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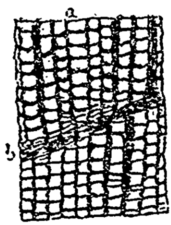
VOL. VI. JUNE 15, 1861. No. 3.



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ARTICLE X.—*On the Pre-carboniferous Flora of New Brunswick, Maine, and Eastern Canada.* By J W. DAWSON, LL.D., F.G.S., &c.

(Read before the Natural History Society.)

The known flora of the rocks older than the Carboniferous system, has until recently been very scanty, and is still not very extensive. In Goeppert's recent memoir on the flora of the Silurian, Devonian, and Lower Carboniferous rocks,* he enumerates 20 species as Silurian, but these are all admitted to be Algæ, and several of them are remains claimed by the zoologists as zoophytes, or trails of worms and mollusks. In the Lower Devonian he knows but 6 species, five of which are Algæ, and the remaining one a *Sigillaria.* In the middle Devonian he gives but one species, a land plant of the genus *Sagenaria.* In the upper Devonian the number rises to 57, of which all but 7 are terrestrial plants, representing a large number of the genera occurring in the succeeding Carboniferous system.

Goeppert does not include in his enumeration the plants from the Devonian of Gaspé, described by the author in 1859,† having seen only an abstract of the paper at the time of writing

* Jena 1860.

† Journal of Geological Society of London, also Canadian Naturalist.

his memoir, nor does he appear to have any knowledge of the plants of this age described by Lesquereux in Rogers' Pennsylvania. These might have added ten or twelve species to his list, some of them probably from the Lower Devonian. It is further to be observed, that certain specimens found in the Upper Ludlow of England,* appear to prove the presence of *Lepidodendron* in that formation; and that in the paper above referred to, I have noticed specimens from the Gaspé limestone which seem to me to indicate the occurrence of *Psilophyton* and *Noeggerathia* or *Cordaites* in the Upper Silurian of Canada.

It thus appears that, according to our present knowledge, the plant life of the land, so rich in the coal formation, dies away rapidly in the Devonian, and only a few fragments attest its existence in the Upper Silurian. Great interest thus attaches to these oldest remains of land plants; and fragmentary though they are and often obscure, they merit careful attention on the part of the geologist and botanist.

No locality hitherto explored, appears more favourable to the study of this ancient vegetation, than those parts of Eastern America to which this paper relates. The Gaspé sandstones have already afforded six Devonian species, some of them of great interest, and in a remarkably perfect state of preservation; and from beds of similar age in New Brunswick and Maine, I am now prepared to describe at least ten species, most of them new. This already raises the species found in the band of Devonian rocks, extending through the north-eastern States of the Union, and the eastern part of British America, to one-third of the number found in all other parts of the world; and the character of the containing rocks, the number of nondescript fragments, and the small amount of exploration hitherto made, justify the hope that a much larger number may yet be discovered.

Of the plants described in this paper, only a few have been discovered by myself. The greater part are from the following sources. (1) The collection of Mr. G. F. Matthew, of St. John, New Brunswick; (2) a collection from Perry, Maine, made by Mr. Richardson for the Geological Survey of Canada; (3) specimens from Perry in the collection of the Natural History Society of Portland. Several of these plants have been long known. Some of those found at St. John are noticed by Dr. Gesner in his re-

* Murchison's Siluria, p. 152, Journal Geol. Socy. Vol IV.

port on the geology of New Brunswick; and specimens were shown to me several years ago, by the late Professor Robb of Fredericton. Those from Perry are mentioned in the report of Dr. Jackson on the geology of Maine, and have also been noticed by Prof. Rogers in the proceedings of the Natural History Society of Boston. No adequate description of them has however yet been published; and it is to this task that I would address myself in the present paper. I shall notice first the plants from St. John, next those from Perry, and finally a new form from Gaspé.

1. St. John, New Brunswick.

The city of St. John stands on the rocks constituting what I have elsewhere termed the coast metamorphic belt of New Brunswick,* an irregular ridge rising through the Carboniferous rocks, and extending from Shepody mountain south-westward along the north side of the Bay of Fundy to the St. John River, westward of which it expands into a broad band of metamorphic and plutonic rocks, extending into the State of Maine. In the vicinity of St. John these rocks consist principally of white and gray crystalline limestone, hard shales and slates of various colours and qualities, quartz rock, and indurated gray sandstone. With these are associated syenite, greenstone, and trappean rocks, some of the latter appearing to be interstratified. The crystalline limestone is of great thickness and destitute of fossils; but contains small quantities of graphite. In the shales near the limestone is a regular bed of graphite, attaining in places a thickness of four feet. It is of coarse quality, and retains obscure traces of vegetable structure. Some of the beds of sandstone and shale contain numerous fossil plants, their carbon being in the state of graphite, and the fragments, though abundant, not easily studied, owing to their imperfect preservation, and the hardness of the enclosing rock. A bed of sandy shale is filled with fragments of *Lingula*, which were discovered by Prof. Rogers, but which neither he nor Mr. Billings, to whom I have shown specimens, can refer to any known species.

The arrangement of the beds at St. John is shown by the ac-

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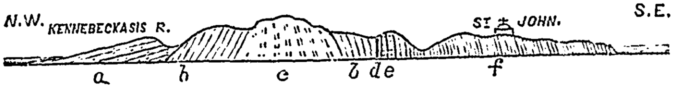
* Acadian Geology.

companying section prepared by Mr. Matthew, and which accords with such observations as I have been able to make.



Section of the vicinity of St. John.

(*a*) Lower carboniferous conglomerate. (*b*) Crystalline limestones of St. John group. (*c*) Syenite. (*d*) Bed of graphite. (*e*) Interstratified trappean rock. (*f*) Slates, shales, and sandstones of St. John group.

With respect to the age of these beds; in the absence of determinable animal fossils, I may state the following facts. (1) The limestone and its associated shales underlie unconformably the Lower Carboniferous conglomerate, which here appears to be the oldest member of that system. This arrangement is general throughout the belt to which the St. John rocks belong. (2) The whole of the beds of the St. John group, appear to be conformable to one another and to constitute one formation. (3) In mineral character, and especially in the occurrence of thick beds of limestone and of graphite, the St. John rocks do not resemble any of the Devonian or Silurian rocks of Nova Scotia, though these occur in a similar state of metamorphism. They more nearly resemble the Devonian of Gaspé. The Devonian rocks known in Nova Scotia, appear to belong to the lower rather than to the upper member of that system,* and they have afforded no plants except indeterminable fragments. (4) The plants found in the rocks of the St. John group, are specifically distinct from those of the Carboniferous system in Nova Scotia and New Brunswick.

In the map attached to Prof. Johnston's Report on the Agriculture of New Brunswick, Prof. Robb has coloured these rocks as Lower Silurian. In my Acadian Geology, on the ground chiefly of mineral character, I have with doubt placed them as Upper Silurian or Devonian. The facts at present known show them to be older than the Carboniferous system, though perhaps belonging to the newest part of the Devonian.

The following are the plants which I have been able to determine:—

* Supplement to Acadian Geology, also Canadian Naturalist, Vol. 4.

1. *Dadoxylon Ouangondianum.**—Sp. nov.

Fig. 1.

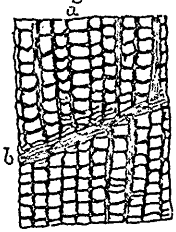
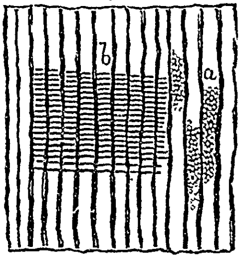


Fig. 2.



Figs. 1and 2.—*Dadoxylon Ouangondianum.*

Fig. 1.—Transverse section 50 diams. (*a*) Wood cells. (*b*) Line of growth.

Fig. 2.—Longitudinal section, radial. (*a*) Disc structure. (*b*) Medullary rays.

Description.—Branching trunks, with distinct zones of growth, and a pith of Sternbergia type. Wood cells very large, with three to five rows of contiguous alternate hexagonal areoles with oval pores. Medullary rays with one to three series of cells, and as many as 14 rows of cells superimposed on each other.

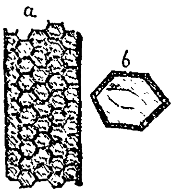
Trunks of this fine coniferous tree are not infrequent in the St. John sandstones explored by Mr. Matthew. They retain their structure in great perfection, especially in silicified specimens. Some of the trunks have been a foot or more in diameter. They show traces of growth rings on their weathered ends, and when perfect, are traversed by the transversely wrinkled pith cylinders, formerly known as *Sternbergiæ.* Under the microscope the wood cells are seen to be of remarkable size, being fully one-third larger in their diameter than those of *Pinus strobus* or *Araucaria Cunninghami,* and also much larger than those of the ordinary coniferous trees of the coal measures. They are beautifully marked with contiguous hexagonal areoles, in which are inscribed oval slits or pores, placed diagonally. The medullary rays are large and frequent, but their cells, unlike the wood cells (prosenchyma), are more small and delicate than those of the trees just mentioned. The pith when perfectly preserved, presents a

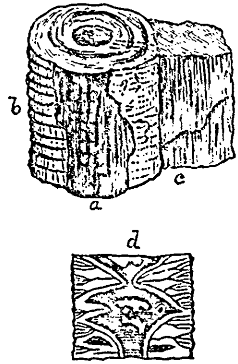
* I have named this species after the ancient Indian designation of the St. John River, *Ouangonda.* I use the generic term Dadoxylon as probably best known to English geologists; but I sympathise with Goeppert in his preference of the generic term *Araucarites* for such trees.

continuous cylinder of cellular tissue, *wrinkled longitudinally* without, and transversely within, and giving forth internally delicate transverse partitions which coalesce toward the centre,

Fig. 4.

Fig. 3.





Figs. 3 and 4.—*Dadoxylon Ouangondianum.*

Fig. 3.—Fragment of wood cell prepared by nitric acid. (*a*) 200 diameters. (*b*) Single areole more highly magnified.

Fig. 4.—Sternbergia pith. (*a*) Outer carbonised coating. (*b*) Transverse plates. (*c*) Fragment of wood attached to exterior. (*d*) Section showing internal structure, natural size.

leaving there a series of lenticular spaces, a peculiarity which I have not heretofore observed in these Sternbergia pith cylinders. It is interesting to find in a Devonian conifer the same structure of pith characteristic of some of its allies in the coal formation, where however, as I have elsewhere shown,* such structures occur in Sigillaria as well; and since Corda has ascertained a similar structure in *Lomatofloyos,* a plant allied to Ulodendron, it would appear that the Sternbergiæ may have belonged to plants of very dissimilar organization.

In my specimen the pith is only half an inch in diameter, and only a small portion of the wood is attached to it; but Mr. Matthew has a specimen of a trunk ten inches in diameter, with the pith one inch in thickness, and another 11½ inches in diameter, with the pith 2½ inches. Both had the appearance of decayed trunks, so that their original size may have been considerably greater.

* Paper on Coal Structures. Journal of Geol. Survey.

Mr. Matthew states in reference to the mode of occurrence of this interesting species, that the wood is always in the state of anthracite or graphite, or mineralized by iron pyrites, calc spar or silica. The pith is usually calcified, but in pyritised trunks it often appears as a sandstone cast with the external wrinkles of Sternbergia. The pith is often eccentric, and specimens occur with two or three centres; but these either consist of several trunks in juxtaposition, or are branching stems. The annual layers vary from $\frac{1}{8}$th to $\frac{1}{30}$th of an inch in thickness, and adjoining layers sometimes vary from $\frac{1}{10}$th to $\frac{1}{20}$th of an inch.

The trunks of this species appear to have had a strong tendency to split in decay along the medullary rays, and in consequence the cross section often presents a radiating structure of

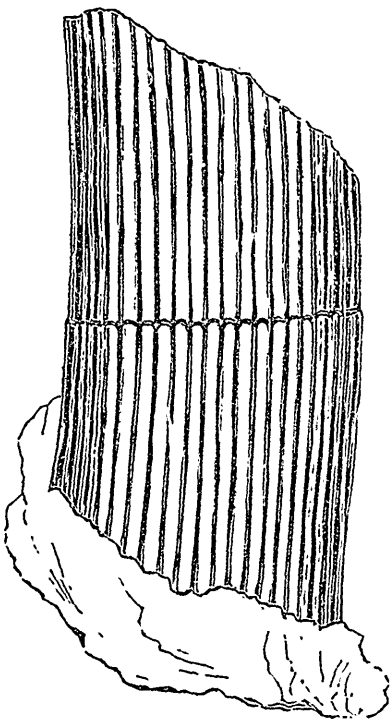


Fig. 5.—*Calamites transitionis.* (p. 168.)

alternating black lines representing the wedges of wood, and white rays of calc spar. The heart wood seems to have had its cell walls much thickened, and in consequence to have been more durable than that nearer the surface. They appear to have been drift trees, and to have bee much worn and abraded before they were imbedded in sediment.

2. *Calamites transitionis.*—Goeppert.

(Fig. 5—*previous page.*)

The specimen figured appears to belong to the species above named, which occurs in the Devonian of Silesia, and also in the Lower Coal Formation. It is a cast in sandstone, showing merely the decorticated surface in an indifferent state of preservation. Specimens of this species were shown to me in 1857, by the late Prof. Robb, and were the first well characterized plants from the St. John rocks, that had come under my notice.

3. *Asterophyllites parvula.*—S. n.

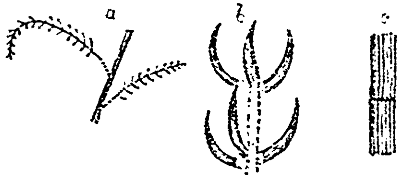


Fig. 6.—*Asterophyllites parvula.*
(*a*) Natural size. (*b*) Portion magnified. (*c*) Stem natural size.

Description.—Branchlets slender. Leaves 5 or 6 in a whorl, subulate, curving upward, half a line to a line long. Internodes equal to length of leaves or less. Stems ribbed, with scars of verticillate branchlets at the nodes.

This delicate little species is found abundantly in graphitic shale, on the surfaces of which its branchlets and leaves appear as shining films of graphite, as if delicately drawn with a black lead pencil. It can be extracted from the shale only in fragments; but associated with these are remains of stems about a line in thickness, with about 16 ribs and prominent nodes with little tubercles indicating the attachment of branchlets.

4. *Cordaites (Pycnophyllum) Robbii.*—S. n.

Description.—Leaves elongated, parallel-sided, an inch or more in width, with very delicate equal longitudinal striæ.

This is the characteristic plant of the graphitic shale above mentioned, to which its leaves, converted into graphite, aid in giving a thin lamination. For this reason I desire to dedicate it to my late lamented friend, Prof. Robb, who has been called away in the midst of labours that would have added much to our knowledge of the geology of New Brunswick. I have seen no specimens of this leaf entire; but it appears to have been a broad lanceolate or oblong leaf, resembling the common Cordaites of the coal measures, but more delicate in its striation. Mr. Matthews has found specimens 3 inches in width.

The generic name *Cordaites* as used here, may require some explanation. I employ it as applied by Unger to the *Flabellaria borassifolia* of Corda, which I regard as the type of all those broad parallel-veined elongated leaves, which have by various authors been placed in the genera *Pycnophyllum*, *Noeggerathia*, *Poacites*, and *Flabellaria*. The first of these names, proposed by Brongniart, I regard as a synonym of Cordaites; but I have no certain information as to its priority to that name. The second, *Noeggerathia*, was originally applied to flabellate and pinnate leaves, quite distinct from that now described.* It has by some authors been restricted to a genus of ferns allied to Cyclopteris and by others still included in that genus;† and latterly it is used by Goeppert,‡ and by Unger,§ to include parallel veined leaves, like the present species, but placed among monocotyledonous plants, and said to be pinnate, though there is no evidence of this in several of the species, some of which may possibly belong to Cordaites, and others, as *N. tenuistriata*, (Goeppert,) are probably stipes of ferns allied to my *Cyclopteris Acadica*. *Poacites*, if *P. cocoina* (L. and H.) is considered its type, cannot include these leaves, and *Flabellaria* is now restricted to leaves of palms, quite dissimilar from Cordaites.

By the use of the generic name which I have selected for the above reasons, I hope to avoid all the confusion in which the nomenclature of leaves of this type has long been involved. I do

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* Lindley and Hutton, Fossil Flora. It is to these leaves, represented by *N. foliosa* and *N. flabellata*, that the name properly belongs, and it appears desirable that they should be more distinctly separated on the one hand from ferns of the genus Cyclopteris, and on the other from plants like that now under consideration.

† Lesquereux in Rogers' Pennsylvania. See also Unger, Genera et Species, and Goeppert, Gattnung.

‡ Flora des Uebergangsgebirges, and Flora der Silurischen, &c.

§ Unger Palæontologie des Thuringer waldes.

not express any opinion as to their affinities, any farther than to state my belief that they present no important point of structural difference from *Corduites borassifolia*, and that this plant as described by Corda,* has a stem closely resembling Lomatofloyos, and therefore of the same type of structure with Ulodendron and Lepidodendron.

5. *Corduites angustifolia.*—S. n.

Description.—Leaves elongated, one-tenth to one-fourth of an inch wide, with delicate equal parallel striæ.

This leaf differs from the last in its proportionate narrowness and decided striation. No specimen showing its extremities has been obtained, in consequence of which, I cannot determine whether it has the retuse apex mentioned as one of the characters of Unger's *Noeggerathia graminifolia*, which in form and dimensions it much resembles. A very similar leaf, probably the same species, occurs in the Devonian and Upper Silurian of Gaspé, and is represented in Fig. 11. It was noticed in my paper on the plants of that region, as probably a Noeggerathia.

6. *Sphenophyllum antiquum.*—S. n.

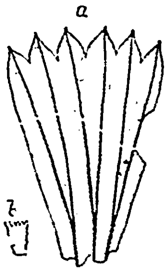

Fig. 7.—*Sphenophyllum antiquum.*
(*a*) Magnified. (*b*) Natural size.

Description.—Leaflets cuneate, one-eighth of an inch wide at apex, and less than one-fourth of an inch long. Nerves three, bifurcating equally near the base, the divisions terminating at the apices of six obtuse acuminate teeth.

This is the first occurrence, in so far as I am aware, of the genus Sphenophyllum in beds older than the carboniferous system. Leaflets only were found, so that it is impossible to state the arrangement of these on the stem; but the form and nerva-

* Flora der Vorwelt; under genus *Flabellaria.*

tion of the leaflets are well defined. Under the microscope the nervures have a striated appearance, and there is a more delicate longitudinal striation visible in the epidermis of the leaf. I may remark here, that though in a somewhat altered rock, and to a cursory glance indistinct, the leaves and other delicate vegetable organs in the shales of St. John, are found under the microscope to present an unusual degree of perfection in their finer markings. They must in the first instance have been imbedded in a quite unchanged condition, and but for the alteration which the rocks have sustained, would have furnished remarkably perfect specimens. The species above described approaches most nearly to *S. erosum* of the coal measures, but differs in its proportions.

7. *Lycopodites Matthewi.*—S. n.

Fig. 8.—*Lycopodites Matthewi.*

(*a*) and (*b*) Natural size. (*c*) Magnified. (*d*) *Lepidophyllum.*

Description.—Leaflets one veined, narrowly ovate-acuminate, one-tenth to one-fourth of an inch in length, somewhat loosely placed on a very slender stem, apparently in a pentastichous manner.

This pretty little species is abundantly displayed in graphite, in the Cordaites shale I have already referred to. With it are found the little scales or Lepidophylla, (Fig. 8, d.) which may possibly have belonged to its fructification.

In addition to the above plants, there is in the sandstone containing conifers, an impression of the bark of a plant which may have been a *Sigillaria.* In the Cordaites shale there are many indeterminable fragments, among which are a small fern leaf, apparently a *Sphenopteris* like *S. Devonica*, Unger, a terminal pinnule of a *Cyclopteris*, which appears to be the same with that described below from Perry, leaves having the appearance of those of *Sigillaria*, (Cyperites), and stems which may belong to *Psilophyton*. There are also some remarkable fragments which in some aspects appear to be transversely furrowed stems with longitudinal striæ, and in other specimens present the appearance of monocotyledonous leaves, with strong longitudinal nerves and more slender transverse ones. These are perhaps stipes of ferns, some species of Cyclopteris presenting a somewhat similar appearance in their flattened petioles. There also occur both at St. John and Gaspé, carbonaceous films of uncertain form, and minutely pitted all over, the precise nature of which I cannot determine.

II. Perry, Maine.

The rocks at this place consist of sandstones and shales, very closely resembling those of Gaspé. They were first described by Dr. Jackson, in his Report on the Geology of Maine. More recently they have been noticed by Prof. Rogers, in the Proceedings of the Natural History Society of Boston. Prof. Rogers regards them as of Devonian date, in which view Dr. Jackson concurs, and the evidence of the plants is favourable to the same conclusion. Their stratigraphical relations have not, however, been accurately worked out. Mr. Richardson, of the Geological Survey of Canada, represents them as apparently resting unconformably on metamorphic rocks of uncertain date, but which, according to some recent observations of Prof. Rogers, may be in part of Upper Silurian age. The fossils from this place which have come into my hands, are preserved somewhat imperfectly in hard coarse sandstone. They consist of the following species:—

1. *Cyclopteris Jacksoni.*—S. n.

