the copper-bearing rocks of Lake Superior. These he shewed to consist of two groups of strata, the "upper" and the "lower," the latter of which was seen at Thunder Bay to rest unconformably upon chloritic slates belonging to an older series, to which the name of Huronian was subsequently given. This older set of rocks, which he had already observed, in 1845, on Lake Temiscamang, he had ample opportunity of studying in 1848, when he devoted several months to an examination of the Canadian coast and islands of Lake Huron, where the formation attains—as shewn by Murray—a thickness of 18,000 feet.

The seasons of 1847 and 1849, and a portion of that of 1848, were employed in studying the rocks of the Eastern Townships. Part of these were shown to be a prolongation of the Green Mountains of Vermont, and to consist of altered Silurian strata instead of "Primary strata," as was previously supposed by American geologists. In 1849 also, a short time was spent in an examination of the rocks about Bay St. Paul and Murray Bay, where coal had been reported to exist. The member for Saguenay county had previously made application to the Legislature for means to carry on boring operations in the vicinity of Bay St. Paul, but before his request was granted it was deemed advisable to obtain the opinion of the Provincial Geologist. By this means the Government was saved a large and useless expenditure of money.

In 1850 an examination was made of the gold-bearing drift of the Chaudière, and the auriferous district found to extend over

an area of between 3,000 and 4,000 square miles. Most of the year, however, was devoted to the collection of specimens for the London Exhibition of 1851, at which Mr. Logan acted as Juror. His visit to England at this time must have been for him an agreeable change. After a lapse of eight years to meet again with men like De la Beche, Murchison, and Lyell, to hear from their own lips of the strides which science had been making, and in turn to tell of all that he had himself seen and done; surely this was a treat that none but the scientific man can understand who has long been well-nigh deprived of the society of brother scientists. For him, however, there was little relaxation from labour, for he toiled early and late in order that the Canadian minerals might be displayed to the best advantage. And every one knows the result—the collection elicited univeral admiration, and Mr. Logan received a highly complimentary letter of thanks from the Prince Consort, and was elected a Fellow of the Royal Society, his name having been proposed by Sir Roderick Murchison.

Returning to Canada in August, before the close of the Exhibition, his explorations were renewed with undiminished vigour, and the remainder of the season devoted to an examination of the rocks in the county of Beauharnois, where the Potsdam sandstones had afforded those curious tracks of crustaceans to which Owen gave the name of Protichnites, and to a further study of the Chaudière gold region. During the winter he again visited England to attend to the distribution of a portion of the Exhibition collection which was to be left there, and see to the return of the remainder.

In 1852 an examination was made of a strip of country on the north side of the St. Lawrence, extending from Montreal to Cape Tourmente below Quebec. The distribution of the fossiliferous rocks was accurately determined, and several excursions made into the hilly "metamorphic country" to the north. In his report on this season's operations, published in 1854, Logan for the first time designated the rocks comprising these hills as the "Laurentian series," substituting this for "metamorphic series," the name which he had previously employed, but which, as he says, is applicable to any series of rocks in an altered condition.

The following season was spent among the Laurentian hills of Grenville and the adjoining townships, a field which proved so attractive that he afterwards returned to it in 1856 and 1858.

Nearly the whole of 1854 was occupied in making preparations for the Exhibition which was to take place at Paris in the following year, and to which Mr. Logan was to go as one of the Canadian Commissioners. It was in the autumn of 1854 also, that a select committee was appointed by the Canadian Government to inquire into the best method of making the information acquired by the Geological Survey more readily accessible to the public. A lengthy report on the subject—indeed on the entire working of the Survey—was published, and the evidence which it contains is of a most flattering character, both as regards the Director and those associated with him.

Then came the Paris Exhibition of 1855, at which the representation of the economic minerals of Canada was so complete and the arrangement so admirable that the collection attracted universal attention. This in itself Logan would have regarded as amply repaying him for his trouble, but greater honour was in store for him. The Imperial Commission presented him with the grand gold medal of honour, and the Emperor of the French made him a Chevalier of the Legion of Honour. Early in the following year (1856) he was knighted by Queen Victoria, and received from the Geological Society of London the Wollaston Palladium Medal in recognition of his distinguished labours in geology. Long previous he had won the confidence and esteem of his fellow-countrymen in Canada, but this seemed to be a fitting time to testify to him their appreciation of his worth. Accordingly, on his return to Montreal, the citizens presented him with a testimonial on which were engraved the words:

"In commemoration of his long and useful services as Provincial Geologist in Canada, and especially his valuable services in connection with the Exhibition of all Nations in London in 1851, and in Paris in 1855, by which he not only obtained for himself higher honor and more extended reputation, but largely contributed in making known the natural resources of his native country."

