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THE

CANADIAN

NATURALIST AND GEOLOGIST.

VOLUME III. JUNE, 1858. NUMBER 3

ARTICLE XVI.—*Note upon the Genus Graptolithus*, and description of some remarkable new forms from the shales of the Hudson River Group, discovered in the investigations of the Geological Survey of Canada, under the direction of Sir W. E. Logan, F.R.S. By James Hall.

(*Continued from our last.*)

GRAPTOLITHUS HEADI.

Description.—Frond robust, four-branched; disk large, subquadrangular, moderately extended along the branches; branches strong, much elongated, sub-angular exteriorly; serratures small, acute, from twenty-two to twenty-four in an inch; fine distinctly marked striæ extend from the base of the serratures nearly across the branch.

The specimen described presents the disk, which in its diameter across the centre between the branches is nearly one inch and an eighth, or nine-sixteenths of an inch on each side of the centre; while from the centre to its extent along the branches it varies from about three-fourths of an inch in one branch to an inch in another. The substance of the disk is strong and somewhat rugose, either from its original character or from the accidents accompanying its imbedding in the rock. The specimen exhibits the inner or serrated side, and the branches are turned so as to be compressed laterally at a distance of two inches or more from the centre; one of the branches presents a length of nearly seven inches from the centre. This species is named after its discover, Mr. John Head.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—Mr. John Head, and Sir W. E. Logan.

Graptolithus alatus.

Description.—Frond composed of four branches; disk much extended along the sides of the branches, giving them an extremely alate character; branches strong, angular on the lower side; upper or serrated side unknown. Some indentations on the exterior side of the branches, which may indicate the place of serratures on the opposite side are about one twenty-fourth of an inch distant.

The only specimen of this species yet recognized is a part of the disk with three of the branches, two of which present the corneous expansion apparently entire, extending about two inches from the centre along the branches, while its margin in the indentation between the branches is not more than three eighths of an inch from the centre. This species is much more robust than *G. quadribrachiatus* or *G. bryonoides*, and the form of the disk when preserved will always be a distinguishing feature.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—Mr. John Head, and Sir W. E. Logan.

Graptolithus fruticosus.

Description.—Branches bifurcating from a long slender filiform radicle, and each division again bifurcating at a short distance above the first; branches and branchlets short, narrow linear; serratures apparently commencing in the lower axil, where there are one or two between the first and second bifurcations. Serratures somewhat obtuse at the tip; lower side longer, upper margin nearly at right angles to the rachis; about sixteen serratures in the space of an inch. Substance of the branches thin, fragile.

In one specimen the position of the serratures is such as to present elongate acute apices in one of the branches.

This species has the general habit of *G. nitidus* and *G. bryonoides*, but is very distinct in its long slender radicle, narrow fragile branches, and distant, obtuse serrations. Two individuals only have been obtained, but the form and habit are so precisely alike, and so distinctive in both of these, as to mark it a very well characterised species.

Locality and Formation.—Island of Orleans; Hudson River Group.

Collectors.—J. Richardson, and E. Billings.

GRAPTOLITHUS INDENTUS.

Description.—Fronds consisting of two simple branches, diverging at the base from a slender radicle, and continuing above in a nearly parallel direction: branches narrow, slender; serratures very oblique, somewhat obtuse, truncated above almost rectangularly to the line of the rachis; about twenty-four in the space of an inch; a depressed line reaching from the serrature to near the base or outer margin of the branch where it terminates in a small node; surface of branches striate.

This species resembles the *G. nitidus* in form, except that it is less divergent, the divergence from the base being at an angle of about thirty-six degrees for half an inch or more, after which the two branches continue nearly parallel. Though it is probable that this character may vary in some degree, it seems nevertheless to mark the species, and in numerous individuals of *G. nitidus* I have seen none with parallel or converging branches. The serratures in the two species differ in some degree in form, and the proportional distances, thirty-two and twenty-four, form a very characteristic distinction. A single fragment of a branch measures six inches, but the full extent when perfect is not known.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—Sir W. E. Logan, and James Hall.

GRAPTOLITHUS NITIDUS.