I think it but just to name this fine species after its original discoverer, and the explorer of the geology of Maine. It is closely allied to *C. Hibernica* and *C. McCoyana* from the Devonian of Ireland; but is sufficiently distinct to constitute a well marked species. It resembles the ferns just named in the dense arrangement of its pinnules, which largely overlap each other; but it differs from them in the arrangement of the pinnæ, in the form of the pinnules, and in the character of the rhachis. It seems quite distinct from any of the ferns from the Devonian of Pennsylvania, &c., described by Lesquereux. The specimen figured is one in the collection of the Natural History Society of Portland.

In Mr. Richardson's collection, single pinnæ occur, and there are also many large stipes which may have belonged to this species.

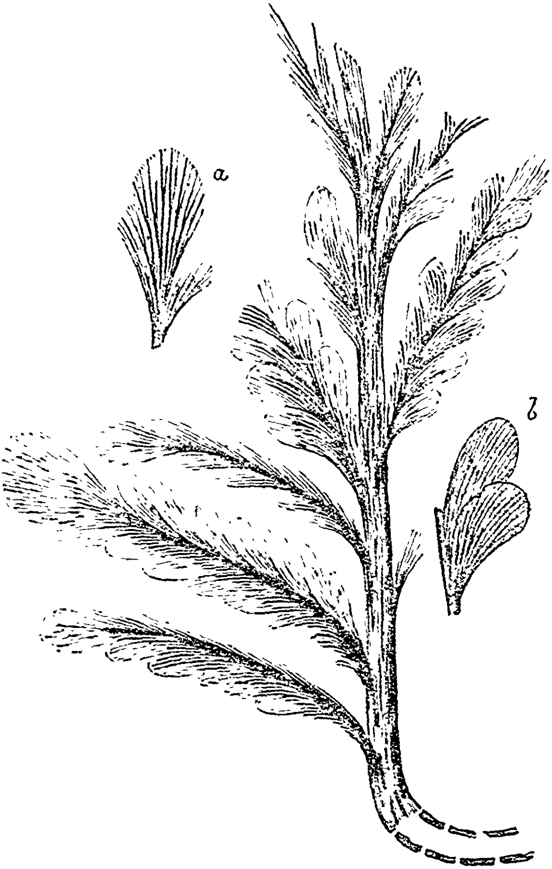

Fig. 9.—*Cyclopteris Jacksoni.*

(*a*) Terminal pinnule. (*b*) Lateral pinnules slightly magnified.

Description.—Frond bipinnate; rhachis stout and longitudinally furrowed; pinnæ alternate; pinnules obliquely obovate, imbricate, narrowed at the base, and apparently decurrent on the petiole; nerves nearly parallel, dichotomous; terminal leaflet large, broadly obovate or lobed.

As above stated, terminal pinnules which may have belonged to this species occur in the St. John beds; but more perfect specimens will be required to render this identification certain.

2. *Lepidostrobus Richardsoni.*—S. n.

(Fig. 10.)

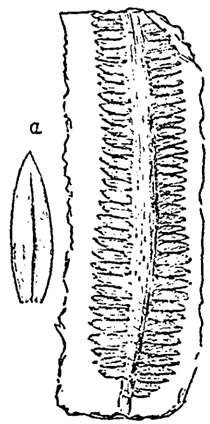

Fig. 10—*Lepidostrobus Richardsoni.*

(*a*) Pinnule magnified.

Description.—Axis not distinctly preserved, form cylindrical?—scales oblong with an obscure midrib.

I refer to the above genus with some hesitation, a well characterised but very puzzling organism, discovered by Mr. Richardson at Perry. It consists of an indistinct but apparently thick stem or axis, with equally pinnate leaves, which seem to have been thick and oblong and show traces of a midrib. It resembles a perfectly flattened Lepidostrobus, more than anything else; but it may have been a branch of a conifer with pinnate leaves.

3. *Lepidostrobus*, ———— S. n.

In Mr. Richardson's collection from Perry, is a rounded and flattened object, 1½ inch in diameter, apparently covered with thick pointed scales. It seems to be a Lepidostrobus quite distinct from the last.

4. *Lepidodendron Gaspianum.*—mihi.

In a specimen in the collection of the Natural History Society of Portland, there is a branch of Lepidodendron, 7½ inches in length, ½ inch in diameter at the larger end, and ⅓ inch in diameter at the smaller. It is flattened and imperfectly preserved, but on comparison with my specimens from Gaspé, I cannot observe any specific difference. This species is evidently closely allied to *L. nothum*, Unger, and possibly could perfect specimens of both be obtained, they might prove to be identical. In the mean time however as the scars and leaves of *L. nothum* are unknown, it is difficult to institute a comparison.

5. *Psilophyton princeps.*—mihi.

Great numbers of slender bifurcating stems appear on the shales brought from Perry by Mr. Richardson. They are not well preserved; but it seems scarcely to admit of a doubt that they belong to this species, so characteristic of the Gaspé sandstones.

6. *Megaphyton?*

A flattened stem two inches in diameter, irregularly ribbed and striated, appears to show a row of scars on the exposed side, as in the above named genus. The scars are not however well defined. The plant has a slender pyritised axis giving off a few bunches or bundles of vessels to the sides. The structure is very imperfect but was possibly scalariform.

7. *Sternbergia.*

In the collection with which I have been favored by the Natural History Society of Portland, is an impression of a Sternbergia not distinguishable from that of *Dadoxylon Ouangondianum*, of St. John, to which species it perhaps belonged. It retains no traces of the wood; but casts of sternbergia in the same naked condition often occur in the coal measures.

8. *Aporoxylon.*

Many fragments of carbonised wood showing aporous cells occur in the Perry sandstones: I refer them in the mean time to the above genus of Unger.

III. Gaspé Sandstones.

From these rocks I have but one species to notice at present. It is that referred to in my former paper as probably a Knorria,*

* Paper on Devonian Plants of Gaspé, Journal of Geological Society, Vol. XV.

but of which I have recently obtained better specimens which induce me to propose for it the name of—

Selaginites formosus.—S. n.

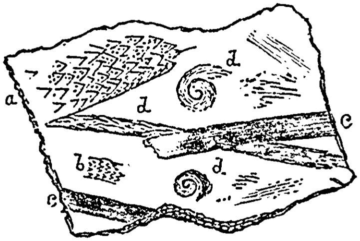

Fig. 11.—Fragment of shale from Gaspé.

(*a*) *Selaginites formosus.* (*b*) Smaller specimen of the same. (*c*) *Cordaites angustifolia.* (*d*) *Psilophyton princeps.*

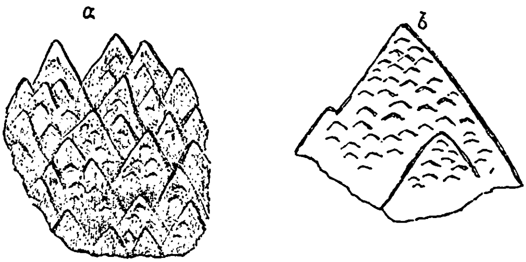

Fig. 12.—*Selaginites formosus.*

(*a*) Small specimen magnified. (*b*) Scale of larger specimen magnified.

Description.—Stems covered with flat broad angular imbricating scales of unequal size, and ornamented with minute scaly points.

The original specimen of this curious plant was a fragment of the bark on sandstone in the collection of Sir W. E. Logan. I have since discovered in the bituminous shale overlying the Devonian coal of Gaspé, and which abounds in vegetable fragments, several portions of flattened stems showing the characters more perfectly. The different sizes of the fragments and of the scales that clothe them would indicate that it was a branching or dichotomous plant. Their condition of preservation shows that the bark was firm and durable. The scales are flat, quite angular and closely appressed, but seem to have been thick, and are evidently free at their extremities and without any indication that they supported leaves. They show no ribs or nervures; but are covered with little subordinate projecting points or scales as shown in the figures.

I formerly referred this plant to Knorria, on account of its scaly stem; but this genus has recently been placed in a somewhat equivocal position by Goeppert,* who finding, as I had previously done,† that the plants called Knorria in the Lower coal measures, are really decorticated or imperfectly preserved Lepidodendra or Sagenariæ, seems disposed to abandon the genus.

The present species might however still remain as a typical Knorria having a scaly stem and quite distinct from Lepidodendron, but to avoid any confusion between it and the plants heretofore known as Knorria but now ascertained to be of a different character, I prefer to place it in the mean time in Selaginites; in the hope that more perfect specimens may soon illustrate more fully its affinities.

Concluding Remarks

In comparing with each other the plants of the three localities above referred to, it will be observed that they have few species in common. Probably two species are common to Perry and St. John, and two to the former and Gaspé; while it is doubtful if one is found in all three. It must be observed however that according to Mr. Billings, the fossil shells of the Gaspé sandstones indicate a Lower Devonian age, while it is quite probable that the rocks of Perry and St. John may be Upper Devonian; and this is the more likely as the plants of the St. John beds are decidedly nearer in their facies to those of the coal formation than are those of Gaspé.

None of the species found in these old beds have as yet been recognised in the carboniferous system in British America; and only one, *C. transitionis*, elsewhere. The generic types are however the same, with the exception of *Prototaxites* and *Psilophyton*,

* Flora der Silurischen, &c., 1860.

† Paper on Lower Coal measures, Journal of Geological Society, Vol. XV. P. 69.

and possibly also the form of Cyclopteris represented by *C. Jacksoni*, which differs from any fern of the coal formation, and is perhaps entitled as Lesquereux maintains to a distinct generic name. The generic assemblage in the beds now under consideration, resembles that in the lower coal formation, and differs from that in the true coal measures, in the prevalence of Lycopodiaceus plants and the comparative absence of Sigillariæ; but the genera Lepidodendron and Sagenaria so characteristic of the lower coal measures are slenderly represented here. It is also to be observed that the genera Asterophyllites and Sphenophyllum, though common to the St. John group and the coal measures, are, in so far as known, absent from the lower coal formation in Nova Scotia and New Brunswick. The former genus is however found in the Lower coal in Silesia. It is interesting to observe in the St. John beds which have been disturbed and metamorphosed before the carboniferous period, a generic assemblage so similar to that of the coal. On the other hand it is still more curious to find that the absence of the great Sigillaroid and Ulodendroid trees, so characteristic of the wide swampy flats of the coal period, gives to the St. John flora a more modern aspect than that of the coal; though in its exclusively cryptogamous and gymnospermous character, and in its generic forms, it is quite as decidedly palæozoic.

In comparing the plants in the Devonian of Eastern America with those of Europe, a smaller proportion of identical species appears than in the case of the coal measures. There may have been in the Devonian period a greater geographical separation or climatic difference between the European and American land than in the time of the coal formation. On the other hand, however, a part of the plants ascertained here belong to the Lower Devonian, which has hitherto afforded only one land species in Europe, while here it contains several well preserved species and even a small bed of coal; and with respect to the Upper Devonian the number of known species is too small as yet to admit of a satisfactory comparison.

I trust that the species described in this and my previous paper are but a small instalment of those to be brought to light by further search. In the meantime I present the following summary of these species, as representing the present state of our knowledge. I have introduced those that are doubtful as well as those fully ascertained; and have arranged them in families according to my present views of their affinities—views which may however admit of important modifications when the plants shall become better known.

Summary of Fossil Plants, from beds older than the Carboniferous system, in British America and Maine.—[Described in this paper; and in that on the Devonian plants of Gaspé, in the Journal of the Geological Society of London, Vol. 15, and Canadian Naturalist, Vol. 5.]

(a).—*Exogenous Gymnosperms.*

1. *Coniferæ.*

(1.) *Prototaxites Logani*, mihi,........Lower Devonian, Gaspé.
(2.) *Dadoxylon Ouangondianum*, m.,..........St. John group.
(3.) *Sternbergia*, (probably pith of last species), Devonian, Perry.
(4.) *Aporoxylon*,....................... Do.

2. *Sigillariæ.*

(5.) *Sigillaria?—Cyperites?*......................St. John.

(b.)—*Doubtful if Gymnosperms or Cryptogams.*

3. *Calamiteæ.*

(6.) *Calamites transitionis*, Goeppert,...............St. John.

4. *Asterophylliteæ.*

(7.) *Asterophyllites parvula*, m.,...................St. John.
(8.) *Sphenophyllum antiquum*, m.,.................St. John.

(c.)—*Acrogenous Cryptogams.*

5. *Lycopodiaceæ.*

(9.) *Lepidodendron Gaspianum*, m.,..........Gaspé and Perry.
(10.) *Lepidostrobus Richardsoni*, m.,..................Perry.
(11.) L.———..................................Perry.
(12.) *Lycopodites Matthewi*, m., ...St. John.
(13.) *Psilophyton princeps*, m.,........Gaspé, Perry, St. John?
(14.) *P.———— robustius*, m.,.......................Gaspé.
(15.) *Selaginites formosus*, m.,.......................Gaspé.
(16.) *Megaphyton?*...............................Perry.
(17.) *Cordaites Robbii*, m., ...St. John.
(18.) *C.——— angustifolia*, m., ...St. John and Gaspé.
(19.) *Sagenaria?* (Knorria)..........Devonian, Kettle Point.

6. *Filices.*

(20.) *Cyclopteris Jacksoni*, m.,...........Perry and St. John.
(21.) *Sphenopteris*,...........................St. John.

Adding to the above the species from the Devonian of New York and Pennsylvania, described in the Reports of the Geology of those states, and in the Memoir of Goeppert above referred to, we may estimate the known land flora older than the carboniferous period in Eastern America, at about thirty species, belonging to at least fifteen genera, all cryptogamous or gymnospermous.

ARTICLE XI.—*On the origin of some Magnesian and Aluminous Rocks.* By T. STERRY HUNT, F.R.S., of the Geological Survey of Canada.

(Presented to the Natural History Society.)

In common with other observers, I have long since called attention to the fact that silicates of lime, magnesia and oxyd of iron are deposited during the evaporation of many natural waters, such as the mineral springs of Varennes and Fitzroy, and the waters of the Ottawa river. I have also suggested that the silicates thus produced may have contributed in a considerable degree to the formation of rocks. (*Amer. Jour. Science*, March, 1860, p. 284). A hydrous silicate of magnesia which approaches in composition to $MgO. SiO^3$, combined with from ten to twenty per cent of water, and mechanically mixed with small portions of oxyd of iron, alumina, and carbonates of lime and magnesia, forms extensive beds with limestones and clays in tertiary strata, in France, Spain, Morocco, Greece and Turkey. It is the sepiolite of Glocker, the meerschaum of some authors, the magnesite of others. The quincite of Berthier, which occurs in red particles disseminated in limestone, is a similar compound, containing some oxyd of iron. The sepiolite from the basin of Paris occurs beneath the gypsiferous group, and in the lacustrine series known as the St. Ouen limestone, where it forms very fissile shaly layers, enclosing nodules of opal (menilite). The structure of this sepiolite, which I have examined and described as above, and that from Morocco, which is used by the Moors in their baths as a substitute for soap, and has been described by Damour, is peculiar. The mineral is made up of thin soft scales, and when moistened with water, swells up into a pasty mass resembling a finely divided talc. Although agreeing closely with this mineral in the proportions of silica and magnesia, sepiolite contains more water, and both before and after ignition is soluble in acids, which talc is not. We cannot however doubt that talc and steatite have been formed from sepiolite, which has undergone a chemical change and become insoluble. It is possible that serpentine may be derived from another silicate richer in magnesia than sepiolite. The frequent association of carbonates of lime and magnesia with talc, and of carbonate of magnesia, talc and serpentine, as in the ophiolite of Roxbury, would seem opposed to the notion that serpentine may have been formed from the alteration of a mixture of sepiolite and carbonate of magnesia. In chlorite, which often forms rock masses almost without admixture, we have an alumino-magnesian silicate which cannot have been derived from sepiolite, inasmuch as this contains for the amount of magnesia present, twice as much silica as chlorite. The oxygen ratios of the silica and magnesia in sepiolite are as 3 : 1, and those of silica, alumina and magnesia (including the variable amount of ferrous oxyd which in part replaces the latter) in chlorite are as 6 : 3 : 5, while in the purest clays the ratio of silica and alumina equals 1 : 1, and in most argillaceous sediments the proportion of silica is still greater. It is evident, therefore, that chlorite could not be formed from a mixture of sepiolite with clay, or even with pure alumina, without the elimination of a large amount of silica, and we are led to regard it as having been generated by the reaction of a silicate of alumina or clay with magnesia, which was probably present in the unaltered sediment in the form of carbonate. Unless indeed the process, which according to Scheerer, has in recent times caused the deposition from waters, of neolite, a hydrous alumino-magnesian silicate approaching to chlorite in composition, be the type of a reaction which formerly generated beds of chlorite, in the same way as those of sepiolite or talc.

A silicate of lime allied to sepiolite, has not so far as I am aware, yet been noticed among unaltered sediments, and among crystalline strata calcareous are more rare than magnesian silicates, although double silicates of lime and magnesia (pyroxene and hornblende,) often form beds, and wollastonite, either alone or mingled with carbonate of lime, sometimes constitute rock masses. The double silicates of alumina and lime are however abundant; the lime-feldspars, scapolite, epidote (saussurite), and white garnet, all form beds in crystalline rocks. Reactions in water at the earth's surface, and at no very elevated temperature, may have given rise to double silicates of lime and alumina corresponding to neolite, and allied in composition to the zeolites, and these by subsequent metamorphism have been changed into anhydrous silicates. The production of harmotome, chabazite, and apophyllite by the waters of a spring at Plombières, at temperatures not above 160° F. as observed by Daubrée, lends probability to such a view.

But while we admit the possible direct formation of double silicates in water at ordinary temperatures, there is not wanting evidence that the reaction which we long since pointed out, (Proc Royal Society of London, May 7, 1857) between silicious and argillaceous matters and earthy carbonates, in presence of alkaline solutions intervenes in the metamorphism of sedimentary rocks and in the production of many silicious minerals. The blue Silurian limestones of the island of Montreal, when treated by acids leave an insoluble residue, which contains about ten per cent. of soluble silica, mixed with an argillaceous matter whose analysis gave silica 73·0, alumina 18·3, potash 5·5, and only traces of lime and magnesia. In the vicinity of an intrusive dolerite, however, the limestone is changed in colour, and leaves by the action of acids a greenish matter which consists of silica 40·2, alumina 9·3, peroxyd of iron 5·2, lime 36·6, magnesia 3.7. The free silica and that of the intermingled aluminous silicate, has thus been saturated with protoxyd bases, still however, retaining the alumina in combination. A similar reaction with more aluminous matters, would give rise to epidote, garnet, magnesian mica, scapolite or feldspars like labradorite and anorthite, and it is not impossible that in such reactions a portion of alumina may sometimes be set free, and give rise to corundum, spinel, diaspore or völknerite.

In the ordinary modes of decomposition of minerals containing alumina, this base separates in the form of silicate, and the conditions required for its elimination in a free state are but imperfectly understood. We have elsewhere pointed out the decomposition by alkaline and earthy carbonates, of solutions of sulphate of alumina or native alum, as one source of free alumina, and insisted upon the existence of pigotite, a native compound of alumina with an organic acid, as an evidence that this base is sometimes like oxyd of iron, (and oxyd of manganese) taken into solution by water aided by organic matters. A hydrate of alumina gibbsite, is found associated with limonite, and the aluminous minerals from the south of France described by Berthier and Deville, show that free alumina is much more common in nature than was formerly supposed. Berthier long since gave the name of bauxite to an earthy pisolitic ore which occurs either massive or imbedded in limestones of tertiary age, at Baux, and many other localities in the departments of Gard and Var, and also in Calabria, and the Grecian Archipelago, forming in some places an abundant rock.* This substance is a variable mixture of a hydrate of alumina, apparently approaching diaspore in composition, with hydrous peroxyd of iron, sometimes constituting a workable iron ore, and at other times a veritable ore of alumina. It contains besides small portions of silica, titanic, vanadic, and phosphoric acids, and occasionally encloses grains of corundum. A compact dark red variety gave Deville, alumina 57·6, peroxyd of iron 25·3, and water 10·8, besides 3·1 of titanic acid, and 2·8 of silica. In other specimens the proportions of alumina and iron oxyd are nearly equal, or the latter predominates, as in one example where the proportions were 48·8 of iron oxyd, and 32·2 of alumina; and another, 60 of iron, and 18 of alumina and titanium. In these analyses the carbonate of lime, generally present, was first removed by a dilute acid; the prolonged action of stronger, acids completely dissolves the hydrated oxyds. By an intense heat this substance is converted into crystalline corundum, resembling emery in its physical character, but the presence of grains of corundum in the hydrated mineral seems to show that the transformation may take place at ordinary temperatures. The emery of Greece and Asia Minor, which is associated with variable proportions of oxyd of iron, is according to Dr. J. Lawrence Smiths always more or less hydrated.

The argillaceous matter enclosing some varieties of this bauxite or impure diaspore, is white, without plasticity, and very rich in alumina; one specimen freed from the red ferruginous portions,gave alumina 58·1, silica 21·7, peroxyd of iron 3·0, titanium 3·2, water 14·0. This substance approaches in its composition to collyrite, and the dillmite which is the gangue of the diaspore of Schemnitz. These materials however contain from 20 to 40 per cent. of water. Scarbroite, schrotterite, and allophane are similar matters; the latter, unlike a clay in its structure, appears to have been deposited from solution. The subsulphate of alumina, known as websterite or aluminite, is often met with in layers and concre-

* Deville. *Ann. de Chime et Physique*, (3) lxi. 309.

tionary masses in tertiary clays,* and is sometimes mingled with a silicate having the composition of allophane. This frequent occurrence of alumina still retaining a portion of sulphuric acid, confirms the view which we have elsewhere expressed, that solutions of native alums have by their decomposition furnished the alumina for many of the minerals in question, while the conditions under which this base is taken into solution by organic matters, still require investigation. The careful examination of unaltered sedimentary deposits, is calculated to throw great additional light upon the origin of the crystalline rocks.