The Natural History Society of Montreal presented him with an address, and made him an honorary member, while the members of the Canadian Institute of Toronto, of which Sir William was the first President, had his portrait painted and hung up in their hall. They also presented him with an address expressive of their affectionate esteem and respect. Sir William's reply to this was so full of feeling, and so highly characteristic,

that we give a portion of it: "Whatever distinctions," said he, "may be bestowed on us at a distance, it is upon the respect, esteem, and confidence shewn us at home, that our happiness and satisfaction must chiefly depend. I can assure you with sincerity that the honor conferred upon me when you elected me the first President of the Institute, was one highly prized, although the circumstances of a distant domicile and the intent pursuit of the investigations with which I am charged, rendered it extremely difficult for me to be of much use in your proceedings. . . . . It is a fortunate circumstance for me that my name should be connected with an act of grace on the part of Her Majesty, which serves to confirm your feeling in regard to the fact that as Canadians we enjoy a full share in the honors and privileges of British subjects. And I am proud to think that it was perhaps more because I was a Canadian, in whom the inhabitants of the Province had reposed some trust, that the honor which has been conferred upon me by Her Majesty was so easily obtained. That I am proud of the honors which have been bestowed upon me by the Emperor of France, in respect to my geological labors, and also by my brother geologists in England, there can be no doubt. But I have striven for these honors because I have considered they would tend to promote the confidence which the inhabitants of the Province have reposed in me, in my endeavors to develop the truth in regard to the mineral resources of the Province; and in this work none could have been more interested in my success than the members of this Institute." *

In August, 1857, the American Association for the Advancement of Science held its annual meeting in Montreal, and for several months previous Sir William was hard at work getting his museum in readiness to receive his brother geologists. Owing largely to his untiring exertions, the meeting was a most successful one. He himself read two interesting papers, one on the "Huronian and Laurentian Series of Canada," and another on the "Sub-division of the Laurentian Rocks of Canada." After the business of the Association was concluded, accompanied by Professor Ramsay, who had come over to represent the Geological Society of London, and Prof. Hall, he made a Geological tour through New York State. Returning from this

* Can. Journal, New Series, Vol. 1, p. 404.

trip, he spent the autumn months among the Laurentian rocks of Grenville. Here too, as already mentioned, he continued to work during the season of 1858.

For several years after this, his time was much taken up with the preparation and publication of the *Geology of Canada* and its accompanying Atlas, the former of which appeared in 1863, and the latter in 1865. Before these could be completed, however, many facts had to be added to the stock already obtained, and besides a large amount of geological work among the Laurentian rocks of Grenville and the rocks of the Eastern Townships, a personal examination of many parts of the country, as well as of portions of the New England States, was rendered necessary.

In 1862, Sir William was again present, in the capacity of Juror, at the London International Exhibition, and again displayed a large and interesting collection of economic minerals. Another opportunity of seeing his scientific friends in Britain was also afforded him in 1864, when he went to London to superintend the engraving of the Atlas already mentioned. In 1866, a geological collection was again prepared for the Paris Exhibition of 1867, and Sir William worked so closely in getting up a geological map to accompany it that he is said to have nearly ruined his eyesight. 1868 found him once more on this side of the Atlantic, hard at work in the Pictou coal-field, and the results of this season's work constitute the last of his reports. In 1869, he resigned his appointment to Mr. Selwyn, the present Director of the Survey.

The few remaining years of his life were occupied chiefly with a study of the rocks of the Eastern Townships and portions of New England; but, unfortunately, the conclusions at which he arrived concerning them were not published.

No man has done as much as Sir William Logan to bring Canada before the notice of the outside world, and no man is more deserving of being held in remembrance by the people. Just as statesmen or generals have risen up at the moment of greatest need to frame laws or fight battles for their country, so Sir William appeared to reveal to us the hidden treasures of Nature, just at a time when Canada needed to know her wealth in order to appreciate her greatness. For rising nations require to know what their resources are. He possessed rare qualities—qualities, which, combined, eminently fitted him for his work.