Description.—Frond composed of two simple branches, diverging from a small radicle; branches narrower towards the base, gradually expanding towards the extremities, which in perfect specimens appear to be rounded, and the last serrations a little shortened; serratures small, shorter at the base, and becoming gradually developed as they recede from this point; acute at the extremities, almost vertical to the line of the rachis, and making an angle of about sixty degrees, the two sides being almost equal in length; about thirty-two in the space of an inch. A well-defined groove or depressed line extends from the base of the serrature obliquely towards the base of the branch, and at its termination the surface of the branch is marked by a minute but distinct round tubercle.

This beautiful little species differs very distinctly from any others of this genus, in the thickened substance of its branches, the closely arranged serratures, and the minute tubercles at the base of the grooves or striæ. The specimens usually preserve considerable substance, and are far less flattened than most of the other species, owing either to their original character or to the nature of the surrounding matrix. The impressions of the oblique lines or striæ are often well preserved in imprints of the fossil left in the slate.

The impressions of *G. bryonoides* resemble those of this species; but the branches are broader, and the striæ are less rigid and less distinctly impressed, while the absence of tubercles, and the coarser serratures, when visible, at once serve to distinguish the species.

In mode of growth and general aspect this species resembles the *G. serratulus* (Pal. N. Y., vol. 1, p. 274, pl. 74, fig. 5, a, b.) of the Hudson River shales; but in the latter the serratures are coarser and more oblique, the lower side being much the longer. The branches of that species are also more distinctly linear, while in this they become gradually wider from the base, and are very distinctly striate and tuberculate in well-preserved specimens.

The preceding description applies to the specimens of this species where the branches diverge abruptly, or nearly at a right angle, from the radicle.

Locality and Formation.—Point Lévy, Hudson River Group.

Collector.—J. Richardson.

Graptolithus bifidus.

Description.—Two-branched; branches very gradually and uniformly diverging from the base to the extremities; surfaces obliquely striated; serratures moderately oblique; extremities often nearly vertical to the rachis, and submucronate (?); from thirty-eight to forty in the space of an inch; radicle short.

This species resembles in general features the *G. nitidus*, and might be mistaken for that species with the branches approximated by pressure. In several individuals examined the serratures are much closer, being from six to eight more in the space of an inch, while the general form is constant. The outer margins of the branches are curved for a short distance from the radicle, and thence proceed in a uniform divergent line. The entire branch is very narrow at the base, but becomes gradually wider, the full width being attained at about half an inch from the bifurcation, while a few of the serratures towards the outer extremity, not having attained their full development, leave the branches narrower in that part. The same feature is observed in *G. nitidus* and others of this general character. and probably may be observed in all species where the extremities of the branches are entire.

Locality and Formation.—Point Lévy ; Hudson River Group.

Collectors.—J, Richardson, E. Billings.

Graptolithus patulus.

Description.—Frond composed of two simple widely diverging branches from a small radicle; branches long-linear, having a width from the base of the serratures to the back of the branch of from one-sixteenth to one-twelfth of an inch; serratures oblique, with vertical mucronate points, which from base to apex are more than half as wide as the branch. A well-defined line or ridge extends downwards from the apex of the denticle two-thirds across the branch.

Fragments of this species are numerous upon some slabs of greenish or blackish-green slate where no other species occurs. The fragments are sometimes five or six inches in length, offering in different individuals little variation in width. Sometimes the branches are compressed vertically, and present the smooth, linear base or exterior, which is less in width than when compressed laterally.

The lateral faces of the branches exhibit considerable variety of surface, dependant on the degree of compression, or in some instances, the replacement or filling of the interior by iron pyrites. In such cases, or when the branch is not flattened, the surface is deeply striated, or wrinkled obliquely. In some of the extremely compressed individuals the surface has some appearance of vesicular structure; but this is probably due to influences attending the mineralization of the fossil, or the filling up of the original canal, and not to the structure of the substance itself.

Locality and Formation.—Point Lévy, Hudson River Group.

Collectors.—J. Richardson, E. Billings.

GRAPTOLITHUS EXTENSUS.

Frond probably two-branched ; branches long-linear, varying in width in different individuals from one-twelfth to one-tenth of an inch exclusive of the serratures, and from one-tenth to one-eighth of an inch including the serratures. Serratures oblique, with the extremities slender and nearly erect, mucronate at the tip ; about twenty in the space of an inch ; base of branch scarcely narrowed, showing a few smaller serratures ; surface strongly striated, the striæ being preserved in those specimens which are extremely compressed.