ARTICLE XII.—*On Canadian Caverns.* BY GEORGE D. GIBB M.A., M.D., F.G.S. London, England.

(Extracts from a Paper read before the British Association, Sept. 1859.*)*

The prominent feature of a large portion of the province of Canada is the presence of various limestone rocks belonging to the Silurian formations. Until lately, the existence of caverns in these rocks, as well as in those lying subjacent—namely, the Laurentian of Sir William Logan, was almost unknown; as, with the exception of an isolated account here and there, no regular description of any cavern had appeared. Owing to the labours of the Canadian Geological Survey, and of several private individuals, a number of caverns have been discoved at distances remote from one another; some of these have received but a passing notice in the publications of the Survey, and are not, therefore, useful as a means of reference. The present communication it is hoped, will supply that deficiency, as in it I propose to embody, short descriptive accounts of all the caverns of Canada which are known up to the present time. The details of some of them are not so full as could be desired; nevertheless, with all the available sources of information within my reach, together with personal observation in some, on the whole the general descriptions may be relied upon as accurate, and as containing a correct account of the geological formations in which they lie.

The caverns of Canada may conveniently be divided into two classes; the first comprises those which are at the present time washed by the waters of lakes, seas, and rivers, including arched,

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* In this connection we may notice apatelite, a basic persulphate of iron, which occurs in conditions similar to aluminite.

perforated, flower-pot, and pillared rocks, which have at one time formed the boundaries or walls of caverns, and all of them unquestionably the result of aqueous action. The second comprises caverns and subterranean passages which are situated on dry land, and so far as we know, not attributable to the same causes in their origin as the first, or at least not applied in the same manner.

In the first class are included the following :—

1. Caverns on the shores of the Magdalen Islands.
2. Caverns and arched rocks at Percé, Gaspé.
3. Gothic arched recesses, Gaspe Bay.
4. The "Old Woman," or flower-pot rock, at Cape Gaspé.
5. Little River Caverns Bay, of Chaleur.
6. Arched and flower-pot rocks of the Mingan Islands.
7. Pillar sandstones, north coast of Ga pé.
8. Niagara Caverns.
9. Flower Pot Island, Lake Huron.
10. Perforations and caverns of Michilimacinac, L. Huron.
11. The Pictured Rocks, Lake Superior.
12. St. Ignatius Caverns, Lake Superior.
13. Pilasters of Mammelles, Lake Superior.
14. Thunder Mountain and Paté Island Pilasters, L. Superior.

In the second class are :—

15. The Steinhauer Cavern Labrador.
16. The basaltic caverns of Henley Island.
17. Empty basaltic dykes of Mecattina.
18. Bigsby's Cavern, Murray Bay.
19. Bouchette's Cavern, Kildare.
20. Gibb's Cavern, Montreal.
21. Probable caverns at Chatham, on the Ottawa.
22. Colquhoun's Cavern, Lanark.
23. Quartz Cavern, Leeds.
24. Probable caverns at Kingston, Lake Ontario.
25. Mono Cavern.
26. Eramosa Cavern.
27. Cavern in the Bass Islands, Lake Erie.
28. Subterranean passages in the Great Manitoulin Island, Lake Huron.
29. Murray's Cavern and subterranean river, Ottawa.
30. Probable caverns in Iron Island, Lake Nipissing.

The majority of those in the first class are on a level with the water, whilst the remainder are elevated above, varying from a few to upwards of sixty feet.

In the second class the level varies, but nearly all are above that of the sea, as will presently be described; none penetrate the earth to a considerable depth, but this may be found to be otherwise as the explorations are continued. In none have animal remains been found, excepting in one instance, and they were discovered loose and not imbedded in stalagmite; and so far as I am aware, not a single object, such as a flint arrow-head or spear, used by the ancient inhabitants of the country, has been observed. This circumstance may in some measure detract from the value of the present communication; that part of the enquiry has still to be worked out, as many of the caverns have been but very partially explored, indeed some have scarcely been examined; and as several of them branch off by means of fissures and galleries, running from distinct chambers (most of the latter containing stalag. mite), we may yet hope for interesting discoveries, particularly in that district of country in which exist the huge caverns of Mono and Eramosa in the Niagara limestone rocks of the Upper Silurian formation. The researches of Mr. Sterry Hunt, of the Canadian Geological Survey, have shown that these limestones are essentially dolomitic, and thus perhaps favourably constituted for the development of caverns.

(As examples of the caverns noticed by Dr. Gibb we take the following:— EDS.)

CAVERNS ON THE SHORES OF THE MAGDALEN ISLANDS.

On passing the interesting group of islands in the Gulf of St Lawrence, known as the Magdalens, the observer is struck with their beautiful and picturesque appearance, which is suddenly presented to his view. The cliffs, which vary in height, present equally various colours of red in which the shades predominate; these contrasted with the yellow of the sand-bars, and the green pastures of the hill-sides, the darker green of the spruce trees, and the blue of sea and sky, produce an effect, as Captain Bayfield describes, extremely beautiful, and one which distinguishes these islands from anything else in the Gulf. Such an agreeable picture it has been my own good fortune to witness and admire. The striking feature in their formation is the dome-shaped hills rising in the centre of the group, and attaining a height of from two hundred to five hundred and eighty feet. They are composed of the

Triassic or New Red Sandstone formation, which forms their base, being surmounted or topped by masses of trap rocks. The highest of the Magdalens is Entry Island, with an elevation of five hundred and eighty feet; its red cliffs rise at its north-east point to three hundred and fifty feet, and are what they have been described, truly magnificent and beautiful. The soft and friable character of the brick-red cliffs forming the shores of these islands, with their remarkable capes and headlands, have in many places yielded to the force of the waves, and have become worn into arches and caverns. This is most strikingly manifest at Bryon Island, which is nearly surrounded by perpendicular or overhanging cliffs, which are broken into holes and caverns, and fast giving way to the action of the waves. From the same cause are to be seen detached peninsular masses in a tottering state, which now and then assume grotesque forms. There is something peculiarly interesting in this singular group of islands, lying so isolated about the centre of the great Gulf of St. Lawrence; and curiosity would be well repaid by a visit from one of the neighbouring ports.

Caverns and Arched Rocks at Percé, Gaspé.

On the eastern coast of Gaspe, in the Gulf of St. Lawrence, there is a range of limestone cliffs, which commence on the south-west side of Mal Bay, at the perforated rock, called Ile Percé, and thence run in a north-north-west direction. Immediately south of these cliffs, which are six hundred and sixty-six feet in perpendicular height above the level of the sea, as described by Bayfield, are the Percé mountains, the highest of which, Mount Percé, is twelve hundred and thirty feet, and is visible forty miles out to sea.

The town "Ile Percé," as it was called in Charlevoix's time, occupies the shores of Percé Bay, running from point Percé to White Head. This writer mentions in the second volume of his "Histoire de la Nouvelle France," p. 71, that Sir William Phipps, in his expedition against Quebec, landed at Ile Percé in Sept., 1690, pillaged the town and robbed the church.

A reef connects the Percé Rock with Point Percé. This remarkable perforated rocky islet, which gives the name of Percé to this locality, is two hundred and ninty-nine feet in height, precipitous all round, and bold to seaward. This islet and the island of Bonaventure are considered outliers of the conglomerate rocks which enter into the formation of the main land at Percé, the former would seem especially to be a continuation of the range of cliffs on the south-west side of Mal Bay. The Split Rock is an almost inaccessible mass of this strata, and stands up like a wall, in continuation of the limestone-cliffs of Barry Cape (Point Percé). It is five hundred yards long, one hundred broad, and is remarkable for the presence at its western half of two large holes or arches, through one of which a sloop at full sail can pass at high water. There is a lateral arch at the north east side, scarcely perceptible from the water.

The perforations in this rock have been formed by the action of the waves of the sea, the same cause which has in the progress of time effected the disjunction of these outliers from one another and the main land. From the present position of the islet, which lies almost north and south, I am disposed to consider its northern aspect as the oldest, the two arched openings at that side forming what were once the entrance to deep caverns running into the rock southwards, which in the course probably of ages has been washed away by aqueous denudation. This view is strengthened by an examination of the intervening shores as they exist at present. The coast line of Ile Percé runs along to Bonaventure Island, with an imaginary position of the land at one time between the south-west part of the latter island and the shore at the Bay of Percé, at the point where the cliffs commence at its southern third. This gives the southern coast a semicircular course, with a low shelving beach corresponding to that which now exists at Percé Bay on the one side, and the western coast of Bonaventure on the other; whilst the northern coast is rocky and precipitous, probpierced with many caverns, and gradually diminishing in height to the southward.

Bouchette's Cavern, Kildare.

This cavern was visited and first described by Colonel Bouchette (Surveyor-General of Canada) in the report of his official tour though the *new settlements of the lower province in 1824.* It is situated in the township of Kildare, about thirty-five miles due north of the city of Montreal, but the precise locality I have been unable to determine, although from the description it may be close to the village of the same name. The southern part of the township is traversed by a broad band of the Potsdam sandstone, in continuation of the same rock running in a north-east direction from the south-western part of the township of Rawdon. That part of Kildare north of this band is composed of gneiss of the Laurentian system most probably interstratified with some bands of crystalline limestone, in which the cavern is developed.

It was about the year 1822 that two young Canadian peasants, whilst prosecuting their sport of hunting the wild cat, pursued two of their game, until entering an obscure hole a little above the bank of the river, they lost sight of them. The more enterprising of the two attempted to enter the aperture in the rock, at that time barely sufficient to admit of his crawling into it, but without success. Providing themselves with lights, a second attempt was more successful, "for not only did they secure their prey (of which they have preserved the skin to this day), but they discovered," says Colonel Bouchette, "another of the many phenomena of nature, a description of which cannot be uninteresting."

The following account is given in the Colonel's words:—

"I descended into the cavern by means of a trap-door, which has recently been placed at one of its angles for the facility and convenience of strangers desirous of visiting this singular spot, having as my guides two of the inhabitants of the neighbouring house, bearing lighted tapers. The height of the cave where we entered is five feet, from which angle branch off two caves, the lesser whereof is of the following dimensions:—

Length......................		25 feet
Breadth varying from.........	$2\frac{1}{2}$ to	9 "
Height.....................		5 "

It bears about a south-east course from the entrance.

The other has in length......		70 feet.
Width from................	7 to	8 "
Height gradually increasing...	5 to	13 "

"The increase in the loftiness of the cave originates from the declivity of the ground part, which, at the north-eastern extremity, is at least twenty-three feet from the surface. It forms nearly a right angle with the first, at its south-western end, and an angle scarcely obtuse at the other with another cave, whose

Length is..................	80 feet
Average width..............	6 "
Height.....................	5 "

At the south-eastern extreme of this cave branches off another of inferior size and consequence, bearing about a due north course, as may be deduced from the angle it makes with the last describ·ed:—

It is in length................	20 feet
Width......................	5 "
Height.....................	5 to 4 "

"At the outward angle formed by this cave with the preceding one, is to be seen a nearly circular aperture of about a foot and a half in diameter, which leads to a cavern yet unexplored, the extent whereof is not known with any certainty; but conjecture and supposition will have it to extend two arpents—an astonishing distance as a natural subterraneous passage. Summing the lengths of the several caves above-mentioned together, we have a total distance of a hundred and ninety-five feet of subterraneity in the solid rock offering a beautiful rock of crystallized sulphurate of lime, carved as it were by the hand of art, and exhibiting at once the sublimity of nature, and the mastery of the all-powerful Architect of the universe."

From the foregoing description there would seem to be five different caverns or galleries, and probably many more, if the fifth has been since explored. Three of them branch off from the entrance in different directions, whilst the remaining two do so at the termination of the central gallery. The roof throughout is covered with stalactites, but as no mention is made of stalagmite, nor of the presence of bones, we are left to conclude that they were absent, although the chances were much in favor of finding the latter, in consequence of there being a free and unobstructed entrance into the cavern.

ARTICLE XIII.—*Flint drift and Human Remains. Extacted from the Duke of Argyll's opening address . President of the Royal Society of Edinburgh.*

(From the Edinburgh New Phil. Journal.)

"The attention, not of geologists only, but of men of science in several departments, has, during this and the preceding year, been fully awakened to the importance of a discovery which is really of much older date—viz., that flint implements, the work of man, are found in beds of drift gravel associated with the bones of the last generation of the great extinct mammalia. The full significance of this fact is only now being fully recognized, and many of the conclusions which it may tend to establish are subject to much doubt, and will probably form the subject of increasing controversy. But it is only necessary to have a clear idea of the facts as they have been now ascertained, to see that one conclusion at least is placed beyond all question—viz., that great physical changes on the surface of the earth, and these, in part at least, effected by the agency of water, have taken place since the creation of man.

Whether this conclusion carries the creation of man farther back than had commonly been supposed, or whether it merely brings nearer to us than we had before conceived the last great changes which have produced the existing surface, is the main question on which debate arises. As geology gives no certain data for computing positive, but only relative time, this question is necessarily involved in much obscurity. But there are certain limits within which, after all, the controversy is confined. It is well to observe that, according to the principle on which geological times and epochs are classified, the human epoch remains, after these discoveries, very much where it stood before. It is true that many of the large animals, with which the traces of men seem to be connected, are now extinct; but a very much larger number are still living. The Molluscan Fauna, which plays so important a part in ages of geologic time, is absolutely the same. The general aspect of animal life is the present aspect, with the exception that a certain number of species of the larger Herbivora and Carnivora have become extinct. But such extinctions, local in many instances, and total in some, have taken place in historic times, and are in visible process of accomplishment even now. Such extinctions do not constitute a new Fauna, nor, according to the received principle of classifying past times, do they mark a new geological age. The era of man, therefore, remains, geologically speaking, in the same relative place in which it stood before—the very last and latest of the world.

But the fact that human implements are found under great beds of gravel and of earth formed by water, whether of rivers or of the sea, at an elevation which in either case would imply changes of level, such as, if general, would be enough to revolutionize the whole aspect of our now habitable surface, is a fact which casts new and important light on the (geologically speaking) very recent date at which those changes have taken place.

Whether the men who formed the implements were or were not contemporary with the living quadrupeds whose bones are associated with these implements, seems to me a subordinate question. The mere fact of such association may not absolutely prove the point, because it is conceivable that the bones may have been merely re-aggregated from an older fossiliferous deposit. But I suspect that the reluctance to admit the contemporaneity of man with those animals results from the reluctance to admit man's priority to such physical changes as are supposed to separate us from a Fauna typified by the Mammoth and the Elk. If, therefore, the fact of such priority be proved from the stratigraphical position of the flint relics, wholly independent of any argument derived from organic remains, the importance of the question respecting the human age of the great mammals will be much diminished. It may be well, therefore, to keep our attention firmly fixed on what is really the important question—the nature and position of the strata in which, and under which, the flint implements have been interred. Going no farther for light upon this question than the particular beds at Amiens and Abbeville in France, where the implements have been found in greatest abundance, it is enough to record the fact. The flints are embedded in a stratum of gravel, which rests directly on an eroded surface of the chalk, and contains along with the hatchets, the bones of the great extinct mammalia. This is again surrounded by a bed of sand from seven to ten feet thick, in which only a few rare bones and implements have been found. This is again capped by a second bed of gravel from two to five feet thick; and lastly, on the top of all, is a bed of brick earth, in which, as if to afford the very poetry of illustration, are to be seen the tombs of Roman-Gaul. Such is the position of the beds with reference to each other. But what is their position with reference, not to each other, but to the surrounding country? The gravel-bed extends to points upwards of a hundred feet above the level of the river Somme, which occupies the bottom of the existing valley. It is described by Professor Rogers, a most competent and accurate observer, as extending to the summits of the plateaux which determine the existing drainage. Whether, therefore, the water which formed these beds were marine or fluviatile, in either case such changes of level are implied as would be sufficient, if general, to alter widely the existing distribution of land and sea.

Here, then, the question arises, Were those changes local—confined perhaps to the district of Western France? Connected with this question, another immediately occurs: Is not this bed of gravel identical in character and compositson with similar deposits in other countries? Is there anything to distinguish it from the gravels containing precisely the same mammalian bones which are familiar to geologists in almost every country, and which have been recognized every here and there over the whole of Europe, from Siberia to Palermo, and from the basin of the Thames to the valley of the Danube? So far as I have been able to gather from the papers which have detailed the facts, there is nothing to indicate any difference whatever, except that, at least until this discussion arose, human implements had nowhere else been recognised as associated with the drift. The absence of such remains elsewhere, however, would go for little in establishing a difference because it is clear that the men who existed before the formation of the Abbeville beds were rude, and probably widely scattered savages, distant outliers of their race. The chances therefore, were infinite against the preservation either of them or of their works. But even this distinction, it would appear, is being broken down. It is now recollected that so long as sixty years ago, human implements had been discovered in Suffolk under similar conditions, and the fact communicated to the public in an archæological journal by the discoverer Mr. Frere. The spot has been visited by Mr. Prestwich, fresh from the Abbeville beds, and he recognises the same phenomena. But this is not all. The scent, once taken up, is becoming stronger and stronger, every day. Closely connected with the period of the drift-gravels are the ossiferous caves and caverns so common all over Europe where limestones prevail. They have been long known to contain a profusion of bones of the extinct as well as of living mammalia. Here, again, it is now confidently asserted that human implements are being found under conditions which leave no doubt that, whether man was or was not contemporary with these animals, he must at least have preceded the action of these agencies which brought the bones together. The evidence in this case must necessarily be more liable to erroneous interpretation than in the case of implements found in undisturbed beds of gravel, because caverns must at all times have been a resort of savage tribes whenever the entrances were accessible from the surface. But the evidence seems to be such as is sufficient to convince examiners so careful and acute as Dr. Falconer and Mr. Prestwich of the undoubted priority of man to that diluvial action which appears to have swept into those caverns their mixed contents. But this is not all. It is now recalled to mind, that so long ago as 1833, a M. Schmerling had published Researches into the Ossiferous Caverns of Belgium, in which, not implements of man only, but his teeth and his bones, and portions of his skull, had been found so thoroughly mixed up with the remains of the lower mammalia as to leave in his mind no doubt, if not of their contemporaneous life, at least *of their contemporaneous entombment* in the spots where they are now found. These are remarkable facts; and in so far as they indicate that the phenomena of Abbeville are closely related to others observed in many different parts of Europe, they go far to prove that the French gravel-beds were due to no mere local cause, but to some diluvial action which was general, and therefore in all probability due in great part to the waters of the sea.

I need not point out how many and how interesting are the questions which this discovery raises in our minds. Was this incursion of the waters of the sea, over a pre-existing land, sudden and transient, or gradual, and of long duration? In the Abbeville beds there seems to be clear evidence of four successive stages of submergence, each distinguished from the other by different mineral conditions. The first bed, that in which the bones were entombed along with the human implements, indicates an action strong, if not violent, but not of long duration. The second indicates, by its finer materials, the action of a gentler force. The third seems to be very much a repetition of the first; whilst the last can only be accounted for on the supposition that fine sediment had time to accumulate in comparatively tranquil waters. The interest of the question is very much centred in the nature of the action which began this series of events. Perhaps it may be well to look at the conclusion come to in respect to the origin of the mammaliferous drift-gravel by the geologist who has devoted most special attention to the subject, and before the discoveries of Abbeville had disturbed any preconceived idea. I find Mr. Prestwitch, in a lecture delivered in 1857, coming to this conclusion in respect to the ossiferous gravels of the Thames:—"Taking into consideration the absence of contemporaneous marine remains, and noting the immense mass of but slightly worn débris derived from and covering irregularly the sedimentary deposits; and the fact that it has evidently been transported from greater or less distances, combined with the occurrence in the gravel of the remains of large land-animals, of trees, and of fresh-water land-shells we have, I conceive, at all events in these facts, indications of at least one land-surface here destroyed, and its rocks, plants, and animals involved in one common wreck and ruin."

An able and elaborate paper on the "Distribution of the Flint-Drift of the South east of England," &c., was communicated to the Geological Society of London by Sir R. Murchison in 1851. The phenomena he describes seem everywhere to be a precise repetition of those of Abbeville. Everywhere the flint drift, which is often, as there, covered by brick-earth, clay, or loam, is characterised by the bones of the great extinct mammalia, and everywhere, according to the author's view, gives evidence of sudden and violent diluvial action. Everywhere also, this drift-gravel rises high above the levels of the existing drainage, whilst, at the same time it gives evidence that the general configuration of the surface was substantially the same as now. Everywhere, also, wherever shells have been preserved, they belong to our existing fauna, and thus prove beyond a doubt that, geologically speaking, the age of the drift is the age of the existing world. "In short," he says, "the cliffs of Brighton afford distinct proofs that a period of perfect quiescence and ordinary shore action, very modern in geological parlance, but very ancient as respects history, was followed by oscillations and *violent* fractures of the crust, producing the tumultuous accumulations to which attention has been drawn."