He was strong in body, of active mind, industrious and dog gedly persevering, painstaking, a lover of truth, generous possessed of the keenest knowledge of human nature, sound i judgment, but always cautious in expressing an opinion.

He belonged to that school of geologists—unfortunately no so numerously represented as it ought to be—whose motto is "Facts, then theories," and was wholly above rasping down facts to make them fit theories. As a consequence, he rarely had to un-say what was once said; and this is why he so thoroughly gained the public confidence. So long as he felt that he was in the right, he held to his own views as tenaciously as did ever any true Scot; but if shewn to be in the wrong, he knew how to surrender gracefully.

Those who have clambered with him over our log-strewn Laurentian hills know well what were his powers of endurance. He never seemed to tire, never found the days long enough. His field-books are models of carefulness, replete with details, and serve as an example of the painstaking way in which he did all his work. They were written in pencil, but regularly inked in at night, when the camp fire was often his only light. In addition to his field-book proper, he frequently kept a diary, and delighted to jot down little every-day occurrences, or sketch objects of interest—for the hand that could so well wield a hammer, could also guide a pencil and produce drawings of no mean artistic skill. His descriptions of his backwoods experiences are often very amusing, and we cannot resist giving a specimen. He had been travelling through the forest for two months and had suddenly come upon the house of a settler called Barton, whose good wife was justly alarmed when Sir William and party entered her dwelling. Sir William describes his appearance, on this occasion, as follows:—"We are all pretty-looking figures. I fancy I cut the nearest resemblance to a scarecrow. What with hair matted with spruce gum, a beard three months old, red, with two patches of white on one side, a pair of cracked spectacles, a red flannel shirt, a waistcoat with patches on the left pocket,—where some sulphuric acid, which I carry in a small vial to try for the presence of lime in the rocks, had leaked through,—a jacket of moleskin, shining with grease, and trowsers patched on one knee in four places, and with a burnt hole in the other; with beef boots—Canada boots, as they are called—torn and roughened all over with scraping on the stumps

and branches of trees, and patched on the legs with sundry pieces of leather of divers colours; a broad-brimmed and round-topped hat, once white, but now no colour, and battered into all shapes. With all these adornments, I am not surprised that Mrs. Barton, speaking of her children, and saying that here was "a little fellow frightened of nothing on earth," should qualify the expression by saying, "but I think he's a little scared at *you*, Sir."

It was not alone in the field that Sir William was busy. His office work was often most arduous, and during the earlier years of his directorship, in addition to preparing his annual report, he even kept the accounts, entering every item of expenditure, so that he could at any time shew exactly how every penny of the public money placed at his disposal had been spent. He also tells us that, with his own hands, he made, at that time, four manuscript copies of the Annual Report of Progress, often reaching more than one hundred printed pages—one copy for the Government, one for the House of Assembly, one for the Legislative Council, and one for the printer.

His manner of living was simple as it was solitary. Like his four brothers, he never married, nor does he seem to have formed many intimate friendships. Still every one who knew him loved him and respected him, and if you go the length and breadth of all the land, you will everywhere hear his praises, alike from rich and poor.

He peculiarly possessed the power of inspiring others with his own enthusiasm; not only those in his employ, but even uneduc ted farmers and backwoodsmen—men who, as a rule, are rather sceptical about the advantages to be derived from geology.

Though possessed of private means, he spent little upon himself; not that he was parsimonious, but he cared not for fashion or luxury. But with him Science never pleaded her needs in vain. The first grant of the Legislature, to make a geological survey of the Colonies, was £1,500—an amount which, Sir William quaintly remarked, was but a drop of what would be required to float him over twenty-five degrees of longitude and ten of latitude. This was, of course, very soon spent, and not only this, but at the end of the second year the Survey was £800 in his debt, and he had no guarantee whatever that his money would be returned to him. Since then the Survey has been constantly indebted to him for books, instruments, and other aids, and the building on St. James street, now used for office

purposes, was built by him, two years ago, and rented to the Government for about half the amount which he could have obtained from other tenants. To Logan also, McGill University owes much; for, in 1864, he founded and endowed the "Logan Gold Medal" for an honor course in geology and natural science, and, in 1871, gave $19,000, which, together with $1,000 given by his brother, the late Mr. Hart Logan, forms the endowment of the "Logan Chair of Geology."