The branches of this species bear a very close resemblance to those of *G. octobrachiatus*, but an individual in which the base is preserved shows in its peculiar curving and smaller serratures a feature which belongs only to the two-branched forms. The serratures also appear to be more slender, and are slightly closer in their arrangement ; branches of the same size in the two, presenting respectively eighteen and twenty serratures.

This species in separate branches of from three to six or eight inches in length, is abundant on some slabs of decomposing grayish-brown shale, associated with *G. bryonoides*, *G. nitidus*, and others.

Locality and Formation.—Point Lévy ; Hudson River Group.

Collectors.—J. Richardson, E. Billings, Sir W. E. Logan, James Hall.

GRAPTOLITHUS DENTICULATUS.

Description.—Frond apparently consisting of two broad branches (the base and junction of which are obscure in the specimen ;) margins defined by a rigid line, beyond which on the inner side are serratures which have the form and character of small denticulations inserted upon the margin of the branch and vertical to its direction, broad at base, abruptly tapering above, and ending in mucronate points ; about sixteen in the space of an inch.

This very peculiar species is readily recognised by the denticulations, which have the character of small sharp teeth fixed upon the margin of the branch. These denticles are more widely separated, as well as different in character, from those of any other species observed.

Locality and Formation.—Point Lévy, Hudson River Group.

Collectors.—Sir W. E. Logan, James Hall.

Graptolithus pristiniformis.

Description.—Stipe simple, with serratures on both sides; serratures closely arranged, very oblique, acute, mucronate; thirty-two in the space of an inch.

This species approaches to *G. pristis* (Pal. N.Y., vol I., p. 265, pl. 72, fig. 1), but the serratures are more ascending, and the extremities more distinctly mucronate. The specimens observed however, are imperfect fragments, which are very closely compressed, being barely a film upon the surface of the shale, and the determination is somewhat unsatisfactory.

Locality and Formation.—Point Lévy; Hudson River Group.

Collector.—J. Richardson.

Graptolithus ensiformis.

(*Genus* Retiolites? Barrande.)

Description.—Stipe simple, sub-ensiform or elongate-spatulate, usually broader in the middle and narrower towards the extremities; a central rib, with strongly marked obliquely ascending striæ which reach the margins; serratures obscure, apparently corresponding to the striæ; margin usually well defined.

Several specimens of this form occur on a single slab of slate, associated with *G. tenaculatus* and *G. quardribrachiatus.* The oblique striæ apparently indicate the direction of the serratures, and in one specimen there is an appearance of obtuse indentations upon the margin; but it is scarcely possible at the present time to define satisfactorily the character of these serratures. In form and general character this species differs from all the others sufficiently to be readily distinguished.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—J. Richardson, Sir W. E. Logan, James Hall.

Graptolithus tentaculatus.

(*Gensus* Retiolites, Barrande.)

Description.—Stipe simple, linear, elongate-lanceolate or sometimes elongate-ellipticle when entire; mid-rib double, extending much beyond the apex of the frond; exterior margins when entire, reticulate and armed with mucronate points, (and with mucronate points alone, or smooth, when imperfect,) with an extended setiform tentacle-like process from each side of the basal extremity; substance of the centre reticulate or cellular?

This species presents much variety of appearance dependant upon the condition of preservation. In specimens most nearly entire, the double midrib often extends beyond the apex nearly as far as the length of the frond ; the margins present a series of oval or sub-hexagonal reticulations, every second one (and sometimes each one,) of which is armed by a minute mucronate spinule. When these outer cells or reticulations are broken away, the transverse walls between them often remain, and the specimens then present an undulating margin, with a short mucronate extension, which is the original wall between the marginal reticulations, and which is continuous with the striæ or fibres which traverse the frond from the midrib to the margins. On each side of the basal extremity the long setiform fibres extend obliquely forward to the distance of half an inch, and between these are two short terminal ones, like the processes on the sides of the frond.

In many specimens the whole exterior reticulate portion is removed, leaving the frond with straight or nearly straight parallel sides, the long extended midrib above, and the two setiform processes from the lower extremity ; while in some specimens these parts are also removed. The serratures cannot well be determined in any of the numerous individuals examined, but they doubtless correspond to the vein-like markings of the centre, and the reticulate marginal extension.