Unless, then, the Abbeville beds can be separated from those so widely prevalent in other countries, the discovery of human implements underneath this drift will rather tend to bring nearer to us than had ever been supposed some great and sudden diluvial action, than to cast any very clear light on the absolute time—that is, on the time measured by years or centuries—which has elapsed since the creation of our race. The facts which have been brought to light prove, indeed clearly enough, that since man walked the earth some great changes have affected the condition of its surface; and it is impossible as yet to say what bearing this discovery may be found to have on that remembrance of at least one great catastrophe, which is not more a part of sacred history than it is of profane tradition.

We must not, however, shut our eyes to the indirect effect which this discovery must have on the question of positive time. In the first place, there is a school of geologists, led by our distinguished countryman Sir Charles Lyell, who disbelieve generally in these conclusions which point to violent and sudden changes; and, in the next place, it must be remembered that changes which in point of geological time might well be accounted rapid, might nevertheless well occupy thousands of our years. There is proof in these gravel beds of the Somme of a double motion, one of submergence to the depth of certainly more that 100 feet, another of subsequent elevation, during which the immense mass of material which had been brought down and deposited by water, has been worn through and broken into escarpments, either by the existing stream or by more powerful currents. We have no data from which to measure in years the time which the accomplishment of such a series of changes may imply. But I think the general impression left upon the mind must be in favour of a very high antiquity. Farther light may be cast upon this subject if the drift-gravels of France, the south of England, and other countries can be co-ordinated with any one of the stages of operation to which we owe the superficial deposits of Scotland and the north of Europe generally. It is well known that in these last there is one prominent characterestic which is absent farther south. I mean the abundant proofs of glacial conditions, or an arctic climate. On this subject there is a paper of great interest in the last "Quarterly Journal of the Geological Society," by Mr. Jamieson, founded on observations made mainly in the county of Aberdeen. The cycle of changes which this geologist thin[illegible]n be clearly traced, as necessary to account for the superficial deposits of our own country, amount to no less than five great epochs, including two of submergence and two of elevation, and involving changes of level to the extent of more than 2000 feet. Scotland has long ago furnished evidence as clear as that founded on the French flint implements, that at least previous to the last of these elevations man had reached her shores, and navigated her rivers and estuaries in those rude canoes, hollowed out of trunks of oak by stone hatchets, which have been frequently found in elevated beds of silt and gravel in the valley of the Clyde. And here we strike upon evidence which has some bearing upon the question of time. Closely connected with the period preceding the last elevation of the land, we have proof that an arctic climate prevailed over a large part of the northern hemisphere, whose climate is now comparatively temperate. But this period seems clearly to have been one of long duration—that is to say, of such duration, and lasting under such conditions of comparative rest, as to allow the development of a glacial fauna. Close to my own residence on the Clyde each low ebb exposes numerous examples of the *Pecten Islandicus* and of those very large *Balani*, which are confined to arctic seas. These beds of shells, which are all of existing species, but of species which have retired from our now more genial temperature to a northern habitat, were first described by my friend Mr. Smith of Jordanhill, and his observations and conclusions have since been abundantly confirmed. We have no knowledge how this period was brought to a close. But there seems to be evidence that it had come to an end, and that for a long time before the last elevation of the land, and before man had appeared in Scotland. This seems to be a legitimate deduction from the fact that the canoes in the elevated Clyde beds are formed of oak of large dimensions and of great age. Forests which afforded such timber must have flourished in a climate not much more rigorous than that which exists at present. Here again, then the earliest footprints of our race are traced up to a point, preceding indeed some important physical changes, but clearly subsequent to the establishment of all the main conditions which now affect the distribution of animal and vegetable life.

As regards the extinction of some animals, I have spoken as if the contemporaneousness of man with them whilst yet living ought not to be absolutely assumed merely from the fact that his implements are associated with their bones. But on this point new evidence is being rapidly collected and brought together. Mons. Lartet, a distinguished French naturalist, has found what he considers to be a distinct evidence of the mark of human weapons on various parts of the skeletons of the extinct mammalia of the drift. These marks have been detected on the skull of the *Megaceros Hibernicus*, or great Irish elk—an animal which stood some ten feet high—on the bones of the *Rhinoceros tichorinus*, and on those of various species of the ox and deer, which are now either extinct or confined to the last remnants of a declining race. The marks are of various kinds—some of them peculiar—indicating a sort of sawing with some instrument not of the smoothest edge. M. Lartet has ascertained that these blows and cuttings could not be made except on fresh bones—that is to say, on bones undried and retaining their animal cartilage. Farther he has succeeded in producing on the bones of existing animals precisely the same peculiar forms of incision by using one of the old flint implements found in the same beds of gravel, whilst he has equally found that similar marks are incapable of being produced by implements of metallic edge. His conclusion is thus stated by himself:—"If, therefore, the presence of worked flints in the diluvial banks of the Somme, lone since brought to light by M. Boucher de Perthes, and more recently confirmed by the rigorous verifications of several of your learned fellow-countrymen, have established the certainty of the existence of man at the time when those erratic deposits were formed, the traces of an *intentional* operation on the bones of the rhinoceros, the aurochs, the megaceros, the cervus sommensis, &c. &c., supply equally the inductive demonstration of the contemporaneousness of those species with the human race."

The great number of flint implements which have been found in the French beds—said to amount to upwards of a thousand in a few years—when compared with their great rarity elsewhere, is not perhaps so curious as at first sight it may appear to be. Flint implements can only be made where flints are accessible; and it is well known that the flints of particular beds, or strata of the chalk, are more easily fashioned than others. It is therefore probable that some such favourable locality had existed in the chalk of that part of France, and that what may be called a manufactory of them had been established there. It is remarkable that some of the implements are only half finished, whilst all of them exhibit such sharp edges and angles as are sufficient to prove that they have not been transported far from the spot where they were made, nor subjected to long wear from use.

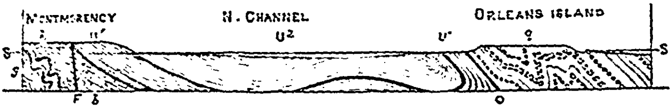
On the whole, then, it is not to be doubted that the discovery of human implements under repeated beds of aqueous drift and and sediment, so high above the levels of exising rivers, or of the existing sea, is a fact of very great significance and importance. In its bearing on geology, it is principally interesting as proving at how recent a period portions at least of the earth have been subject to powerful and rapid diluvial action. In its bearing on human chronology, everything depends on the degree of suddenness and rapidity with which water may have been brought to act upon the former surface. But here anything like data for positive computation entirely fails us. We have no knowledge, in historic times, of any aqueous operation on so grand a scale. Making however, every deduction which can be made, we must be prepared to find that the facts thus brought to light in the valley of the Somme will be held to furnish important collateral evidence in support of the reasoning founded on other sciences, such as philology and ethnology, which has long demanded, for the development of our race, a number of years far exceeding that which is allowed by the chronology previously received. It is the beautiful expression of Sir Thomas Browne, which I find quoted by Dr. Mantell in a former paper on this subject, that "Time conferreth a dignity upon the most trifling thing that resisteth his power:" and it is impossible to look at these rude implements—perhaps the earliest efforts of our race, in the simplest arts of life—without being impressed with the high interest of the questions with which they seem to be inseparably connected.

ARTICLE XIV.—*Considerations relating to the Quebec Group, and the Upper Copper-bearing rocks of Lake Superior.* By SIR W. E. LOGAN, F.R.S., Director of the Geological Survey of Canada.

(Read before the Nat. Hist. Society.)

In a communication addressed by me to Mr. Barrande on the fauna of the Quebec group of rocks, (Canadian Naturalist and Geologist vol. v. p. 472), after showing that the organic remains discovered last year at Point Lévi placed the group about the horizon of the Calciferous formation, I stated that the apparent conformable superposition of the group on the Hudson River formation was probably due to an overturn anticlinal fold or overlap.

Fig. 1.



g, Laurentian gneiss.	*q*, Quebec group.
b, Trenton limestone.	*F*. Fault.
u^1, Utica shale.	*O*, Overlap.
u^2, Hudson River shale.	*S*, Level of the Sea.

Horizontal and vertical scale, 1 inch to 1 mile.

The character of this overlap is exhibited in the accompanying wood cut (fig 1) of a vertical section in the neighbourhood of Quebec, extending from the Montmorency side of the St. Lawrence across the north channel and the upper end of the Island of

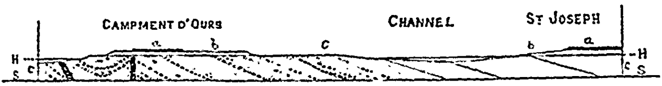
Orleans. The road from Beauport to the Montmorency runs over a floor of Trenton limestone, which has a very small dip towards the St. Lawrence; farther back from the river the rock has a gentle dip in an opposite direction giving evidence of a very flat anticlinal form, which could scarcely be detected without the aid of the general distribution of the formations in the neighbourhood. On the south side of the road there occurs a dislocation which can be traced the whole way from Beauport church to Montmorency falls, where the effect it produces is easily discernible. Here the channel of the Montmorency is cut down through the black beds of the Trenton formation to the Laurentian gneiss on which they rest, and the water at and below the bridge flows down and across the gneiss, and leaps at one bound to the foot of the precipice, which immediately behind the water is composed of this rock. At the summit the Trenton beds are seen on each side; on the right bank they have a thickness of about fifty feet, and are marked by the occurrence of *Leptæna sericea* (Sowerby), *Strophomena alternata* (Conard), *Orthis testudinaria* (Dalman) *Lingula crassa* (Hall), *Conularia Trentonensis* (Hall), *Calymene Blumenbachii* (Brongniart), and *Trinucleus concentricus* (Eaton). The dip of these beds is down the stream at a very small angle; but at the foot of the precipice and immediately in contact with the gneiss, about the same thickness of black limestone is tilted up to an angle of fifty-seven degrees; it is followed by about an equal amount of black bituminous shale with the same slope. In this attitude these rocks climb up the face of the precipice presenting their edges to the chasm on each side; they are succeeded by about eight feet of hard grey sandstone weathering brown in beds of from ten to eighteen inches, interstratified with black shale; on this repose gray arenaceo-argillaceous shales composing the sides of the chasm out to the waters of the St. Lawrence, the distance being about a quarter of a mile, and the dip which is towards the St. Lawrence by degrees diminishing to about thirty-five degrees.

These tilted beds are fossiliferous, the species contained in the limestones being *Stenopora petropolitana* (Pander), *Ptilodictya acuta*, (Hall), *Strophomena alternata*, *Leptæna sericea*, *Orthis testudinaria*, *Camerella nucleus* (Hall), *Lingula* allied to *L. obtusa*, *Descina crassa* (Hall), *Bellerophon bilobatus* (Sowerby), *Conularia Trentonensis*, an undetermined *Orthoceras*, *Cyrtoceras constrictum* (Hall), *Calymene Blumenbachii*, *Cheirurus pleurexan-*

themus (Green), *Trinucleus concentricus, Asaphus platycephalus* (Stokes); those contained in the black shales are *Graptolithus bicornis* (Hall), *G. pristis* (Hessinger). There is thus no doubt whatever that the limestones are of the Trenton and the shales of the Utica formation.

On the opposite side of the north channel at the upper end of the Island of Orleans there occur about 500 feet of black bituminous shale interstratified with occasional beds of gray yellowish-weathering calcareous sandstone, and arenaceous limestone; they in some parts hold *Graptolithus bicornis* and *G. pristis,* and there is little doubt are subordinate to the Utica or Hudson River formation. They dip S. W. $\angle 50^\circ$, and there rests upon them (the contact being visible) a series of magnesian shales and conglomerates dipping in the same direction and at the same angle. These magnesian strata are of the same character as those at Point Levis, and belong to the Quebec group. They thus overlap the black shales which are probably overturned as represented in the diagram (fig. 1).

Fig. 2.



a, Birdseye and Black River limestone.
b, Ste. Marie sandstone.
c, Huronian slate conglomerate and jaspar conglomerate.
H, Level of Lake Huron.
S, Level of the Sea.
Horizontal and vertical scale, 1 inch to 1 mile.

In his explorations of last year on Lakes Superior and Huron Mr. Murray ascertained that the lowest rock in that neighbourhood well characterised by its fossils belongs to the Birdseye and Black River group, and that it rests conformably upon the sandstones of Sault Ste. Marie. These sandstones and their equivalents, consisting of red and yellowish-white beds, are traceable on the south side of Lake Superior from Marquette to the River St. Marie and compose Sugar Island and probably the north part of Neebish Island; they extend to the north part of St. Joseph Island, and are met with on the Island of Campment d'Ours. In one of the white beds near Marquette, Mr. Murray obtained a *Pleurotomaria* resembling *P. Laurentina* of the Calciferous formation and observed the occurrence in the same bed of a species of *Scolithus*. The mass on Campment d'Ours is of the same color and friable character as the yellowish-white beds near Marquette and is marked by the same *Scolithus*, and there is little doubt that the two exposures are of the same series. On Campment d'Ours the sandstone reposes on the Huronian series; it is eighty feet thick and is very nearly horizontal, (fig. 2.) It is succeeded in ascending order by the following series of beds:—

Bluish-gray shales interstratified with thin beds of yellowish compact limestone, presenting an escarpment over the sandstone; the fossils observed are *Stenopera fibrosa*, *Ptilodictya fenestrata*, *P. acuta*, *Strophomena alternata*, *Rhynconella plicifera*, and a small undetermined *Lingula*..	20
Measures concealed..	60
Ash-gray compact limestone in beds of from three to five inches thick, interstratified with a five-inch bed of drab colored compact limestone; among the fossils are *Stenopera fibrosa*, *Glyptocrinus ramulosus*, *Strophomena alternata*, *Pleurotomaria subconica*, *Subutiles elongatus*, *Ambonychia amygdalina*, *Cyrtodonta Huronensis*, *Vanuxemia inconstans*, *Orthoceras tenuifilum*, *O. Murrayi*, *Leperditia Canadensis, and Asaphus platycephalus*..	4
Ash-gray compact limestones in beds of from four to six inches, underlaid by a dark brownish-gray arenaceous limestone bed of about ten inches, and divided by thin layers of gray calcareo-argillaceous shale; all the strata are very fossiliferous, and the species they contain are *Glyptocrinus ramulosus*, *Ptilodictya multipora*, *Coscinium flabellatum*, *Strophomena alternata*, *S. filitexta*, *Rhynconella recurvirostra*, *Orthis subequata*, *Vanuxemia inconstans*, *Cyrtodonta Huronensis*, *C. subcarinata*, *Pleurotomaria subconica*, *Trochonema umbilicata*, *Murchisonia perangulata*, *Orthoceras recticameratum*, *Cheirurus pleurexanthemus, and Leperditia Canadensis*..	30
Ash-gray compact limestone of the same character as the preceding, but still more fossiliferous; the beds contain *Tetradium fibratum*, *Stenopora fibrosa*, *Columnaria alveolata*, *Petraia profunda*, *Strophomena alternata*, *S. filitexta*, *Rhynconella recurvirostra*, *Ambonychia amygdalina*, *Cyrtodonta Canadensis*, *C. Huronensis*, *C. mytiloidea*, *Vanuxemia inconstans*, *Ctenodonta nasuta*, *Pleurotomaria subconica*, *Eunema strigillata*, *Subulites elongatus*, *Orthoceras tenuifilum*, *O. Murrayi*, an undescribed *Cyrtoceras*, *Asaphus platcycephalus, and Leperditia Canadensis*..	16
	130

The fossils of these limestones leave little doubt that they belong to the Birdseye and Black River group, and the underlying sandstones and other rocks, constituting the upper copper-bearing series of Lake Superior, may thus represent the Chazy, Calciferous, and Potsdam formations and be equivalent to the Quebec group and the black shales and limestones beneath.

This equivalency and the disturbance which brings the Quebec group to the surface (the course of which disturbance has already been given in the communication addressed to Mr. Barrande) suggest the following considerations.

From the occurrence of wind-mark and ripple-mark on closely succeeding layers of the Potsdam sandstone where it rests immediately upon the Laurentian series, we know that this arenaceous portion of the formation must have been deposited immediately contiguous to the coast of the ancient Silurian sea, where part of it was in some places even exposed at the ebb of tide. No want of conformity is known to exist between the Potsdam and Calciferous formations, and the Quebec group being of Calciferous age and 7000 feet thick, it follows that during the Potsdam period, while the typical sands of the formation were on a level with the surface of the sea, there must have existed a depth of water of at least 7000 feet over the area on which were subsequently deposited the strata of the Quebec group.

As constituting the great metalliferous formation of the continent this group is traceable under various designations from Gaspé to Alabama, thence sweeping round on the west side of the Mississipi through Kanzas to Lake Superior, without suffering any diminution in its volume, thus forming the measure of a deep sea in the course indicated, and probably still farther to the Arctic ocean. Within this line northward in so far as Canada is concerned, we find a marginal outcrop of these rocks of only a few feet in thickness on the north coast of Lake Huron from Lake Superior to Lacloche. Including the Potsdam sandstone they are altogether absent between Lake Huron and the neighbourhood of Kingston. In the area between the Laurentide and Adirondac Mountains, from a line between Lake Ontario and the Lac des Chats eastward to Lake Champlain on the one hand and the St. Maurice on the other, the united thickness of the Potsdam, Calciferous and Chazy formations scarcely attains 1000 feet. With the exception of a small mass of the Potsdam sandstone at St. Ambroise near Quebec, we have no evidence of a marginal outcrop of the formation between the St. Maurice River and the Mingan Islands, while a similar outcrop of the Calciferous and Chazy formations has not been observed from the longitude of Lake St. Peter to the same group of islands; in these islands themselves the thickness of the three formations does not exceed

500 feet, but beyond this we are not yet sufficiently acquainted with the Lower Silurian rocks to make any statement.

From these facts however it would appear probable that during the Potsdam period the older rocks which formed the coast of the Lower Silurian sea extended under comparatively shallow water south-eastwardly from the St. Lawrence and Ottawa to the position of the fault which brings the Quebec group to the surface between Gaspé and the Mohawk river, and south-westwardly from a line between the Mohawk and Lake Superior as far as Alabama. From this shallow area they descended quickly into deep water all around, thus constituting a subaqueous promontory from the so-called azoic rocks of the north-east, and forming with them what Professor Dana I believe has termed the nucleus of the North American continent.

But though the volume of the Quebec group makes it apparent that over the area occupied by it and the subjacent black shales, there must during the Potsdam period have existed a deep sea, it is yet to be remarked that many of the members both of the lower and upper parts of the group have by no means the character of deep sea deposits. To obtain the conditions required for the accumulation of the coarser members of the series, which commence near the *bottom of the group*, it must be supposed that about the beginning of the Calciferous period, a great continental elevation occurred, carrying the shallow water deposits of the Potsdam high above the sea and bringing the area at the base of the Quebec group comparatively near the surface. The successive coarse deposits of the group indicate a subsequent gradual subsidence at unequal intervals until the early shallow water strata were again submerged, to be first partially covered over by deposits of the Chazy formation, and then almost universally by those of the Birdseye, Black River and Trenton.

In this way may be accounted for the break which occurs in the succession of life between the Calciferous and Chazy, in the development of the latter formation between the Allumette Island and Montreal, as well as among the Mingan Islands; and the break in the succession of deposits between the Potsdam and Birdseye at St. Ambroise, between the Laurentian and Birdseye from the north shore of Lake Huron to Kingston, in the vicinity of Bay St. Paul and of Murray Bay, and in Lake St. John on the Saguenay.

The break in the succession of life between the Chazy and Birdseye, is not so great as that between the Calciferous and Chazy. It is not yet quite certain that in Canada a single species passes upwards in the latter case, while in the former, the proportion which does so is about one-sixth. It seems to be in accordance with this, that we have evidence of a somewhat sudden submergence for the introduction of the Birdseye and Black River group, and a somewhat rapid accumulation of its deposits. Where these rest upon the Huronian and Laurentian series, the beds of contact are often composed of angular fragments of the rock beneath, and it frequently happens that the surface on which these beds rest, is rough and uneven, broken into sharp projecting ledges and deep fissures, which have been filled up and covered over by the deposits in question, before sufficient time had elapsed to permit the asperities of the bottom to be worn to a smooth surface.

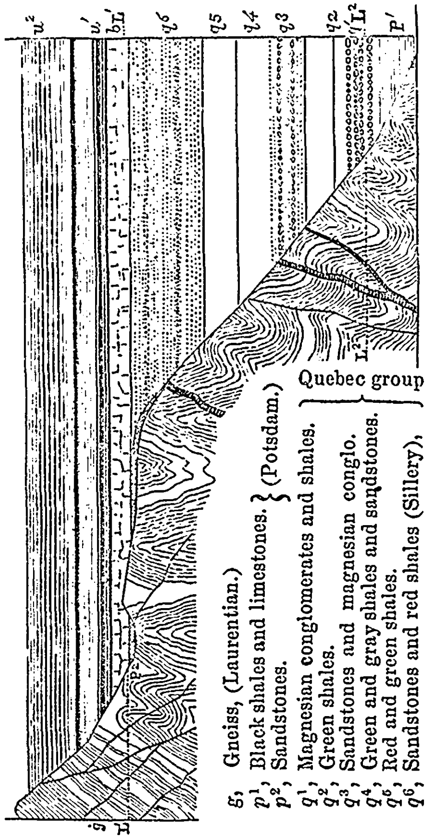
An instance in illustration of this occurs on the Snake Islands, west of Lacloche in Lake Huron, where the Birdseye and Black River group rests on the quartzites of the Huronian series, and the lowest bed of the group is made up of angular fragments of the quartzites cemented together by the fossiliferous limestone; there is *another* at Marmora, where the same group, supported by Laurentian rocks, fills up deep angular cavities in the surface. Dr. Dawson has pointed out a striking instance of the phenomena at Hog Lake, in Huntingdon; others occur at Sloat's Lake in Loughborough and places adjacent, as well as at Kingston Mills, and the same phenomena are observable in the neighbourhood of Murray Bay.