Since resigning his position as Director of the Geological Survey, he has carried on explorations at his own expense, and at the time of his death arrangements had been nearly completed for putting down a bore-hole in the Eastern Townships, at a cost of $8,000; as he thought that this would enable him to prove the truth of his views with regard to the age of the metamorphic rocks there.

Every one knows how nobly he acted when asked by the East India Company, in 1845, to make an examination of their territory for coal. The inducements were strong, and no one could have blamed him for giving up his Canadian appointment under the circumstances. But listen to what he says about it: "The field of research was new, and India a country attracting much more European attention than this. I felt perfectly certain the investigation would lead to a very extended reputation. The salary offered me was more than double what I have here, an efficient staff was to be provided, with all kinds of those aids which an Indian Government could so readily afford. But, influenced by a rooted attachment to this country, and feeling that perhaps some favor have been extended to me, because I am a Canadian, I did not accept the offer." *

Sir William was the first to give us any definite information about those wondrous old Laurentian rocks which form the backbone of our continent. He shewed us that they were older than the Huronian, and that they consisted of a great series of metamorphosed sedimentary rocks, which are divisible into two unconformable groups, with a combined thickness of not less than 30,000 feet. The great beds of limestone which he found in the lower series, the plumbago, the iron ores, the metallic sulphurets, all seemed to point to the existence of life in the Laurentian days; but the discovery of *Eozoon Canadense* made

* Report of the Select Committee on the Geological Survey, p. 22.

conjecture give place to certainty. Now we *know* that the world of that far-off time was not a lifeless world. Life, whatever that may be, had been joined to matter.

The first specimens of *Eozoon* were found by Dr. James Wilson, of Perth; but at the time of their discovery were regarded merely as minerals. In 1858, however, Mr. J. McMullen, of the Geological Survey, discovered other specimens, the organic origin of which so struck Sir William that in the following year—four years before their true structure and affinities were determined by Dawson and Carpenter—he even exhibited them as fossils at the meeting of the American Association.

In widely extending our knowledge of the early geological history of the earth, Sir William has done a great work; indeed this may be regarded as his greatest work. Its importance has everywhere been recognized, and the name Laurentian, which he chose for the rocks at the bottom of the geological scale in America, has crossed the Atlantic, and is now applied to the homotaxial rocks of Europe. Sir Roderick Murchison, who dedicated the fourth edition of "Siluria" to Sir William Logan, even substituted Laurentian for "Fundamental Gneiss," the name which he had given to the rocks of the West Highlands of Scotland. "I at first," says Murchison, "termed them 'Fundamental Gneiss,' and soon after, following my distinguished friend, Sir William Logan, I applied to them his term, 'Laurentian,' and thus clearly distinguished them from the younger gneissic and micaceous crystalline rocks of the Central and Eastern Highlands, which were classed as metamorphosed Lower Silurian."

Logan was not a voluminous writer, and during the latter years of his life writing was a great effort to him. Occasional papers from his pen have appeared in the *Transactions of the Geological Society* of London, in the *Canadian Naturalist* and the *Canadian Journal*, and some of these have already been referred to; but most of what he has written is to be found in the *Reports of Progress* annually submitted to the Government, and in that invaluable book, the *Geology of Canada*, which is, to a large extent, a digest of what is contained in the reports published previous to 1863. He sometimes expressed himself quaintly, but everything he wrote is clear and exceedingly concise.

In addition to being a Fellow of the Royal Society and of the Geological Societies of London and Paris, he was a member

of numerous other learned societies both in Europe and America. At the time of his death, and for many years previous, he was one of our Vice-Presidents; but though frequently solicited to accept the office of President, he always declined,—not on account of any lack of interest in the Society, but because he felt his time was too fully occupied to permit of his successfully discharging the Presidential duties. We have already alluded to some of the medals which were awarded to him; but it may be mentioned that altogether he was the recipient of more than twenty, including two from the Royal Society.

And now, in concluding, let me say to you, my friends, if you would do honour to the memory of that noble old man, who fought so long, so bravely, for his country, for science, for you, then honour the cause for which he fought: strive with all your might to advance the interests of that cause, and to raise up a superstructure befitting the solid foundation which Logan has laid. He himself even hoped to build the superstructure; but his anticipations were not realized, for life was not long enough, and we must take up the mantle which he has dropped.

B. J. H.

NATURE AND THE BIBLE.

This is the title of a series of lectures delivered, last winter, by Dr. Dawson, the Principal of McGill College, before the Union Theological Seminary of New York. These lectures were founded by the late Professor Morse, after the plan of the Bampton and Boyle lectures. The general subject of the lectureship is defined to be "the relation of the Bible to the sciences." Dr. Dawson has selected some of the points of contact which are now most debated, and has treated them in six lectures. These are printed in a handsome volume, and form a handy repertory of replies to many of the current attacks upon the Christian theory of the system of nature.

At the very outset, there is claimed for the naturalist the fullest freedom in pursuing the methods of his own science, untrammelled by the methods of theology. Otherwise the testimony of each to other would be valueless; but if, in strictly following his own path, the naturalist arrives at results which are in accordance with statements given in Genesis, and if these statements are many thousand years in advance of the knowledge current at the time when the Pentateuch was committed to writing, it will of course follow that Moses had sources of information not accessible to ordinary historians. As to whether Moses himself committed these books to writing, or as to the manner in which his information was obtained, neither point is necessary to be considered in the argument of these lectures.

The lecturer points out that a complete revelation of the natural sciences, in advance of the requirements of mankind, could not be expected. All that can be expected is an avoidance of those errors which were current at the time, and also, when physical phenomena are recorded as facts, that the record, although scanty, should not teach anything which clashes with any certain results arrived at by other methods. The Mosaic books commence with a cosmogony. All other religions do the same. The Buddhist, the Brahmin, and the Greek all required a theory of the origin of the world. Even the roving Cree of our prairie provinces has a legend of the Kitchi-Manitou who

formed the earth and the sky. The Confucian Chinaman and the positivist Fortnightly Reviewers, similar products of advanced thought and culture, are alone careless of the past and future—content with the barren philosophy of utilitarianism: These are stunted forms of thought—curious and interesting as are those clipped and trimmed trees sometimes seen in royal gardens—but the natural and healthy instinctive intelligence of mankind is ever questioning as to the "why?" the "whence?" and the "whither?" of our universe. Those who would deprive us of our metaphysics, and whose whole hope for the cure of the world is placed in positivism, universal education, and competi tive examinations, may look to China for their ideal land of culture and intelligence.

Dr. Dawson justly dwells with considerable emphasis upon the fact that the recent discoveries of science concerning the identity of light, heat and motion explain some parts of the Mosaic record which were before obscure. For instance, the announcement of the creation of light before the sun is said to have existed, is a remarkable instance of the avoidance of a very natural error, and the gradual development of life upon the globe as related by Moses, runs in the same course with the story of the fossiliferous rocks. Upon such points as these Dr. Dawson is one of the first living authorities. He stands among a very few, at the very summit of this branch of science. His knowledge is not the knowledge of the closet only, but the knowledge of a man who has won it by hard labour and patient investigation in the field, the forest, and the mine; and to the study of the facts of natural science the whole of a busy life has been devoted. When, therefore, as in these lectures, he declares that no antagonism exists between the two records, we know of no man more entitled to a patient hearing.

Although we are disposed to allow full credit to the lofty monotheism of the Hebrew mind, as indicating a belief in the unity and uniformity of natural law, we are not disposed to acquiesce in the lecturer's disparaging reference to the "crudities of Greek philosophy." It seems to us that the secret of the universe cannot be discovered either by the theological method of the Hebrew, by the subjective method of the Greek, or by the objective method of modern science alone. All three are necessary, and all three find their synthesis in Christian science. The mind is oppressed by the elaborate ritual and stern sacrificial