As an instance of the probably rapid slope with which the bottom of the Lower Silurian sea descended from shallow to deep water during the Potsdam period, in the neighbourhood of Quebec, we see that the surface of the gneiss now supporting the Trenton formation at the Falls of Montmorency, must have been as much as 7000 feet above that under the Island of Orleans, where the Quebec group makes its appearance, while the distance between the two positions does not exceed a mile and a half; this would give a slope of nearly forty-five degrees, and perhaps it would not be extravagant to take it as more or less typical of the slope on the whole line to Alabama.

As the black shales and limestones subordinate to the Potsdam and the deposits of the Quebec group accumulated, the edges of the strata would abut against this slope, and ultimately both they and the early shallow water deposits on the higher terrace would be covered over by the Birdseye, Black River, Trenton, Utica, and Hudson River formations, as represented in the accompanying diagram, (fig. 3.)

Fig. 3.

Scale, 1 inch to 1 mile.



g, Gneiss, (Laurentian.)
p^1, Black shales and limestones. } (Potsdam.)
p^2, Sandstones. }
q^1, Magnesian conglomerates and shales.
q^2, Green shales.
q^3, Sandstones and magnesian conglo.
q^4, Green and gray shales and sandstones.
q^5, Red and green shales.
q^6, Sandstones and red shales (Sillery),

b, Limestones (Birdseye Black River and Trenton.)
u^1, Black Shales (Utica.)
u^2, Dark gray shales and sandstones, (Hudson River.)
L^1, At the level of the sea during the Potsdam period.
L^2, " " " at the commencement of the Calciferous.

Without enquiring into the origin of the forces which have produced the corrugations of the earth's crust, we may suppose that if a sufficient lateral pressure were applied to strata thus accumulated and arranged, there would result a set of parallel folds and overlaps, running in a direction at right angles to that of the pressure, with prevailing overturn dips in the direction of movement; the greater strength, however, of the solid crystalline gneiss in this particular case, offering more resistance than the newer strata, would cause a break coinciding with the inclined plane at the junction of the gneiss and Quebec group; the strata of this group pushed up the slope would raise and fracture the strata of the formations above, and be ultimately forced into an overlap of that portion resting on the higher terrace, after probably thrusting over to an inverted dip that part of the upper beds with which they came in contact. The strata of the upper terrace, relieved from pressure by the break, would remain comparatively quiescent, and thus the limit of the more corrugated area would coincide with the slope between the deep and shallow water of the Potsdam period. But the resistance offered by the gneiss would not merely limit the main disturbances, it would probably also guide or modify in some degree the whole series of parallel corrugations, and thus act as one of the causes giving a direction to the Appalachian chain of mountains.

REVIEWS AND NOTICES OF BOOKS.

Life on the Earth, its Origin and Succession, by JOHN PHILLIPS A.M., LL.D., F.R.S., Late President of the Geological Survey and Professor of Geology in the University of Oxford.

This volume contains the substance of the Bede Lecture, delivered at Cambridge, in May 1860. Like everything that Prof. Phillips does, it is clear, accurate and scholarly. It gives in small compass and in a manner intelligible to all, a summary of the facts known to Geology respecting the introduction and order of succession of life on the earth, without any of the exaggeration and looseness of statement too common in popular books. It can be safely recommended to every one desirous of knowing the present state of this subject, and its bearing on the Darwinian doctrine of the origin of species by natural selection. The work might afford many interesting extracts, but we content ourselves with copying the Author's concluding reflections, which are full of great truths, and with recommending our readers to procure the work for themselves.

"These various speculations on the subject of Fossil plants and animals, and the origin and progress of life, may perhaps, to the student of exact science, appear little more than the chase of a phantom, a wandering after unattainable truth. There is, however, something seductive in the problem of the origin of life, and one who has entered on this charmed path, will seldom leave it without reluctance. Vain and ill-judged as are some of these attempts, they ought perhaps not to be visited with the heavy condemnation which sometimes has been heaped upon them. Men may have mistaken views about the diluvial catastrophe; false conceptions regarding electricity as the agent of imparting life; wrong notions about the nature of atoms, and yet not reason, at least intentionally, as 'atheists,' denying the incessant watchfulness of God over the arrangements which he has appointed. It is hard to believe this of any serious thinker, even of Lucretius, however strongly he may contend for the regular operation of natural laws, in opposition to the capricious meddling of those monstrous personifications of human passions, which were accepted for deity by the 'too superstitious' men of Athens and Rome. Erroneous opinions have but their day, and are, perhaps less mischievous, than the indolence which acquiesces in dull and incurious conformity with whatever may reign for the moment. Truth, or what appears such to human reason, operating on real facts and just inferences, this is the end of scientific research; while we seek it, let us not be too much troubled if some run in courses wide of our own, and ask questions we think not likely to be answered. If we do not ourselves believe the origin of created life to be discoverable by a creature limited to the observation of sensible phenomena, why should we restrain the enterprise of those who, vainly striving after something that is unattainable or fabulous, may yet win much that is accessible, valuable and real?

"According to most of the hypotheses we have been considering, the forms, structures and habits of life, which we now circumscribe by specific characters, however distinct these may seem to be, are only constant for this moment, slowly varying through this period, as they have varied in preceding periods, possibly then at a greater rate than now. The forms that now are have had a long series of progenitors, gradually changing from the earliest times; many of the earlier races of a great common stock having died out, while others came into view; the whole theatre of life always full of action, but the actors continually changing, however slow the process of change.

"But, as already observed, the evidence of most value for deciding the probability of such a progressive change in the forms of life is to be furnished by geology. That it does not furnish good evidence in favour of gradual and indefinite change is perhaps generally allowed; but that it does furnish evidence of interrupted and limited change, and that the changes mark steps of progress, is a prevalent opinion. It is the opinion of Mr. Darwin, that if the record of life in the fossiliferous strata were complete, those changes which now appear interrupted and sudden would be found to have been continuous, and the progress by steps would become an inclined plane of easy ascent. This incompleteness he assumes to be enormous; so much so that the traces of whole periods of immense duration, including the first period, are lost; what we possess being merely fragments of the record, which indeed never was complete, owing to the character of some kinds of deposits. Thus we must not expect to be able to arrange the fossil remains in a real however broken series, since the true order and descent may be, and for the most part is irrecoverably lost.

"Surely this imperfection of the geological record is overrated. With the exceptions of the two great breaks at the close of the Palæozoic and Mesozoic periods, the series of strata is nearly if not quite complete, the series of life almost equally so. Not indeed in one small tract or in one section; but on a comparison of different tracts and several sections. For example, the marine series of Devonian life cannot be found in the districts of Wales or Scotland, but must be collected in Devonshire, Bohemia, Russia, and America. When so gathered it fills very nearly if not entirely the whole interval between the Upper Silurian and the Carboniferous Fauna. So in England the marine intermediaries of the Oolitic and Cretaceous ages are not given: but the Neocomian Strata supply the want. We have no Meiocene Strata in England, but their place is marked in France and America.

"Even the great breaks alluded to are bridged. The Permian series of life contains some Mesozoic interpolations; and the Lias contains reliquiæ of some Palæozoic genera. The upper chalk of Maestricht and the South of France extends toward the Tertiaries the reign of the Upper Mesozoic beds.

"On the whole, it appears that there exist ample materials for testing any hypothesis of the sequence of life which includes the marine races; and that there is much ground for believing, in regard to the chasms which do exist in the series of freshwater and terrestrial races, that if filled, they would not lead to other inferences than such as appear consistent with the records of the sea. If the monuments of the earlier life of the globe are essential witnesses, but too few and independent for a satisfactory test of a given hypothesis of the sequence of life, it is unfortunately ineligible for admission among accepted truths.

"Caloric, electricity, chemical action, are all influential on life; elevating and depressing it, carrying it on or bringing it to a close, according to the measure and mode of application of these powers of nature. Employed as they are in the current of life, and at every moment acting on and being acted on by it, nothing has seemed easier to speculation than to conceive these agencies so operating on appropriate matter as to *make* the vital machine which could not be kept in motion without them. The only thing wanted is the due co-ordination of these powers, in the appropriate matter. Here unfortunately is the difficulty—*due co-ordination* of independent powers in matter *rightly adapted* implies the directing mind of the Master of power and matter. The formula is imperfect—

We start, for LIFE is wanting there

"Given, however, the appropriate matter, and the stroke of life upon it, what have we—no living thing—but vitalized matter. Capable of what? Self-development? Into what simple organic form? The answer seems to have been an Infusory Animalculum, before the scrutiny of the microscope had shewn the real complexity of most of these children of unknown fathers, the transition stages of others, the definite course of life of all. At present the first hopeful product of the cryptogamy of electricity and carburetted moisture would be a fertile cell, for cells are the ultimate term of the mechanical analysis of organic beings.

"Given then a cell with walls; composed of carbon, hydrogen and oxygen; capable of self-division and so of increasing in number. Let it be born in the sea according to Telliamed, or, in moisture, or slime, according to Lamarck, or if it suit better the following phenomena, in the air. What follows? An aggregation of cells. Plant or animal? Perhaps neither, but a living being, capable not of moving, but of being moved, says Lamarck, by the external powers influential on life, like Volvox. What next? Reproduction of other Volvoces by self-division, or the growth of new individuals within the parent.

"Here the process, so far as our knowledge and observation go, at present, must stop—the aggregate of cells breaks up into smaller aggregates, or is resolved into solitary cells again, and our little circle of discovery is completed.

"Given, therefore, something more; a current of water guided by cilia through the mass; removal and renewal of cells; addition of a new substance to line the canals, in forms determined by these currents; the growth of germs capable of being separated and going through the same series of events; in short a sponge, for the possession of which Botany and Zoology have had a long conflict, and which seems placed at the very lowest limit of specific life.

"What is the next step, or rather leap, is hard to say; for if we go to the minute Foraminifera, that is a group of aggregated and perforated shells, with cilia, which helps us very little or not at all in the advancement of animalization; but if we ascend *per saltum* to the Zoophyta most allied to Spongiadæ, and claim affinity with Alcyonium, we require the large postulates of freely moving polypi, with eight arms round the contractile mouth, a complete digestive cavity, and ova of definite character.

"Then again is another hiatus between the Alcyonidæ and the Mollusca, which neither fossil nor recent life can fill; and thus in what seem to be the first and easiest steps we can imagine, nothing but postulate upon postulate will bring us on our way. But postulates in the sense here used are equivalent to special endowments, not in the least easier to conceive of than separate creations; for what are these but endowments, and has not every special structure its appropriate germ and mode of growth?

"If it is not possible in the existing ocean, among the innumerable and variable radiated, amorphozoan, and foraminiferous animals, to construct one chain of easily graduated life, from the fertile cell to the prolific ovarium and digestive stomach, it must be quite in vain to look for such evidence in the fossil state. In the face of the assumptions requisite to imagine such a chain, we cannot venture to adopt it as a probable hypothesis, and thus the idea of one general oceanic germ of life, whether we like it or not, must be abandoned. Reasoning of the same kind will convince us that to derive by any probable steps any one great division of the animal kingdom from another, involves too much of a hazardous assumption to be adopted by a prudent inquirer.

"Take, therefore, the hypothesis in an easier shape, and accept as primary structures in general forms all the great invertebral divisions which reside in water; let us suppose them capable of indefinite variation, and inquire what is the geological evidence in proof of each later group being derived from some earlier one by descent with modification. Take the least incomplete series of forms, viz. the Mollusca, and undoubtedly the most favourable of all the marine groups for the application of hypothesis.

"The earliest known Mollusk is the Brachiopod Lingula; which, as already observed, recurs in all the systems of strata, and is still living. It gives no generic branches. The next earliest are the Dimyarian genera, Ctenodonta and Cucullella, which cannot be regarded as descended from any conceivable Brachiopod, or accepted as progenitors of Modiola, Orthonota, Cardiola or Pleurorhynchus; still less of their Monomyarian companions, Ambonychia, Avicula and Pterinea. It is inconceivable that from these or anything like them could be derived the Gasteropod, Euomphali, Loxonemæ, &c., or that the Heteropod Bellerophon, the Pteropod Theca, or the Cephalopod Orthoceras, are consanguineous, any one of them with any other. All these grea classes then are *according to the evidence* equally aboriginal, though no of equal antiquity.

"Without bringing in similar results from the other invertebral classes we may boldly affirm that the later series of Cambro-Silurian life cannot possibly be derived from the earlier series, according to the evidence preserved to us; but on the contrary requires absolutely the admission of separate stemmata, certainly for every principal group, apparently and probably so for every genus or natural assemblage of much resembling forms with similar structures.

"The explanation offered by most palæontologists is that these several stemmata are of independent origin, separate creations in fact, using this term to indicate a process unknown to us, by which the Creator has provided for the appearance of new forms and structures at definite times and in certain places, which it is in the province of palæontology to search out. The explanation offered in the hypothesis of Mr. Darwin, is that the groups of life which appear to be and really are distinct, in the Cambro-Silurian rocks, are not aboriginal forms; but derived from progenitors of far earlier date, belonging to few types or to one; the original form, and the transition forms being unknown to us.

"Now they are not unknown to us by any impossibility of being preserved, for the strata of the Cambro-Silurian series are of a kind in which organic remains of great delicacy are often preserved, and indeed such are preserved in these very strata; and by the hypothesis the life-structures which are lost must have only gradually differed in their nature from those which are preserved. It follows, therefore, that the earlier living progenitors of the Cambro-Silurian series, not only lived long before but must have lived somewhere else. But as in all the known examples of this series of strata, wherever found, we have everywhere animals of the same general type, and nowhere the traces of earlier progenitors, it is clear that everywhere we are required by the hypothesis to look somewhere else; which may fairly be interpreted to signify, that the hypothesis everywhere fails in the first and most important step. How is it conceivable that the second stage should be everywhere preserved, but the first nowhere?

"This difficulty occurs again and again, not only at the great breaks of the series of strata accompanied with much disturbance and change of sea-bed, but during the ordinary and least interrupted accumulations of deposit, for example, in the Silurian and Oolitic systems, in each of which new families and genera, new types of structure in short, make their appearance frequently at definite stages, and always compel the hypothesis to the same answer—look elsewhere for the progenitor—the father is never buried with his children.

"Is there not at the base of all these hypotheses of one continuously branching stream of variable life, some trace of the common errors of assuming that to be true without limits, which is acknowledged to be true in a restricted sense; of employing infinite time to integrate quantities which are subject to no law of varying magnitude; and of assigning a resultant to unknown and inconstant directions? Do we not find the 'mutability of species' illustrated by examples of *limited* change, effected by the *directing* agency of man; and then what stands for an inference that *unlimited* changes have been effected or are in progress by the *undirected* combination of external conditions? Are we sure that varieties which are given by nature in successive generations, can be *summed in one direction* by the variable preponderant of a number of *concomitant variable* conditions of life? Can we remove 'natural selection' from the large synonymy of 'chance,' except by giving to one of the variable conditions of which it is the sum, direction, definite value or effect? Is it not the one acknowledged possession by every species of an inherent tendency to propagate its like? Would not the effect of this one constant among any number of variables without law, be to preserve the characters of the species for ever? And if 'natural selection' were regarded as giving direction to these variables, in combination with that constant tendency, what would be the final result but that which has always been recognized, viz. a species varying within limits which are to be sought out by experience? But, finally, if Natural Selection be thus gifted with the power of continually acting for the good of its subject—encouraging it, or rather compelling it to continued advancement,—

Αἰεὶ ἀριστεύειν καὶ ὑπείροχον ἔμμεναι ἄλλων,

how is this beneficent personification to be separated from an ever watchful providence; which once brought in to view sheds a new light over the whole picture of causes and effects?

"It may be thought that, while professing to keep to the old and safe method of reasoning on known causes and ascertained effects, we deviate from this principle in regard to the origin of life, and introduce an unknown cause for phenomena not understood, by calling to our aid an act of 'creation.' Be it so, let the word stand for a confession of our ignorance of the way in which the governing mind has in this case acted upon matter; we are equally ignorant in every other instance which brings us face to face with the idea of forces not manifested in acts. We see the stream of life flowing onward in a determined course, in harmony with the recognized forces of nature, and yielding a great amount of enjoyment, and a wonderful diversity of beautiful and instructive phenomena, in which MIND speaks to mind. Life through many long periods has been manifested in a countless host of varying structures, all circumscribed by one general plan, each appointed to a definite place, and limited to an appointed duration. On the whole the earth has been thus more and more covered by the associated life of plants and animals, filling all habitable space with beings capable of enjoying their own existence or ministering to the enjoyment of others; till finally after long preparation, a being was created capable of the wonderful power of measuring and weighing all the world of matter and space which surrounds him, of treasuring up the past history of all the forms of life, and of considering his own relation to the whole. When he surveys this vast and co-ordinated system, and inquires into its history and origin, can he be at a loss to decide whether it be a work of Divine thought and wisdom, or the fortunate offspring of a few atoms of matter, warmed by the *anima mundi*, a spark of electricity, or an accidental ray of sunshine."

An Introduction to the study of Gothic Architecture. By JOHN HENRY PARKER, F.S.A., &c. 2nd edition revised and enlarged. Oxford and London: J. H. & J. Parker. Montreal: B. Dawson & Son.

The new edition of this excellent manual has been carefully revised by the author, with considerable additions. The book is one of facts and not of fancies and theories. It states only what is well known, and has been established by painstaking research. It was originally written as part of a series of Elementary Lectures delivered to the junior members of the Oxford Architectural Society. The illustrations which it contains are remarkably good, and may be understood by any one. In this country where architecture is just beginning to attract attention, this book will prove useful to amateurs in the way of forming their tastes, and directing them in matters of beauty and utility. It may be questioned whether the Gothic or any of its accepted forms is just the style of architecture best adapted for the climate of this Province, still, having so many points of excellence to commend it, especially for ecclesiastical buildings, it may be hoped that skilful adaptations of its peculiar forms may be devised to render it suitable for our use. We heartily commend this interesting and beautiful little book to the attention of our readers.

A course of six Lectures on the Chemical History of a Candle, to which is added a Lecture on Platinum. By M. FARADAY, D.C.L., F.R.S., &c. Delivered before a Juvenile Auditory at the Royal Institution of Great Britain, London, with numerous illustrations. Edited by William Crookes, F.C.S. London: Griffin, Bohn & Co. Montreal: B. Dawson & Son.

This is another of these admirable little books by Professor Faraday, in which in the simplest and most beautiful language he aims at instructing young persons in some of the interesting phenomena of the material world. The subject seems commonplace, and yet it possesses an abundant interest, and affords varieties of outlets into the various departments of philosophy. There is not a law under which any part of the universe is governed which does not come into play, and is not touched upon in these phenomena. The learned Professor treats in the most graphic way of the various kinds of candles which are used for the purposes of light, and of the chemical action which they manifest. Light, heat, water, air, and their elements are all explained and beautifully illustrated. This little book is worth its weight in gold. It brings profound knowledge and most extensive research down to the understandings of the young. Its simplicity never genders into childishness, as too many books for children do, but it is withal manly and vigorous. Old and young may read this book with interest and profit.

Bush wanderings of a Naturalist; or notes of the field sports and Fauna of Australia Felix. By an old Bushman. London: Routledge, Warne & Routledge. Montreal: B. Dawson & Son.

The author of this little book went out to Australia at the height of the gold fever, but finding himself unsuited by previous habits for the labour of gold digging, betook himself to the bush, nd along with another, sought an independent livelihood by hunting the game of the country. The kangaroo and the wild dog are the only large animals of the chase in that country. The hunter's life is therefore not put to hazard by wild and ferocious animals. But for small game Australia cannot be surpassed. The duck, pigeon, quail, and snipe, may be killed in almost any quantities, at the proper season, in those districts where they have not been shot out. The book contains many acute and interesting observations as to the habits of these animals, and is a valuable addition to our knowledge of the fauna of that region of the world. The narratives are written in a lively and pleasing style, and the incidents although not of a thrilling or wonderful kind, are yet both curious and interesting. To the lover of natural history we recommend this contribution of fresh and trustworthy materials, for the illustration of his favourite study.

The Metals in Canada, a Manual for Explorers. By WILLSON & ROBB.

This little book might with great advantage be in the hands of all our numerous explorers and "prospecters" for metallic deposits. It gives in the first chapter a succinct view of the usual modes of occurrence of all the more important metallic ores. It next treats of the proper mode of exploring for them; after which it takes up several of the metals, as gold, silver, copper, lead, &c., in detail, and with special reference to the localities in which they occur in Canada. The last chapter contains a summary of the more useful tests for the principal metals.

The authors acknowledge their *obligation* to the Reports of the Geological Survey for the facts which they state as to local geology and mineralogy, and announce themselves as established in the capacity of mining engineers in Montreal.