system of the Hebrews, where the moral phase of our nature is alone developed. As Mr. Gladstone well puts it, "the beauty and joyousness of life was entrusted to the Greeks as their mission," while we moderns dwell mainly upon its utilities. The teaching of Nazareth gathered up the truth from all sides, so the Christian philosopher may be at once as monotheistic as Joshua, as pantheistic as Spinoza, and as utilitarian as Bentham. It will require more than one age or one race to show the whole design of God, and the Hebrews are but one colour, dominant though it may be, in the glorious and intricate web which He is now weaving on the "loom of time." Crude though many of the Greek speculations were, we owe to them our intellectual freedom and our intellectual philosophy. We owe to them even the last abstractions of our physics, and more than all, that precious inheritance of ideal beauty in art which no purely Hebrew philosopher ever dreamed of. Dwelling, as we of this age mainly do upon the methods of God, the secondary divinities, as it were, of chemical and molecular force, we tend to lose our way; but the Hebrew, absorbed in the living and personal unity underlying all, does not recognize sufficiently the beauty and diversity of that outward nature which is well called the garment of the invisible God.

As might be expected, our author strenuously, and we believe, triumphantly maintains that the days of creation are not natural days, but periods of time. He shows that the notion of days of 24 hours is a comparatively recent one. This any one may verify for himself by reading the three last books of St. Augustine's Confessions. It is, moreover, clear from the narrative; for the natural day, depending upon the sun, could not have had any existence until the sun was created, upon the fourth day. Clearly, whatever Moses meant by "day," it could not be the usual period of 24 hours, but might well be a period of time occupied by the events which he groups together, and which we now know to have been of very great duration. The succession of creation is shown, in the fourth lecture, to be indicated in the Mosaic record according to the facts of Geology. One difficulty alone appears, which is recognized with great candour, on p. 105: it is that Moses records a great development of vegetable life in the same period when the dry land first appears, the third day, whereas no corresponding fossils have as yet been discovered in the rocks.

We have already seen that the old sceptical objection to the truth of Genesis, based on the formerly incredible statement of Moses that light was created long prior to the creation of the sun, has disappeared before the advancing science of our day. In reply to objections based upon the absence of fossil vegetation in the earliest rocks, it might fairly be urged that these primitive rocks, whenever yet seen, bear evidence of great alteration, which has re-arranged their constituents into crystalline forms. But Dr. Dawson points out that the discovery of Eozoon and the occurrence of graphite in these rocks, demonstrate the existence of organized life at that early period. This subject is ably treated by Sterry Hunt, in his address before the American Association, in 1871, and was more fully worked out in an address delivered in New York. He has for many years been maintaining that the enormous accumulations of iron oxides and metallic sulphides, and the great quantities of graphite which occur in the Laurentian rocks, can only be accounted for by supposing the existence, during that age, of a large development of organized life. To this conclusion, he states the views of Bischof also point, and in this direction the current of scientific opinion is now running. We may, therefore, confidently wait, in the belief that before long the following out of the line of research will justify in the fullest manner the Mosaic narrative. As it exists, it must be admitted that there is a difficulty, but it is much less formidable than it was a few years ago.

On page 24, the lecturer abundantly refutes that ridiculous theory, inculcated so generally of late years, that Moses intended to convey by the word translated "firmament" in our version, the idea of a hard and solid arch, like a hammered metal plate, in which the sun, moon, stars and planets were firmly fixed, like lamps. This absurd notion seems to have been suggested by a misconception of the true force of the Latin word "*firmamentum*," which our translators found in the old Vulgate version. They retained the English derivative, which certainly never had any meaning of dense solidity in its customary usage, and in the margin they put the word "*expansion*," as being the nearest equivalent to the Hebrew, and although not in common use, like the word *firmament*, yet important to be borne in mind in a close examination of the passage. This may be seen in any marginal Bible; and yet, with the most audacious unfairness, the impugners of Genesis seek to fasten the "hammered plate"

theory on Moses—a theory which they they themselves evolved out of their own consciousness, and which never was held by Greek, Roman, Chaldean or Egyptian, but was invented in modern times and foisted on Moses to bring the Bible into contempt. No other book is treated so unfairly as the Bible. Our English word "heaven" is derived from an Anglo-Saxon word, "hefan," to heave up, and we every day speak of the "vault," or the "arch," of heaven. Shakspere constantly speaks of the "floor" of heaven. Could any one suppose that any idea of solidity is conveyed by the use of this class of words? Dr. Dawson gives a very apposite quotation from Milton, precisely defining our English usage.