Remarks on the Final Causes of the Sexuality of Plants, with particular Reference to Mr. Darwin's Work 'On the Origin of Species.' By Charles Daubeny, M.D. (J. H. & Jas. Parker.)

Although put forth in a mere pamphlet, it is well that the Professor of Botany in the University of Oxford should record his opinion of Mr. Darwin's theory, regarded from its botanical side. Estimating the discovery of the sexuality of plants as the greatest step which has ever been made toward obtaining an in-sight into the secrets of the vegetable organization—a principle which has of late been almost elevated to the rank of a demonstrated truth by minute observations,—he proceeds to say that—

"Those who believe with the Author (Mr. Darwin), that all animals, as well as plants, have sprung from not more than four or five progenitors, will trace in the sexual system the cause of the existence of all but the lowest forms of life; not indeed in the sense in which the vulgar understand it, as if no fresh individual of a species could have been called into existence by any other and simpler agency, but because no deviation from the primeval type, and therefore no progress towards a more improved form, could otherwise have taken place, except indeed in a few exceptional cases, under the influences of different external conditions. For my own part, I am unwilling to be set down as yielding an entire and unqualified assent to this doctrine, when pushed to its extreme consequences; for although I must leave it to Naturalists more equal to the task than myself, to enter the lists against an antagonist furnished with so vast an armoury of facts, and gifted with so singular a power of applying them to the purposes of his theory, I must demur at considering the distinctive faculties of the beings that stand in the higher ranks of the creation as mere developments of those which exist in the lower. I can hardly bring myself to believe, that the activity, the quick perceptions, the various instincts, which we observe in the vertebrate, can have been elaborated out of the dull vegetative faculties of the invertebral class; and still less that the reason, the imagination, the moral sense of man, can have been owing to a mere expansion of the brain of the Gorilla."

Towards the conclusion, Dr. Daubeny adduces a counter-argument to the proposed theory which, though employed by some naturalists in the controversy, has not been perhaps as yet sufficiently estimated. The foundation of Mr. Darwin's reasonings is the achievements of human skill in the domestication of animals, and the facts connected with domestication are those to which he constantly refers with confidence in support of his theory. "All the rest, however appropriate to the development of his argument, however well calculated to remove objections, or to impart a degree of probability to his speculations, seem either to lie beyond the range of actual experience, or to lend him only that indirect support which may be afforded by their accordance with the hypothesis, once assumed to be true....But," continues Dr. Daubeny, "although human ingenuity has doubtless introduced many very striking deviations, both in plants and animals, from the original type, it has never yet, I believe, proceeded so far as to give rise to what naturalists would regard as a new species, that is, an individual incapable of producing a fertile progeny with any other member of the parent stock."

In connection with this pamphlet, may be read the summary of the arguments of Prof. Asa Gray, which we presented in *Athen.* No. 1710. Thus the reader will have the calm pleadings of two distinguished botanists for and against the ingenious Theorist now taking his trial in the Court of Natural Science. Both botanists however, agree that Variation and Natural Selection are "probably inadequate to the work which they have been put to."—*Athenæum.*

The Canadian Naturalist. A series of conversations on the Natural History of Lower Canada." By P. H. Gosse, London, 1840.

The intelligent author was fully aware when he published the above work, that confusion arose from want of a thorough knowledge of entomological nomenclature. The book has a good circulation in the Provinces, and is accessible to young students of entomology. To my knowledge the tyro has frequently made confidential reference to it for the purpose of naming his insects. I have therefore reviewed the whole of the entomological index, commencing with the

COLEOPTERA.

Brachynotus Bennettii, (page 78), should be *Podabrus tricostatus,* Say.

Rhizotroga fervens, (p. 106), should be *Phyllophaga quercina,* Knoch.

Phyllodecta vittelina, (p. 185), should be *Gastrophysa vitellinæ,* Linn.

Meloe proscarabœus, (p. 185), should be *Meloe angusticollis,* Say.

Chrysomela 10-notata, (p. 185), should be *Calligrapha Philadelphica,* Linn.

Odontomis trinervia, (p. 224), should be *Chrysobothris dentipes,* Germ.

Nephropis Canadensis, (p. 224), should be *Leptura Canadensis,* Oliver.

Lyctus reticulatus, (p. 230), should be *Diagrapha reticulata,* Fabr., and *Lyctus terminalis,* (p. 231), should also be placed under the genus *Diagrapha.*

Stenuris divaricata, (p. 232), should be *Stenurus* (*Dicerca*) *divaricata,* Say.

Anoplis rusticorum (p. 232), should be *Buprestis rusticorum,* Kirby.

Platycerus placidus (p. 272), should be *Parandra brunnea,* Fabr. *Placidus,* Say, belongs to the genus *Lucanus.*

Gymnodus rugosus (p. 272), should be *Osmoderma scabra,* Beauv., and on the page following *Gymnodus Drakii,* which is *Osmoderma eremicola,* Knoch.

Pathophagus latibrosus (p. 320), should be *Onthophagus Hecate,* Pz.

Boletophagus cristatus, (p. 251), should be *Boletophagus cornutus,* Pz.

Eumolpus Bigsbyana, (p. 122), should be *Calligrapha Bigsbyana,* Kirby.

Cucujus rufus, (p. 122), should be *Catogenus rufus,* Fabr.

Ips. quadripunctata, (p. 122), should be *Ips. 4-signatus,* Say.

Thanatophilus marginalis, (p. 136), should be *Oiceoptoma marginata,* Fabr.

Lampyris corrusca, (p. 296), should be *Ellychnia corrusca,* Linn.

Elater metallicus, (p. 185), I know of no Elater ("changeable crimson and green") of this name, *Limonius metallescens,* Mels. is a var. of *L. plebejus,* Say, which if occurring in the North, may be the insect mentioned by Gosse.

Carabus catena, (p. 185). There is no Carabus of this name in the Coleopterous fauna of the North. The one alluded to is evidently *Carabus Canadensis,* Leconte.

Staphylinus chrysocephalus, (p. 319). There is no Staphylinus of this name in the catalogue. It is either a nondescript or var. of *S. cingulatus,* Grv. I have seen but one specimen which was taken at Toronto, by F. H. Ibbetson, Esq., who identified it as distinct from *cingulatus.*

LEPIDOPTERA.

Thymele briso (p. 184), belong to the genus *Nisoniades,* Hübn.

Melitæa myrina (p. 192), belongs to the genus *Argynnis,* Fabr.

Hesperia Peckius (p. 193), should be *Pamphila Peckii.*

Platypteryx erosa (p. 194). No geometra of this name occurs in North America. The moth noticed by Gosse is probably *Poaphila erosa*, Guén.

Angerona sopeta (p. 194), is a wrong citation. The genus Angerona of North America has but one described species. *Chlorissa putatoria* does not occur in Canada. Mr. Gosse has evidently applied European names to the greater part of the moths mentioned in his work. *Geo. clematoria* cannot be found in the Northern Insect fauna. The species of Phragmatobia (p. 195), which Mr. Gosse took to be the European *fuliginosa*, I take to be *P. assimilans*, and the only described North American species.

Smerinthus occelatus, (p. 222), should be *S. geminatus*, Say.

Pamphila cernes (p. 228), should be *P. origenes*, Fabr.

Hipparchia andromacha (p. 246), should be *Debis Portlandia*, Fabr.

William Couper, Quebec.

The Canadian Journal, No. 33; Drift Deposits of Western Canada.

On this interesting subject, to which Mr. Bell directed attention in a late number of the *Naturalist*, Prof. Chapman communicates some valuable notes to the *Canadian Journal*, Toronto. The deposits may be divided into a lower and upper member. The former consists of dark blue and greyish clays in some places with yellowish bands, and is destitute of boulders or nearly so. This deposit much resembles our Leda clay of Lower Canada, but no marine fossils have been found in it. The upper member consists of sand and gravel, with numerous boulders. When these rest on the rock without the intervention of the lower member the former is always striated and polished; and this effect has been observed up to a height of 1500 feet. Prof. Chapman mentions several additional localities of fresh water shells in these deposits, beside those referred to by Mr. Bell; and thus sums up the mammalian remains which they contain:—

"In some of these re-sorted beds, the bones and teeth of both extinct and existing mammals are occasionally found. The extinct forms comprise: a species of Mastodon (*M. Ohioticus?* see *Can. Jour.* New Series, vol. iii. p. 356); the *Elephas primige-*

nius; and apparently an extinct species of the horse. The remains of existing species found in these deposits (always confining our remarks to Western Canada), include the Wapiti, the Moose, Beaver, Muskrat, &c. These two classes of remains have been found together. In a railway cutting through Burlington Heights, near Hamilton, the tusk of a Mammoth (*Elephas primigenius*) and the horns of a Wapiti (*Elaphus Canadensis*) were met with at a depth of about forty feet below the present surface of the ground.* I have also seen the lower jaw of a Beaver (*Castor fiber*), obtained from the same locality. The flint arrow-heads, and other wrought implements of Amiens and Abbeville, which are now attracting so much attention in Europe, occur, apparently, in deposits of the same kind and age."

With respect to the conditions of deposition of these beds Prof. Chapman presents the following general views:—

1. "A general depression of the land, at the commencement of the Drift period, must have taken place to such an extent as to admit of the deposition of the lower clays. These latter were evidently derived from the limestones and other Silurian and Devonian strata lying beneath and around them. Hence their generally calcareous nature. Their derivation from this source is proved, moreover, by the pebbles of Trenton limestone and other fossiliferous rocks which they frequently contain. Extensive denudation must thus have occurred both immediately prior to, and during, the deposition of these clays; but it may be questioned whether the bolder contours offered by the denuded rocks, such as the escarpment that sweeps from the Niagara river to Cabot's Head on Lake Huron, were not produced during the first uprise of the palæozoic strata from the earlier seas in which their materials were accumulated, ages before the period now under discussion. It appears, at least, to be a well-admitted point, that these rocks had been elevated into dry land before the deposition of the higher formations in the south and west.

2. "After the deposition of the lower Drift clays, a sudden and abrupt change in the character of the sediments took place. A striking example of this may be seen in the natural sections about Hogg's Hollow, a few miles north of Toronto. The change in question must have been effected by a still further depression of the country, bringing the higher lands and gneissoid strata of

* See a paper on the Geology of this district, by Charles Robb, C.E., in Canad. Journal, New Series, Vol. v. p. 510.

the north within the influence of the waves, and yielding the sands, gravels, and boulders of the upper Drift accumulations. This depression permitted an invasion and broad extension southwards of the ice-covered Arctic seas, the true cause, in all probability, of the cold of this epoch. The depression must have exceeded 1,500 feet, since northern boulders are found at that height above the sea, on the Collingwood escarpment. The gneissoid boulders there met with, must at least have traversed the basin of Georgian Bay; but the glacial striæ which also occur there, may have been produced by the action of ice, originating at the spot itself. The three or four distinct sets of striæ observed at this locality, however, do not radiate from any fixed point, but run in the usual north and south direction, some being a little east and others a little west of north.*

3. " At the close of this second series of phenomena, a gradual uprise of the land appears to have taken place, and a vast area, extending over and around our present lake basins, then became converted into a fresh-water sea. This probably found its outlet to the ocean through what is now the broad valley of the Mississippi. Its waters stood at a great elevation above the waters of our present lakes, and were gradually lowered to these levels by physical changes in the surrounding country, and more especially by the depression of a higher region lying to the east. During this gradual fall and retrocession of the great lake waters, the upper layers of the Drift were re-sorted, mixed with newer sediments, and thrown up here and there into secondary ridges; and the remarkable terraces which form so salient a feature in the general aspect of our lake shores and intervening districts, were then in chief part produced. The escarped faces of these Drift terraces, it should be observed, *always front the present lake-basins*, and thus look in some places towards the north, and in others towards the south, &c., according to the direction of the nearest shores. This would necessarily arise if they were produced, as here imagined, by a gradual lowering of the waters, with intervening periods of repose. The shells of fresh-water mollusca, buried in the modified Drift, at various levels above the existing lake-waters, and in localities so far apart—for these shells have been found throughout the region south of the lakes,

* On a visit to this spot, since the publication of the "Note on the Geology of the Blue Mountain Escarpment," in the *Canadian Journal*, Vol. v. p. 304, some additional sets of striæ were observed.

in addition to the localities mentioned in this paper—prove incontestibly the former expansion and union of our lakes, or, in other words, the presence in this part of Western America, of a widely extended fresh-water sea, covering an enormous area. A curious circumstance, and one of great significance in its bearings on this question, is the fact that all the inclined layers of modified Drift (to the east, at least, of Lake Superior) appear to slope towards the west or south. A remarkable instance of this, hitherto, it is believed, unnoticed, may be seen near the mouth of the Niagara river, at Lewiston. At this spot, oblique layers of modified Drift, in beds made up of coarse gravel and pebbles, point nearly due south, and thus bear witness to the fact, that the current, which occasioned the inclined stratification, must have set directly up the gorge, *or against the direction of the present stream.*

"The assumption of an immense fresh-water lake of this character, gradually falling from a high level, necessarily involves the additional assumption of an eastern barrier, extending at one period between the lake-waters and the Atlantic. This view was maintained by some of the earlier investigators of our geology, and, notably, by Mr. Roy, in his much-discussed paper on the terraces of Lake Ontario, communicated to the Geological Society of London, in 1837.* The difficulty of finding a satisfactory location for a barrier of this kind, led Sir Charles Lyell, however, to reject the idea of an original lake extension, and to refer the formation of our terraces entirely to the action of the sea, during the slow uprise of the land at the commencement of the present epoch. In this, he has been followed by all Geologists who have subsequently examined these terraces. The difficulty may perhaps be surmounted, by assuming the earlier and greater elevation of that portion of the country lying to the east of the gneissoid belt which connects our northern Laurentian district with the Adirondack Mountains of New York. The subsequent depression of this region would open an eastern outlet to the lake-waters, and gradually lower these to their present levels. But whatever the explanation, the undoubted fact remains, that,

* See likewise the paper already referred to, by Sanford Fleming, C.E., on the physical characters of the Nottawasaga Valley.—*Can. Journ.* First Series, Vol. i. Mr. Roy's paper, I believe, was never printed.

at the close of the Drift period, a vast fresh-water sea extended over the greater portion of Western Canada, and at a level o. at least 500 feet above the present surface of Lake Ontario."

Prof. Chapman does not enter into the question of the relative age of the Drift deposits of Upper Canada, as compared with the marine Pleistocene beds of Lower Canada described in this Journal by Mr. Billings, Dr. Dawson, and Mr. Bell. Our present belief is that the upper member described by Prof. Chapman must correspond with the Saxicava sand and the lower member with the Leda clay. Dr. Dawson has shown* that at Pakenham on the Ottawa, and also toward Lake Champlain, the Saxicava sand, or its equivalent, is rich in fresh-water shells, while it contains very few that are marine, and these principally *Tellina groenlandica.* Mr. Bell has in his late paper largely added to facts of this class. On the other hand, such cases have not occurred in the eastern part of Lower Canada. This points, as Mr. Bell infers, to a passage into estuarine and fresh water conditions toward Upper Canada, and we need not be surprised that these actually occur there. The Saxicava sand also, like the upper deposit in Upper Canada, often contains Laurentian stones and boulders. With respect to the equivalency of the Leda clay to the lower member of Prof. Chapman's series, we may remark that the mineral character of the two deposits corresponds. Further, the Leda clay holds few boulders and except in its upper part very few fossils. Indeed many parts of it are quite destitute of these, especially where the upper layer has been removed by denudation before the deposition of the sand or gravel. This may possibly be its general condition in Upper Canada.

Should these views prove correct, it will not be necessary to suppose that the enormous lakes indicated by the fresh water deposits of Upper Canada emptied themselves into the Mississippi; since the character of the Saxicava sand in its upper parts implies the influx of much fresh water from the west. Still the occurrence of marine shells in Lower Canada at heights of more than 400 feet above the sea, points to entire submergence of the country around Lake Ontario; and it may well be that the ancient extension of the lake was only one of the phases of the process of elevation in the period indicated by our Saxicava sand. It still requires however the discovery of marine shells in the

* Canad. Nat. Vol. iv. p. 16, Vol. v. p. 194.

lower part of the Upper Canada Drift to remove from the relations of these deposits in Upper and Lower Canada, all that ambiguity which has so often been referred to in papers in this Journal. In the mean time, we hail the labours of Prof. Chapman and Mr. Bell as important contributions towards this end, and as already pointing out a probable solution of the difficulty.

J. W. D.

MISCELLANEOUS.

A few Notes on Analysis by the aid of the Spectrum.

As colour is so conspicuous a characteristic of many substances, it is not surprising that the chemist largely avails himself of its indications in qualitative analysis. These indications are, however, neither so reliable nor so extensively useful in chemical determinations as might at first sight appear; for in the first place, the colours of many substances vary very much, according to their state of aggregation, and to other circumstances not affecting their chemical constitution,—in the second place, the colour of a compound does not appear to be a resultant of the colours of its elements,—and lastly, the unassisted eye is unable to distinguish hues differing but slightly, unless opportunity for comparison with each other be afforded; or, in case of compound tints, to determine the tints compounded, as for instance, whether an olive green result from an intermixture of violet and yellow, or of orange and blue.

Any inaccuracy arising from imperfection of the eye, can however be almost, if not altogether, eliminated by prismatic decomposition of the light reflected from, or transmitted through the coloured substance; and by comparing the spectrum thus produced with the solar spectrum, the most precise information can be obtained respecting the tint under examination. Thus, to recur to the illustration adduced above, the different refrangibilities of the component colours would enable us readily to distinguish the one olive green from the other. Undoubtedly the best mode of thus examining the colour of a substance, which is either a liquid or capable of solution in a liquid, is that employed by Dr. Gladstone in his late researches on the absorption of light by coloured media. In his experiments, a wide, thin beam of light was transmitted through a long, narrow, and gradually tapering hollow wedge of glass, filled with the liquid under examination; so that while one edge of the sheet of light passed through an indefinitely thin stratum of liquid, the other edge passing through the thick extremity of the wedge, traversed a stratum of about three-fourths of an inch thick. The light thus transmitted was decomposed by a prism held parallel to the *width* of the sheet of light. Thus a broad spectrum was thrown up for examination. That portion of the spectrum adjacent to the thin edge of the wedge, and formed by light which had traversed it, differed of course but little from the solar spectrum; but it was not found as might perhaps be supposed, that the brilliancy of the colour of the spectrum uniformly diminished towards the thick end of the wedge. On the contrary, some hues were found (with most media) to diminish much more rapidly, and be *extinguished much* sooner than others; so that while the one side of the broad spectrum, that towards the thin edge of the medium was terminated by a straight line, the other side was bounded by a deeply indented sinuous outline, certain bands of colour extending much further towards the thick end of the wedge than others. For example, when a solution of sesquichloride of chromium was the medium, the violet, indigo, and yellow rays were almost immediately extinguished, leaving a broad projection of blue and green, and a *narrower*, but much longer, arm of red. Thus is explained the fact that dilute solutions of this salt appear green, and concentrated solutions purple. In this manner relations of colour between combinations containing a common element were discovered, which the unaided eye could not have detected. More than this, unfailing means of determining the presence of certain elementary substances were pointed out; thus didymium invariably announces its presence in solution, even when in small quantity, by two very black lines, one in the yellow and one in the green.

Interesting as these results are, and important as they may become, the somewhat similar investigations pursued still more recently by Kirchoff and Bunsen, are of surpassing interest and importance.

The distinctive hues imparted to flame by certain substances have long served to indicate their presence in blow-pipe analyses. It has been further observed, that different substances impart distinctive appearances to the electric flame, appearances especially remarkable when analyzed by the prism. It has been reserved, however, for the philosophers above named, to examine elaborately these peculiarities of bodies, and accurately to distinguish from one another by this means certain bodies susceptible of such examination. They have showed that when a portion of one of the metals of the alkalies or alkaline earths, or indeed of almost any chemical element, is introduced into a flame, a beam of light from which passes through a prism and forms a spectrum, its presence in the flame is signalized by the simultaneous appearance of one or more vivid lines of light in the spectrum. Thus sodium or any of its salts in any flame, gives two adjacent lines of bright orange, while lithium gives a brilliant red line. They have further demonstrated, that these characteristic lines are constant in position, notwithstanding very great variations in the intensity of the flame, and independently of the form of combination in which these substances may be supplied. Still further they have established the statement that when any of these metals are placed upon a fine platinum wire enclosed with a similar wire in a glass tube, sparks from a Ruhmkorff's induction apparatus being made to pass from wire to wire, the spectrum of the light so generated, is identical with that of the flame into which these substances are introduced.

Analytical processes founded on this principle prove to be of unapproachable delicacy and precision. When a small portion of a powder to be analyzed is projected into a flame, or better still, is enclosed in the little apparatus above referred to, the presence of considerably less than one hundred thousandth part of a grain of sodium, or potassium, or lithium, can be detected with certainty by the practised observer. Already have investigations of this nature brought to view at least two new metals; one, cæsium belonging to the calcium group of metals, and one, yet unnamed, belonging to the sulphur group of elements. The former, discovered by the originators of this mode of investigation, announced itself by two blue lines, one especially bright being towards the violet end of the spectrum. The latter, found associated with selenium and tellurium, by Crookes, signalized its presence by a remarkable and unmistakable bright green line, leading to its identification as a hitherto unknown element.

The same investigators show that a flame giving any bright line in the spectrum, while transparent to other light, is opaque to that particular ray. Hence a kind of negative spectrum of a flame may be produced in which the bright lines are replaced by dark ones, by placing behind it a much more brilliant light giving a continuous spectrum. Thus magnesium gives when present in an alcohol flame a spectrum having three intense green lines very near together. Let now the alcohol flame be illuminated by the incomparably more vivid oxy-calcium light, and the spectrum before feeble is greatly enhanced in brilliancy, all the light from the latter source, except that corresponding to the three green lines, freely penetrating the flame. It follows that though these green lines are absolutely illuminated as much as at first, yet being relatively illuminated much less they appear as three lines of shadow across the spectrum. It will be apprehended that what has here for distinctness' sake been said of the magnesium spectrum and of three lines in it only, applies equally well to all spectra with all their luminous lines. Here then as Kirchoff intimates, is the explanation of the apparent paradox that while light from all artificial sources is characterized by bright lines, the solar spectrum, as first pointed out by Wollaston and Fraunhofer, is marked by numerous dark lines. It is in fact a negative spectrum. In the words of that author; "the sun possesses an incandescent gaseous atmosphere which surrounds a solid nucleus having a still higher temperature. If we could see the spectrum of the solar atmosphere, we should see in it the bright bands characteristic of the metals contained in the atmosphere. The more intense luminosity of the sun's solid body, however, does not permit the spectrum of its atmosphere to appear; it reverses it; so that instead of the bright lines which the spectrum of the atmosphere by itself would shew dark lines are produced." With these facts in view we are prepared to learn that the attempt has been made, not wholly unsuccessful, though yet incomplete, to analyze the solar atmosphere. The mode of procedure is intelligible enough. Two spectra in close proximity—the one, that of the sun—the other, that of any metal in the electric spark—are viewed simultaneously in the same telescope. If all the bright lines of the latter correspond exactly to certain of the dark lines in the former, it seems a warrantable conclusion that that metal is present in the incandescent solar atmosphere. If this exact correspondence is wanting it may be similarly affirmed that that metal is present, if present at all, in comparatively minute quantities. On such grounds Kirchoff asserts that the solar atmosphere certainly contains Iron, Chromium, Nickel and Magnesium, while if Silver, Copper, Zinc, Aluminum, Cobalt and Antimony are present they are in such small relative proportion as to fail to give any evidence of their presence in the spectrum.

S. P. R.

CHEMICAL SCIENTIFIC INTELLIGENCE.

Schonbein has advanced the opinion that oxygen exists in three states ;—

1st. As ordinary, comparatively inactive, or neutral oxygen; 2nd. as ozone, negative oxygen,—O; and 3rd. as what he has termed antozone, positive oxygen,+O; and further that from the mutual action of the two last mentioned modifications of oxygen ordinary oxygen proceeds. He supposes that oxygen exists in the form of ozone in the oxides of silver and gold, and in several of the peroxides, as manganese, lead, &c., as well as in some other oxygen compounds; but that it is antozone which unites with protoxides of hydrogen, barium, &c., to form their peroxides. Thus he explains the facts that ozone eliminates inactive oxygen from peroxide of hydrogen, and that oxide of silver and peroxide of hydrogen decompose each other upon contact, suggesting that double decomposition takes place in either case according to the equations.

$$\left\{ HO, (+O) \right\} + (-O) = HO + (+O-O) = HO + O$$

$$\left\{ HO, (+O) \right\} + \left\{ Ag\ (-O) \right\} = HO + Ag + (+O-O) = HO + Ag + O$$

One objection to this hypothesis hitherto has been that antozone is as yet merely hypothetical. But Schonbein now announces that he has isolated this form of oxygen by acting upon peroxide of barium with monohydrated sulphuric acid, a gas being liberated which smells like ozone and turns the ozone test-paper blue, but which differs from that substance by its power of forming with water peroxide of hydrogen. He also announces that large quantities of this gas, about $\frac{1}{3000}$th, exist ready formed in a dark blue species of fluor spar found at Wulsendorf and long distinguished by its disagreeable smell. When this substance is triturated under water large quantities of peroxide of hydrogen are immediately formed. In further support of his view he affirms that whenever in the slow oxidation of phosphorous ozone appears, corresponding amounts of peroxide of hydrogen are simultaneously formed; and that other slowly oxidizing substances, as zinc, have the same power of decomposing, so to say, oxygen into ozone and antozone. His views are worthy of attentive consideration, not merely because a class of reactions otherwise inexplicable is explained, but because of their accordance with certain views respecting the nature of elementary molecules rendered necessary by he theory of types in chemistry and by the dynamical theory of heat.

Deville and Debray recommend for the economical production of oxygen the calcination of sulphate of zinc, which at a heat less than that required to decompose binoxide of manganese breaks up into a light white oxide suitable for painting, sulphurous acid, and oxygen. As another and even preferable process they recommend the decomposition of sulphuric acid, by allowing a thin stream to traverse a vessel containing platinum sponge and heated to low redness. Oxygen and sulphurous acid are the results. The methods of removing the latter are obvious.

M. Carré freezes water by the cold produced by evaporation of liquid ammonia. His apparatus consists of two iron cylinders, the one three times the magnitude of the other, connected air tight by a tube. The larger vessel filled with a strong solution of ammonia is heated to about 140°. The smaller vessel is at the same time immersed in cold water. The ammonia expelled by heat from the larger liquefies in the smaller cylinder. On removing and cooling the larger vessel the ammonia is reabsorbed by the water so rapidly as to reduce the temperature of the other portion of the apparatus to the freezing point of mercury.

Kopp sums up the results of his investigations respecting the relation between composition and boiling point. They are briefly these. An alcohol $Cn\ Hn_{+2}\ O_2$ boils at a temperature of $(40+9.5n)$ °Cent., the corresponding acid $Cn\ Hn\ O_4$ at 40° higher, and the isomeric compound ether at 82° higher still. The related alcohols, acids and ethers $Cn\ Hm\ O_2$, $Cn\ Hm\ O_4$ and $Cn\ Hm\ O_4$ boil at temperatures easily calculated by adding or *subtracting* 5° for every H in this formula more or less than is in the similar formula of the above series, to or from the boiling point of its related compound. After pointing out similar relations in less extensive classes of substances, he calls attention to the importance of the boiling point of a substance in aiding us to determine its affinities. S. P. R.

NATURAL HISTORY SOCIETY.

The Natural History Society of Montreal, met on the evening of the 29th April, in their Rooms.

The Lord Bishop of Montreal presiding.

The following donations were presented and ordered to be acknowledged :—

Donations of Mammals and Birds from the Smithsonian Institution. 113 species, 148 specimens of birds, and 22 species, 30 specimens of mammals. A portion from Mr. Bernard Ross, Hudson's Bay Company. A report on this collection will be prepared by Mr. Alfred Rimmer.

A collection of Canadian Shells from the Geological Survey, to be placed in the Museum subject to specified conditions.

A pair of Snow-birds (*Niphea hiemalis*), from John J. Day, Esq.

A Shore Lark (*Alauda alpestris*), from Mr. Vennor.

Sir William Logan read a paper illustrated with diagrams, on the Quebec and Point Levi rocks. This paper is printed in the present number.

The next meeting of the Society to be held on the last Monday of the month of May. The Rev. Mr. Kemp to read a paper "On the Structure and Growth of *Zygnema*."

PUBLICATIONS RECEIVED.

1. Memoirs of the Literary and Philosophical Society of Manchester, England. Second series, vol. 15, containing among many articles worthy of note, a paper "On the yellow colouring matter obtained from the leaves of the *Polygonum fagopyrum* or common Buckwheat." At the conclusion it recommends that "in countries where the plant is cultivated it might be worth while to collect the leaves as a dyeing material."
2. Edinburgh New Philosophical Journal, vol. 12, No. 1.
3. The Geologist, vol. 4, Nos. 38. 39. 40. 41.
4. Journal of the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts. Third series, vol. 41, Nos. 2. and 6.
5. Proceedings of the Boston Natural History Society, vol. 7, pages 193 to 256, and pp. 417 to 448, with title page; also vol. 8, pp. 1 to 32.
6. Proceedings of the Academy of Natural Sciences of Philadelphia, 1859, pp. 327 to 356. 1860, pp. 1 to 324. 1861, pp. 1 to 96, with catalogue of the fishes of the eastern coast of America, from Greenland to Georgia, by Theodore Gill.

Report of the Regents of the University of the State of New York.

Proceedings of the American Antiquarian Society.
Historical Magazine (American).
Consolidated Statutes of Canada, from the Government.
Historical Collections of the Essex Institute.
Dr. Gibb on Canadian Caverns.
Harlan's Fauna Americana, 1 vol., from the Rev. A. F. Kemp.

List of Specimens presented to the Natural History Society, by A. S. Packard, Esq. Jr., of Brunswick, Maine.

1. Aporrhais occidentalis, Labrador.
2. Cardium islandicum, "
3. " pinnulatum, "
4. Tellina proxima, "
5. " fusca, "
6. Aphrodite groenlandica. "
7. Thyasira gouldii, "
8. Nucula tenuis, "
9. Leda tenuisulcata, "
10. Turritella erosa, "
11. " costulata, "
12. Littorina rudis, "
13. " littorea, "
14. " groenlandica? Greenland.
15. Bela turricula, Labrador.
16. Mangelia decussata, "
17. " pyramidalis, "
18. Tectura testudinalis, "
19. Margarita cinerea, "
20. " undulata, "
21. Lacuna vincta, "
22. Adeorbis costulata, "
23. Mangelia bicarinata, "
24. Margarita helicina, Greenland and Labrador.
25. Saxicava rugosa, "
26. Chiton marmoreus, "
27. Anomia ephippium, "
28. Pectinaria groenlandica, "
29. Anomia aculeata, "
30. Diadora noachina, "
31. Pecten magellancus, "
32. Mesodesma arctata, "
33. Millepora polymorpha? "
34. Cardita borealis, Pleistocene from Labrador.
35. Astarte sulcata, " "
36. " compressa, " "
37. Turritella costulata " "
38. " erosa, " "
39. Mang. harpularia, " "
40. Diadora noachina, " "
41. Mang. turricula, " "
42. Trichotropis borealis" "
43. Pecten islandicus, Pleistocene from Brunswick, Maine.
44. Astarte sulcata, " " "
45. Balanus porcatus, " " "
46. Pandorina arenosa, " " "

47. Ophioglypha nodosa, Labrador.
48. Chiredolc laeve, "
49. Hyas aranea, "
50. Cancer borealis, "
51. Crangon vulgaris, "
52. Echinarachnius atlanticus, "
53. Asteracanthion polaris, "
54. " rubens, "

With a number of fishes and reptiles from Labrador and crustaceans from Florida, and the following Batrachians :—

Salamandra dorsalis, Mass. S. coccinea, Mass. S. erythronota. S. bilineata.

ANNUAL MEETING.

The annual meeting of the Society was held pursuant to public notice, at the rooms of the Society, on Saturday evening, May 18, 1861, when there were present the following members :—

The President, the Lord Bishop of Montreal; Principal Dawson, Chairman of Council; Dr. DeSola, 1st Vice President; Dr. Hingston, Corresponding Secretary; John Leeming, Recording Secretary; James Ferrier, Jr., Treasurer; Dr. Craik, Curator; Messrs. Davies, Kemp, Murphy, of the Council; and Messrs. Gordon, Gouldie, Weaver, J. C. Becket, Dr. Jones, J. J. Day, Douglas, H. A. Joseph, D. Mackay, Alex. Morris, Gibson, Henry Rose, S. C. Bagg, and other members of the Society.

The minutes of the last annual meeting were read and confirmed.

His Lordship the President of the Society then delivered the following address :

Gentlemen,—Before we proceed to the more special business for which we are assembled at this the Annual General Meeting of our Society, I will ask your patience while as President of the *Natural History Society of Montreal* during the past year, I endeavour to lay before you some brief statements of what we have been doing, and what are our claims to support. We have a charter of Incorporation, and we receive support from the Legislature, upon the plea that we are promoting the study of Natural Science. It is very reasonable that such aid and encouragement should be given in a young country like this, but we can only expect it to be continued upon some good showing that we are accomplishing the work to which we are pledged. This I trust we can justly assert to be the case. But whatever help we may derive from the Legislature, it is rather upon the co-operation of our own members, that we must mainly and eventually rely, if we expect to advance our Institution or extend its usefulness. It is not however reasonable to anticipate any rapid accession of members who will devote themselves systematically to scientific pursuits; but I think there is every reason to believe that the efforts of this Society are really advancing the cause of Science, and that its influence is becoming extended, and its labours more and more appreciated by the public. There are several ways in which the Society seeks to advance its work, and bring its influence to bear upon the public mind. First there is the Museum which occupies all the upper part of this building, and has received some very valuable additions recently, which will be noticed more particularly in the Report. This offers many objects of great interest in various departments, and has been visited by far larger numbers than in any previous year. Then there is the Somerville course of lectures during the Winter free to the public, and which have attracted such immense crowds this year that great numbers of persons have been unable to gain admittance. These Lectures bear in general a popular character; while at the monthly meetings of the Society there have been a number of very able and scientific papers read on various subjects. And lastly in order to give permanence to its labours, and disseminate its usefulness, the Society superintends a bi-monthly periodical, under the title of "The Canadian Naturalist." As to the Lectures delivered during the last year, they were attended by such large audiences, and were so well appreciated at the time, that I will not now delay you by alluding to them in detail. But the monthly meetings of the Society, which are truly the periods of its really scientific work, are not so largely attended, nor I think appreciated, as they deserve. And I should wish to mention some ot the many interesting papers which have been read and discussed by the members on these occasions; reminding you that these meetings are open to all members of the Society, and to all of their friends, ladies as well as gentlemen, whom they may wish to introduce.

GEOLOGICAL PAPERS.

1. *Poole, on Coal Field of Pictou.*—Giving many valuable new facts on a very important Coal district; a colossal specimen of the produce of which was exhibited in Montreal last summer at the great Industrial Exhibition.
2. *Honeyman, on new Localities of Fossils in Silurian rocks of Nova Scotia.*—Facts supplementary to, and extending those in Principal Dawson's paper of last year.
3. *Billings, on Fossils from Point Levi.*—This paper contained the discoveries on which the changes in the view entertained

of the Quebec group of rocks were mainly based. It marks an era in the Lower Silurian Geology of Canada, and illustrates the pre-eminent value of fossils as guides to the ages of rocks.

4. *Kemp, visit to Acton Copper Mine.*—A good popular exposition of the Geology of this very interesting mining district.
5. *Dawson, on the Earthquake of 17th October,* 1860.—A collection of facts relating to the shock as experienced in Canada; with notices of the general phenomena of Earthquakes, and of former Earthquakes in this Province.
6. *Billings, on certain theories of the formation of mountains.*—A very good exposition of the prevailing views, with some valuable theoretical deductions.
7. *Bradley, New Trilobite from Potsdam Sandstones.*—Supplementary to Mr. Billing's Paper, No. 3.
8. *Bell, on Freshwater Shells, in the Tertiary deposits of Canada.*—Interesting new facts respecting the fossils of the Pleistocene deposits; and tending especially to explain the peculiarities of those in Upper Canada, referred to in previous papers in the *Canadian Naturalist.*
9. *Dawson, on the Geology of Murray Bay.*—The local Geology of a very interesting region, showing the characters of several important formations in very good natural exposures.
10. *Logan, on the Lower Silurian Rocks of Lake Superior and Quebec.*—A lucid explanation of the new views entertained by Sir William Logan respecting the age of the Quebec group of rocks, and of the facts in the Silurian Geology of Lakes Huron and Superior, recently obtained by the Survey, with very importantgeneral deductions respecting the physical conditions of Eastern America during the Lower Silurian period.

ZOOLOGICAL PAPERS.

1. *Saunders, on* Menobranchus lateralis.—Interesting observations on the habits of a most curious Batrachian reptile.
2. *Vennor, on Birds wintering in and around Montreal.*—Some good observations by a very promising young naturalist; and showing a much larger number of winter residents and visitors than most persons are aware of.
3. *Ross, on Fur-bearing animals of the McKenzie River Settlement.*—Full of curious new facts about the habits of North American mammalia.

4. *D Urban, on the valley of the River Rouge.*—Giving catalogues of the animals of a district but little known.

ETHNOLOGICAL.

Dawson, on aboriginal Antiquities in Montreal.—An interesting paper respecting some Indian remains found in excavating for buildings near Sherbrooke Street, and tending to prove the site of the original Indian Village.

BOTANICAL.

D' Urban, on the Flora of the Counties of Argenteuil and Ottawa.—A valuable Catalogue of the plants of that part of Canada.

Under this head may also be placed a very interesting memoir and account of the labours of Douglas the great botanical explorer of the West coast of America.—By G. Barnston, Esq.

These papers contain a great deal of most interesting matter on a variety of subjects; and many of them are full of new facts bearing upon Natural History and Geology, and though they may be read afterwards in the pages of the "Naturalist," where, with many other valuable contributions, they are placed on record, yet to any young persons anxious to acquire any accurate knowledge, it would be far more profitable to attend the monthly meetings, at which they are read, because they might acquire much valuable information by conversation and enquiry, respecting details growing out of these subjects. And it is certain if a student once takes up a particular branch and follows it out systematically in detail, that an immense amount of interest is rapidly created; and by careful observation, without any great expenditure of time, he is soon able to contribute many useful facts for the enlargement or correction of our knowledge of Natural History. One great object of popular lectures, and public collections in Museums, is to excite such a taste for Natural Science, that in some persons at least a real interest may be created, and the study systematically pursued. Kindred Societies elsewhere in Canada are labouring in the same field, and each doing their part; let us rejoice with them in whatever success attends their efforts: such as the Canadian Institute of Toronto, the Historical Society of Quebec, and the Botanical Society of Kingston. And through the pages of the Montreal "Canadian Naturalist," our Society is now becoming known and valued far and wide by those who are well able to appreciate its worth. Many copies of every bi-monthly number are exchanged with other scientific Societies, and its papers have again and again been copied, and most favorably noticed in the scientific publications of this Continent, of Great Britain, and the Continent of Europe. During the visit of the Prince of Wales to this city, we presented His Royal Highness with an address, and a copy of three volumes of *The Canadian Naturalist* already published, and also with a very handsome volume of curious meteorological observations by Dr. Smallwood, one of our members, which were graciously received and acknowledged. I feel that I may thus freely eulogize the labours of our Society, because while I have constantly attended to all its proceedings for some years past, and for the last two years have filled the office of your President, yet I can lay no claim to the honor of having contributed to the scientific work that has been accomplished. I cordially give my help to encourage what others, far abler in every department of science than myself, have achieved; and while such men as Sir William Logan, Principal Dawson, the Rev. A. F. Kemp, Mr. Billings, and others, continue to give their time and talents to its support, I am confident that it ought to receive cordial and liberal encouragement from the public of Montreal. It is an Institution which, though still in, what we may consider, an infant state, and with its Museum, as compared with those of the old world collections, only as it were commencing its existence, yet reflects credit upon this city, and I trust will continue to do so more and more. I certainly regret that we have not yet got in Montreal some regular and permanent building for carrying on Astronomical and Meteorological Observations. We are however now arrived at a time, when it is not unreasonable to expect occasional acts of well considered munificence amongst our wealthier citizens to enrich our city with useful Institutions, whether connected with Religion or Charity, Learning or Science; and I trust that the example recently set by one of them in connection with McGill College may lead to many similar instances. Perhaps amongst them we may some day find the means of establishing an Observatory in connection with this Institution, and carrying on a regular course of scientific observations. But at any rate whatever may be hereafter accomplished in any fresh departments, we must not allow the "Natural History Society of Montreal" to stop in its present onward progress, or to fail in making good its own special work, either for want of talent ready to labour in its cause, or a grateful public ready to support it.

Principal Dawson then read the following:—

Report of the Council.

The past year has been characterised by steady progress and prosperity in the affairs of the Society. The papers read have been numerous and important, the publication of the *Naturalist* has been maintained with its usual vigour, the annual course of Somerville lectures has been delivered to crowded audiences, considerable additions have been made to the library and museum, the number of members has increased, and the legislative grant and the increased amount of fees from members have much improved the financial position of the Society. Such details as are necessary under these heads may be stated as follows:—

PAPERS READ.

Since last annual meeting seventeen important papers have been read, all of which have been published in the *Canadian Naturalist and Geologist*, or are now in course of publication, and which have been noticed in detail in the address of the President.

Many other papers not read before the Society, especially a very valuable one by Mr. T. Sterry Hunt, and short notices on various subjects connected with Canadian Natural History, have been published. This Society may thus fairly take the credit of having been the medium through which in the past year many contributions of much importance have been made to Natural History and Geology.

PUBLICATION OF THE NATURALIST.

A very important movement in connection with the *Naturalist* is the employment of a portion of the Provincial grant to the Society in organising a system of exchanges with the leading scientific publications of Britain, America, and the continent of Europe. This will in the ensuing year publish more extensively than heretofore the matter contained in the *Naturalist*. It will afford a wider range of material for comment and selection; and will tend materially to the increase of the Library. It will also much extend the reputation of this Society and of Canadian Science in general; since wherever it is known, the *Naturalist* is now regarded as one of the most important representatives of Natural History on this continent.