> "The firmament, expanse of liquid pure
> Transparent, elemental air diffused
> In circuit to the uttermost convex,"

and shows, by references to Job xxxvi and Ps. civ, that the idea expressed by the Hebrew word was one simply of spreading or expansion. The verb correlative to the noun "*rakia*" expresses an idea of tenuity utterly opposed to solidity. It means to stamp or beat out thin, as when gold is beaten out thin for gilding, or, in another passage, when the enemies of God are said to be scattered or trodden out, as it were, thin under foot, so as to offer no further resistance. We repeat that the idea is one solely of expansion and tenuity.

The origin of the adoption of the word "firmament" must be sought in the Septuagint translation, where *rakia* is translated "*stereoma*," and the enquiry naturally arises why that word was selected in this particular passage; for it has been too hastily assumed that "stereoma" and "firmamentum" can have no meaning but that of a solid arch whatever may be asserted concerning the Hebrew "rakia." The Septuagint translation was made at a time when Greek science had reached its most brilliant period—at the court of the most cultivated of ancient princes, and at Alexandria, the resort of all the scientific men of the age. The advancement of astronomical science at that day is often greatly under-estimated. The relative distances of the planets and their movements were well known and calculated with precision. The heavens were all mapped out, and the seasons, cycles, eclipses and other leading facts in astronomy were thoroughly familiar to all in the year 277 B. C. What specially impressed the mind of the ancient astronomer was the

certainty of these motions and the stability and unchangeableness of the orbits of the heavenly bodies. These were held in their unerring rounds in a way mysterious to them, each in its own zone, beyond which it could not vary. The nature of the supporting power was guessed at in the books passing under the name of Hermes Trismegistus, where the stars are represented as moving in a stable extension of space, in spheres of motion fixed by the opposition of two forces. These books of Hermes are the product of Alexandrian philosophy, and contain many such intimations that our discoveries of modern times were more than guessed at by the philosophy of old days. These fixed zones of motion are clearly indicated in the dream of Scipio, at the end of Cicero's treatise on the commonwealth, and more clearly in the commentary of Macrobius upon this dream, four centuries later. No notion of solidity or hardness was entertained. Scipio passes through the clouds and the air, from sphere to sphere, and looks down upon the earth from the most distant. The idea of law is always present, and the Greek word *stereoma* simply expresses this idea of fixity and stability in the heavens, and is the Greek scientific gloss upon the Hebrew word expansion.

The word *stereoma* occurs but once in the New Testament, at Col. ii, 5, where it means steadfastness or firmness of mind. It is used elsewhere to express that which makes strong or firm. So Aristotle calls the skeleton the *stereoma* of the body, and Theophrastus uses the same word for the keel of a ship, which supports the timbers. It also means that which has been made firm or solid, and hence also its secondary meaning of a solid cubic body. This last cannot be the meaning here, for in this "stereoma" the birds are represented as flying, and the planets as moving. To suppose that a solid body, dense, according to the usual idea of a cube, stretching from the sea beyond the stars, as being indicated by the word, is a manifest absurdity. Moreover, the word *stereoma* is a verbal noun, and the verb is derived from a root signifying to place or stand—hence the verb itself always signifies to confirm, establish, or settle, not to make physically solid. It is so used in Isaiah xlii, 5, where God is said to establish the earth and all things which are therein.

The Latin word *firmamentum*, the equivalent of *stereoma*, is always used in the sense of a stay or support, to make strong. So Cæsar uses it for a cross stay of wood to tie together two props supporting a leaning wall. Livy uses it of a detachment

taken from the reserve to the forefront of a battle, as a support to the troops engaged. Cicero repeatedly speaks of an important witness as a *firmamentum* in a trial, and of an argument as a *firmamentum* in an address. The notion of cubical solidity never belongs to this Latin word. Like all words with a similar termination. it carries out the root meaning of its verb, which signifies to make strong.

While Moses then was dwelling upon the fact of the expansion of the heavens, his translators added also the idea of strength, to bear up those heavenly bodies which they conceived as floating in them. This idea of strength is abundantly indicated in other passages of the Hebrew by other words, but not in this passage, where the physical appearance of the expanse only is denoted. Of all the contemptible theories which have been excogitated by the ingenuity of those who sit in the seat of the scornful, this "hammered plate" theory is the most preposterous.