While all the members of the Editing Committee have exerted themselves on behalf of the *Naturalist*, it is due to Mr. D. Allan Poe to state, that on him has fallen as heretofore the chief burden of editorial supervision, and that the Society is very much indebted to his exertions in this important part of its work.

MUSEUM AND LIBRARY.

The Reports of the Librarian and Curator and of the Library Committee have been submitted. The donations received have been numerous and valuable. The large collection of skins of birds and mammals presented by the Smithsonian Institution is especially deserving of notice, and will at an early meeting of the Society be made the subject of a special report by one of the members of Council. A very important contribution is also the deposit in our rooms through the kindness of Sir W. E. Logan, of a suite of specimens of the invertebrates recently collected by the Geological Survey. These are not a donation to the Society, but are placed in our rooms in order that they may be accessible to students, and that space may be made in the crowded apartments of the Geological Survey for its increasing collections of fossils. This is a gratifying proof of the public utility of the spacious Museum of this Society; and as the collection will be arranged for us by Mr. R. Bell, it will place within reach of the public, means of systematic study not previously enjoyed, in one leading branch of the Natural History of Canada, and will supply perhaps the greatest deficiency previously existing in our Museum.

It is due to Mr. Hunter, the cabinet keeper, to state that he has exerted himself most assiduously in the care of the collection, and also in preparing the numerous specimens presented to the Society.

PUBLIC LECTURES.

In pursuance of the requirement of the bequest of the late Rev. A. Somerville, the annual course of free lectures was opened on Thursday, February 21st, by an address on the objects and prospects of the Society, by the President, the Lord Bishop of Montreal. It consisted of the following lectures:—

1. By Principal Dawson, on the Aboriginal Antiquities of Montreal.

2. By the Rev. Dr. De Sola, on the Arts and Sciences of the Ancient Hebrews.

3. By Wm. H. Hingston, M.D., on the climate of Canada in its relation to life and health.

4. By Ed. Murphy, on the Microscope and Microscopic research.

5. By Alfred Rimmer, on Sea Birds and their habits.

6. By Dr. Wilkes, on Natural Heritage.

GENERAL AFFAIRS OF THE SOCIETY.

Twenty-eight ordinary members, and six corresponding members have been added to our number during the year.

The usual petition to the Legislature having been prepared, and the Recording Secretary having personally called on members of the Government therewith, the Council have much pleasure in reporting that the sum of $1,000 has been placed on the estimates as the annual grant to the Society.

The Treasurer's account appended to this report, shows a most gratifying condition of the financial affairs of the Society. The debt on the building has been reduced to an amount not greater than that on the old building of the Society, the liabilities having in the past year been reduced by $755.19. All the minor accounts have been paid, and there is a prospect that the Society may be able still further to reduce the permanent debt, as well as to carry on its operations with increased vigour.

For the better securing of this last object, the Council would recommend, as necessary to the Society in its present stage of advancement, and as warranted by its financial position, the appointment of some gentleman of scientific tastes and knowledge, as Assistant Secretary and Curator, with a small salary. The great services of Mr. D'Urban in this capacity, are fresh in the memory of the Society, and there are now among our members, several young naturalists of ability and high promise, who could very much benefit the Society and the cause of science, if enabled in this way, to devote a part of their time to its interests. It would be the duty of *such an officer* to prepare the programme of scientific business for each meeting, to write out the proceedings in a form suitable for publication, to determine and arrange specimens presented to the Society, to take measures for the increase of the collection and library, and generally to work out all the details of our scientific operations, which are now necessarily conducted in a very desultory manner. The Council would ask authority from the Society, to engage some person of the requisite zeal and scientific and business knowledge, as soon as possible, and at a rate of remuneration such as the resources of the Society could afford.

Signed, J. W. DAWSON,
Chairman of the Council.

THE NATURAL HISTORY SOCIETY OF MONTREAL IN ACCOUNT WITH JAMES FERRIER, JUNR., TREASURER.

RECAPITULATION.

1861.		Dr. $ cts.
	To balance due the Treasurer, May 1, 1860,.	126 78
May 1.—	" cash for salary to Mr. Hunter,...........	200 00
"	" " " C. McCormick, $30, and G. Appleton, $30, commissions,.....	60 00
"	" " " city assessment,...............	150 00
"	" " " gas and water rent,............	44 70
"	" " " fuel,..........................	125 97
"	" " " advertising and printing,........	260 06
"	" " " books and binding,............	41 46
"	" " " repairs and fixtures,...........	283 70
"	" " " interest,......................	482 50
"	" " " insurance,.....................	38 00
"	" " " incidental expenses,............	66 33
		$1884 00
	To balance due the Treasurer,........	173 25

RECAPITULATION.

1861.		Cr. $ cts.
May 1.—	By cash received from annual subscriptions and diplomas,................	557 00
"	" " received from Dr. Hingston for life membership,.................	50 00
"	" " received from admission fees to museum,......................	66 25
"	" " interest returned on loan paid before maturity,................	37 50
"	" " annual grant from government,...	1000 00
"	" balance due the Treasurer,..........	173 25
		$1884 00

E. & O. E.

JAMES FERRIER, JR.,
Treasurer, N. H. S.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF APRIL, 1861.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	30.508	30.288	30.200	10.4	29.2	26.1	.048	.123	.105	.69	.77	.75	N. E. by E.	N. E. by E.	N. E. by E.	225.40	3 0	....	....	Clear.	Cu. Str. 10.	Cirr. Str. 10. Snow.
2	162	159	220	26.2	34.0	26.1	.111	.170	.105	.86	.80	.80	N. E. by E.	N. E. by E.	N. E. by E.	224.70	5.0	....	7.23	Snow.	Snow.	Snow.
3	246	319	347	25.1	38.2	27.1	.117	.185	.111	.87	.80	.75	N. E. by E.	N. E. by E.	W. N. W.	52.80	3.0	....	1.10	Cu. Str. 10.	C. Cur St. 6.	Clear. Zod. light, bright.
4	280	108	212	15.4	53.4	31.9	.065	.321	.147	.74	.80	.80	S. W.	W. S. W	W. S. W.	2.60	2.0	....	....	Clear.	Clear.	" " "
5	190	173	347	23.7	57.6	33.4	.100	.236	.162	.79	.53	.84	N. E.	S. S. W.	N.W. by W.	61.00	2.0	....	....	"	"	" ft. Aurora Borealis.
6	260	387	332	27.1	56.1	33.2	.111	.282	.162	.75	.63	.86	S. E. by E.	S. E. by E.	S. W.	81.40	1.0	....	....	"	"	"
7	257	202	329	24.1	60.3	31.0	.105	.186	.110	.75	.51	.64	S. by W.	W. S. W.	W. by N.	85.10	2.0	....	....	"	"	" Aurora Borealis.
8	247	381	300	21.1	42.9	30.0	.080	.092	.136	.71	.34	.83	N. E. by E.	N. E. by E.	N. E. by E.	113.80	1.0	....	....	"	"	"
9	124	107	039	20.8	47.4	18.5	.069	.225	.180	.63	.70	.77	N. E. by E.	N. E. by E.	N. E. by E.	59.80	1.0	....	....	"	"	" ft. Aurora Borealis.
10	007	29.945	29.957	20.2	61.0	42.0	.089	.413	.162	.72	.77	.61	N.	N.	S. S. W.	0.10	1.0	....	....	"	"	Str. 2. Aurora Streamers.
11	008	30.006	30.101	30.0	54.6	36.5	.130	.231	.170	.78	.55	.80	N. E. by E.	E. S. E.	N. E. by E.	85.30	2.0	....	....	"	"	Clear. ft. Aurora Borealis.
12	020	29.920	29.874	27.2	52 8	45.0	.111	.276	.251	.75	.70	.84	N. E. by E.	S. by E.	S. S, E.	98.90	3.5	Inapp.	....	Cu. Str. 2.	C. C. Str. 10.	Cirr Str. 10.
13	29.714	474	511	42.1	52.1	44.6	.244	.361	.265	.91	.93	.91	S. E. by E.	S. E. by E.	S. S. W.	88.50	4.5	0.831	....	Rain.	Rain.	Fog.
14	397	411	647	40.3	47.6	36.7	.241	.249	.184	.96	.77	.85	S. E. by E.	S. E. by E.	W. S. W.	151.20	3.5	Inapp.	....	Fog.	Cu. Str. 10.	Cirr Str. 10
15	747	740	914	31.6	40.9	32.4	.149	.145	.143	.84	.60	.79	W. by S.	W. S. W.	W. S. W.	209.80	2 0	....	....	C. C. Str. 10.	" 3.	Clear. Aurora Borealis.
16	934	879	790	26.9	40.3	33.3	.093	.145	.162	.64	.60	.84	N. E. by E.	N. E. by E.	N. E. by E.	134.00	2.5	....	....	Clear.	Cu. Str. 10.	Cu. Str. 10.
17	245	247	127	30.4	34.2	32.7	.130	.175	.156	.78	.89	.85	N. E. by E.	N. E. by E.	N.W. by N.	540.80	4.0	....	3.35	Snow.	Snow	C. C. Str. 8.
18	364	531	467	26.4	40.1	35.0	.105	.208	.162	.78	.82	.80	W. S. W.	S. W.	S. W.	174.70	2 0	....	....	Clear.	C. C. Str. 4.	" 4.
19	550	612	739	33.4	45.8	32.9	.144	.204	.137	.78	.68	.74	N. N. W.	W. S W.	W. S. W.	28.40	3.0	....	....	"	" 10.	Clear.
20	814	900	801	31.7	52.1	39.2	.139	.251	.195	.74	.63	.82	W. by E.	W. S. W.	W. S. W,	29.70	3.0	....	....	C. C. Str. 8.	Clear.	Cu. Str. 10.
21	779	879	931	35.4	51.7	41.2	.162	.252	.197	.80	.68	.79	W. S. W.	W. N. W.	W. S. W.	132.90	2.0	....	....	Clear.	Clear. Solar Halo.	Str. 2.
22	871	771	731	38.2	42.2	43.0	.206	.206	.261	.90	.78	.96	E. by N.	N. E. by E.	N. E. by E.	49.20	3.5	0.120	....	Cu. Str. 10.	Cu. Str. 10.	Rain.
23	741	791	879	41.9	53.0	46.7	.228	.355	.286	.87	.84	.92	S. E.	S. W.	E. N. E.	46.40	4 0	0.014	....	" 10.	C. C. Str. 10.	C. C. Str. 10.
24	687	601	647	40.0	46.6	44.2	.210	.280	.225	.89	.88	.80	N. E. by E.	N. E. by E.	S.	75.40	3.5	0.160	....	Rain.	Rain.	Cirr Str. 10.
25	517	674	967	40.1	48.2	41.0	.215	.242	.212	.91	.74	.82	W. S. W.	W.	W. by W.	229 80	2.0	....	....	Clear.	Cu Str. 4.	" 8.
26	900	924	30.000	40.1	58.2	44.1	.203	.309	.265	.82	.64	.92	W. by N.	W. by N.	S. S. W.	92.20	1.5	....	....	C. C. Str. 6.	Clear.	Str. 2.
27	900	742	29.667	35.7	58.7	39.2	.138	.372	.195	.76	.78	.82	N. E. by E.	N. E. by E.	N. E. by E.	181.50	3.0	....	....	" 8.	Cu. Str. 9.	Cu. Str. 9.
28	412	394	514	38.4	85.0	46.3	.165	.355	.305	.72	.84	.96	N. E. by E.	E, S. E.	S.	227.60	3.5	0.836	....	" 4.	Rain.	Rain.
29	711	700	710	43.0	65.7	52.0	.215	.396	.308	.79	.65	.79	W.	S.	S. S. E.	43.70	3.0	0.250	....	" 8.	Clear.	Clear. Comet visible.
30	747	640	689	43.0	49.0	45.4	.254	.303	.269	.92	.89	.88	N. by W.	E. S. E.	W. N. W.	50.60	3.5	0.710	....	" 10.	Rain.	Rain.
...	.....	......	......	......	......	......	......	......	......	....	....	....	......	......	......	....	....	....	....	....	....	....

REPORT FOR THE MONTH OF MAY, 1861.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &C., &C. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2. p. m.	10 p. m.
1	29.651	29.752	29.950	35.3	46.0	33.0	.149	.192	.131	.74	.62	.70	N. N. W.	N. W.	N. W.	205.40	2.5	Inapp.	....	Clear.	Clear.	Clear. Frost.
2	937	897	923	24.2	42.9	33.0	.096	.171	.156	.73	.62	.85	W. N. W.	W. S. W.	W.	223.60	1.0	....	....	" Frost.	"	"
3	979	920	900	29.0	46.7	38.9	.128	.208	.180	.77	.66	.77	N. by W.	S. S. W.	S S. W.	100.50	2.0	....	....	"	"	"
4	902	907	910	33.1	52.4	44.7	.156	.282	.234	.85	.73	.80	S. by E.	S. S. E.	S. S. E.	60.30	1.5	....	....	"	"	" ft. Aurora Borealis.
5	897	729	914	39.1	67.0	50.8	.180	.470	.258	.77	.73	.71	S. W.	S.	S.	154.00	1.5	....	....	"	"	"
6	716	576	482	39.0	60.0	48.1	.180	.433	.291	.77	.85	.80	N. N. E.	E. by S.	E. N. E.	138.90	2.0	....	....	Cu. Str. 4.	C. C. Str. 6.	Rain.
7	28.900	174	160	50 9	55.1	49.1	.283	.375	.322	.78	.63	.92	S. by W.	S. W.	S. W.	437.40	3.5	2.242	....	" 6.	" 10.	Cirr Str. 10.
8	29.263	380	480	47.0	57.0	48.3	.280	.208	.200	.88	.69	.78	W. S. W.	S. S. W.	N. W.	284.10	3.5	0.016	....	C. C. Str. 6.	Cu Str. 6.	" 10.
9	671	714	766	44.4	60.0	50.0	.218	.261	.265	.76	.51	.75	W. by N.	S. W.	S. W.	105.00	1.0	....	....	" 8.	" 2.	" 8.
10	770	714	591	45.2	65.9	52.1	.234	.265	.264	.80	.42	.69	S. S. W.	S. E.	E. S. E.	114.50	1.0	....	....	Clear.	Clear.	Clear.
11	554	689	689	46.0	65.9	56.0	.221	.359	.336	.72	.58	.75	N. E. by E.	S. S. E.	S. S. W.	53.70	2.5	....	....	C. C. Str. 8.	C. C. Str. 10.	C. C. Str. 9.
12	698	750	839	54.0	63.7	55.0	.277	.392	.349	.75	.69	.81	N. E. by E.	N. E. by E.	S. S. W.	29.70	3.0	0.160	....	Rain.	Cirr. 4. Solar Halo.	Clear.
13	853	708	642	45.1	67.9	54.2	.251	.362	.362	.84	.55	.87	N. E. by E.	S E.	S. S. E.	178.70	2.5	Inapp.	....	Clear.	C. C. Str. 8.	Cu. Str. 8.
14	556	520	503	51.0	58.1	53.7	.348	.469	.269	.95	.94	.90	S. S. E.	S. S. W.	S. W.	230.90	3.0	0.820	....	Rain.	Rain.	" 10.
15	643	679	701	47.5	58.0	53.2	.291	.265	.321	.89	.76	.80	W. by S.	S. S. W.	S. S. E.	0.30	2.0	....	....	Cu. Str. 10.	Clear.	Clear.
16	509	478	618	48.8	58.4	48.5	.302	.337	.285	.82	.70	.85	S. S. W.	W. S. W.	S. S. W.	232.40	2.0	0.262	....	Rain.	C. C. Str. 4.	Cum Str. 8.
17	659	748	929	39.8	51.7	50.0	.201	.302	.272	.86	.32	.78	W. S. W.	W.	W. N. W.	551.00	3.0	0.100	....	"	Cu Str. 9.	" 4.
18	896	946	30.010	44.1	51.3	48.3	.224	.252	.285	.79	.68	.85	W.	W. by N.	N. N. W.	250.70	2.5	Inapp.	....	Cu. Str. 10.	C. C. Str. 6. Solar Halo	" 9.
19	30.009	980	29.904	43.1	68.7	52.5	.245	.509	.264	.92	.75	.69	W.	S. S. W.	S. W.	90.70	2.0	....	....	Clear.	" 4.	" 8.
20	29.857	820	862	44.3	64.2	81.8	.248	.285	.296	.88	.48	.79	S. W.	N. N. E.	N. N. E.	59.40	2.0	....	....	"	" 8.	" 4.
21	902	857	882	48 6	58.1	52.2	.285	.365	.334	.85	.76	.86	N. by E.	S. W.	W. S. W.	145.80	2.5	Inapp.	....	Cirr. 8.	Cu Str. 10.	Clear.
22	950	990	960	45.0	67.0	56.2	.251	.340	.315	.84	.52	.71	N. E. by E.	W. N. W.	W. by S.	67.80	2.5	....	....	" 4.	Clear.	"
23	30.102	30.100	30.026	51.0	77.1	61.2	.277	.492	.413	.75	.53	.77	W.	W. S. W.	S. W.	60.70	2.0	....	....	Clear.	"	C. C. Str. 9.
24	29.970	29.821	29.757	55 3	72.0	61.0	.349	.489	.433	.81	.62	.85	W. S. W.	S. S. E.	S. S. E.	184.20	2.5	Inapp.	....	"	Cu Str. 10.	Cu. Str. 4.
25	505	476	537	54.2	70.2	60.8	.390	.516	.338	.93	.70	.65	S. S. E.	S. W.	S. S. W.	93.90	3.5	0.360	....	Cu. Str. 10.	C. C. Str. 4.	" 4.
26	524	500	405	60.0	74.2	60.3	.396	.412	.403	.76	.55	.79	W.S. W.	W.	S. S. W.	47.40	2 0	....	....	Cir Cum.St. 4.	" 4.	" 4.
27	122	28.883	28.938	84.4	56.0	49.5	.383	.427	.315	.90	.97	.89	S. S. E.	N. E. by E.	S. S W	152.30	3.5	2.986	....	Rain.	Rain.	Showers.
28	256	29.432	29.654	[illegible]	57.0	44.2	.265	.413	.282	.92	.90	.98	S. W.	W. N. W.	W.	230.30	5.0	1.360	....	"	"	"
29	744	739	909	46.7	55.0	49.0	.305	.390	.285	.96	.93	.85	W.	W. N. W.	W.	221.70	4.0	0.436	....	Cu. Str. 10.	Cirr Str 4.	Clear.
30	30.006	963	30.155	46.1	71.0	57.2	.269	.378	.302	.88	.51	.66	W.	W. S. W.	W. S. W.	237.60	2.0	....	....	Cirr. 2.	Clear.	"
31	232	30.102	027	51.0	68.9	48.2	.258	.536	.242	.71	.77	.74	W. S. W.	W. S. W.	S. W.	242.20	2.0	....	....	Clear.	"	"

REMARKS FOR APRIL, 1860.

Barometer……
- Highest, the 1st day, 30·508 inches.
- Lowest, the 17th day, 29.127 "
- Monthly Mean, 29.882 "
- " Range, 1 381 "

Thermometer…
- Highest, the 29th day, 65°7.
- Lowest, the 1st day,—10°4.
- Monthly Mean, 38°99.
- Monthly Range, 55°3.

Greatest intensity of the Sun's rays, 77°3.
Lowest point of Terrestrial radiation,—9°1.
Mean of Humidity, .780.
Rain fell on 9 days, amounting to 2.921 inches; it was raining 60 hours and 42 minutes, and was accompanied by distant thunder on 1 day.
Snow fell on 3 days, amounting to 11·68 inches; it was snowing 46 hours and 35 minutes.
Most prevalent wind, the N. E. by E.
Least prevalent wind, the N.
Most windy day the 17th day, mean miles per hour, 22.53.
Least windy day the 10th day, mean miles per hour, 0.40.
Aurora Borealis visible on 7 nights.
Zodiacal Light bright.
The Electrical state of the Atmosphere has indicated moderate intensity.
Swallow *Hirundo Bicolor*, first seen 23rd day.
Frogs *Rana fontinalis*, first heard 24th day.
Wild Geese *Anser Canadiensis*, first seen passing N. W. 23rd day.
Song Sparrow *Frangilla Melodia*, first heard 4th day.
Thatcher's Comet seen 29th.

REMARKS FOR MAY, 1861.

Barometer. ……
- Highest, the 31st day, 30.232 inches.
- Lowest, the 27th day, 28.883 "
- Monthly Mean, 29.721 "
- Monthly Range, 1·349 "

Thermometer.
- Highest, the 26th day, 74°2.
- Lowest, the 2nd day,—21°3.
- Monthly Mean, 51°86.
- Monthly Range, 42°9.

Greatest intensity of the Sun's rays, 85°0.
Lowest point of terrestrial radiation,—19°3.
Mean of humidity, ·770.
Rain fell on 15 days, amounting to 8 342 inches, it was raining 49 hours, 32 minutes, and was accompanied by thunder on 1st day.
Most prevalent wind, W. S. W.
Least prevalent wind, N. N. W.
Most windy day, the 7th day; mean miles per hour, 18.22.
Least windy day, the 15th day; mean miles per hour, 0.01.
2 Solar Haloes were visible.
Aurora Borealis visible on 1 night.
The Electrical state of the Atmosphere has indicated feeble intensity.
Shad *Alosa Prostabilis*, first caught 30th day.
Amount of evaporation, 2·93 inches.

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