Upon the question of miracles, Dr. Dawson takes the ground that they are not suspensions of law. And this ground is a perfectly tenable one upon its theological side; for it be once admitted that there is an intelligent and powerful Will existent in the Universe, we can easily understand that any wonderful and unusual work can no more be considered as a suspension of law than our own acts of volition, exercised physically, as, for instance, when we arrest the motion of falling bodies, can be considered as suspensions of the law of gravitation. The ultimate cause, in both instances, is a moral cause, that of *will:* the one of a limited human will, and the other of a Divine, Allpowerful Will, containing the ultimate forces of the Universe.

We have space only to advert to the notices of the theories of Huxley and Tyndall regarding the non-existence of vital force. These eminent philosophers are endowed with such a power of vivid expression, and such force of imagination, in addition to their great scientific powers, that it is not surprising if they are sometimes carried away by their own picturesque methods of grouping facts. Sometimes the unscientific mind is led astray by them; and we can never get over a slight feeling of resentment towards Huxley when, after falling down and worshipping his new deity Protoplasm for the space of a month or two, we suddenly discovered that it was nothing but an old familiar friend, albumen in a new Greek dress. Ever since that time, we have been shy of these brilliant paradoxical phrases. Some

instances are given, in these lectures, of those verbal *tours de force*.

We must now take leave of Dr. Dawson's lectures. They are valuable contributions towards a harmony of the conflicting claims of Science and Religion, and very suggestive and provocative of thought. We sincerely hope they will have an extensive sale, for we are sure that they will tend to create a fairer mode of treating the Bible than either savans or theologians usually employ. What with the savans taking metaphors literally, and the theologians taking objective statements metaphorically there never was a book so unfairly treated.

S. E. D.

THE DAWN OF LIFE,

Being the history of the oldest known Fossil Remains, and their relations to Geological time and to the development of the Animal Kingdom.

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"In a little volume entitled "The Dawn of Life" (Hodder and Stoughton), Dr. Dawson, the well-known Canadian geologist, has sketched in a style strictly popular, yet without the least sacrifice of scientific exactness, the curious discovery of the Eozoon, in the limestones of the ancient Laurentian series which attain such an amazing thickness in Canada. Although the existence of orgauic remains in those rocks was, as the author justly remarks, a fair inference from our knowledge of them, and we may add, of the kindred rocks in Scotland and Ireland, better known to us as the Lewisian, it is entirely to the Canadian geologists that this curious solution of a difficult problem is due. It was they who perceived that, the basis of these rocks being limestone, it was more than probable, in spite of the metamorphic character they had assumed, that they were originally sedimentary deposits like the basis of other limestone, and had the same origin in the corruption of the remains of the myriads of little creatures which, both on the surface and in the depths of the ocean, are still, as the dredges of the Challenger teach us, forming beds of chalks and probably vast white cliffs to be revealed in future ages inconceivably remote. To the shrewdness of these American men of science we also owe the inference of vegetable life during the Laurentian period as evidenced by the existence of graphite or plumbago. Thus the final discovery of Eozoon, or the "Canadian dawn-animal," as it has been called from its presence in what we have ground to assume to be the very first of all aqueous deposits, was, as has been observed, somewhat like the discovery of the planet whose existence had been first determined *a priori* from planetary disturbances. How far back this discovery, at first received with scepticism, but now fairly established as a scientific fact, pushes the period of life on our globe beyond what was till lately known as the "primordial period," may be faintly conceived from the circumstance that the Laurentian was found on measurement by the officers of the Canadian Geological Survey to be 3,500 feet thick, in three beds, which have been computed to extend over an area of 200,000 square miles. Next to Sir William Logan, perhaps Dr. Dawson himself has had more to do with this discovery of the earliest known fossil than any one else. He speaks therefore with authority in his account of the nature and probable habits of the dawn-animal, and in tracing out the important relations which the discovery bears to facts and theories which extend far beyond the strict domain of the geologist. His monograph is written in a vein of quiet enthusiasm which is justifiable, and while it attracts the novice, will not be unpleasing to the scientific reader. Very little is really wanting to the full comprehension of his theme beyond the preliminary explanations, the condensed sketch of geological periods, and the wood-cut illustrations which accompany the book. We will undertake to say that even a reader who is entirely unacquainted with the science will, if he have only ordinary curiosity about natural phenomena, find this volume not only perfectly intelligible, but entertaining in a high degree."

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