Some specimens indicate that the central portion may be finely reticulate, which character, with that of the exterior, would be regarded as sufficient to warrant us in referring it to the genus *Retiolites.*

Locality and Formation.—Point Lévy ; Hudson River Group.

Collectors.—J. Richardson, Sir W. E. Logan, James Hall.

PHYLLOGRAPTUS.

Among the various forms in this Canadian collection of *Graptolitideæ* there are several which approach in general form to *G. ovatus* of Barrande, and *G. folium* of Hisinger. They present however some differences of character, varying from broad-oval with the extremities nearly equal, to elongate oval or ovate, the apex usually the narrower, but in a few instances the base is narrower than the apex. These forms are sometimes extremely numerous in the shales, and present on a cursory examination a general similarity to the leaves of large species of *Neuropteris* in the shales of the coal measures.

Instead of the narrow filiform mid-rib represented in the figures and descriptions of the authors mentioned, these specimens present a broad linear mid-rib continued from the apex to the base, and extended beyond the base in a slender filiform radicle, usually of no great extent, but in some instances nearly half an inch in length. The mid-rib is rarely smooth, varying in width, with its margins not often strictly defined. In examining a great number of individuals of one species, I have discovered that this mid-rib is serrated ; and though for the most part the serratures are obscure, they nevertheless present all the characteristics which they exhibit in graptolites of other forms, in which the branches have been compressed vertically to the direction of the serratures.

In this view, the lateral leaf-like portions appear to be appendages to the central serrated portion; but these are nevertheless denticulate on their margins, and the intermediate spaces are well-defined, as if admitting of no communication by serratures or cellular openings with the centre.

In another species the central axis or mid-rib is strong and broad, often prominent and distinctly serrate, the edges of the interspaces being all broken off as if the extremities had been left in the slate cleaved from the surface. At the same time the lateral portions are so well preserved as to show distinct cellules upon each side. We have therefore three ranges of cells visible, the central axis projecting at right angles to the two lateral parts. This remarkable feature leads to the interference that this graptolite was composed of four semi-elliptical parts joined at their straight sides, and projecting rectangularly to each other, presenting on each of the four margins a series of serratures, which penetrating towards the centre, were all united in a common canal, and all sustained upon a simple radicle.

In another more elongate form, the specimens examined are extremely compressed, and I have not been able to detect serratures in the axis, which however is sufficiently wide to admit of this feature.

For these remarkable forms, whether consisting of bilateral or quadrilateral foliate expansions, or with two or four series of cellules, I propose the name of PHYLLOGRAPTUS, from their leaf-like appearance when compressed in the slaty strata.

It is easy to perceive how bodies formed as these are may present different appearances, dependant upon the line of separation of the parts by the slaty luminœ. When separated longitudinally through the centre. the cells of the parts laterally compressed, would be seen with the mid-rib not strictly defined; and the bases of the cells of that part vertically compressed, scarcely or not at all visible. When a small portion of the base of that part which is vertically compressed is preserved, the bases of the cells remain and mark the axis. When instead of being imbedded so that two parallel sides are compressed laterally and the other vertically, the whole frond lies in an oblique position, the two adjacent rectangular parts are spread open and flattened upon the surface of the slate, the specimen then appears as if the cells were conjoined at their bases, or as if separated by a filiform mid-rib. An individual compressed in this manner and then separated through the middle, will present the bases of the two adjacent divisions with the cells lying obliquely to the plane of the slaty laminæ. These and other varieties of appearance are due to the position in which the fossil was imbedded, and the direction of the cleavage or lamination of the slate.

Phyllograptus. (New Genus.)

Description.—Frond consisting of simple foliate expansions, celluliferous or serrated upon the two opposite sides; margins with a mucronate extension from each cellule; or of similar foliate forms united rectangularly by their longitudinal axes, and furnished on their outer margins with similar cellules or serratures, the whole supported on a slender radicle.

These bodies which usually appear upon the stone in the form of simple leaf-like expansions, may possibly have been attached in groups to some other support; but the form of some of them, and the character of the projecting radicle at the base, indicates that we have the entire frond. These forms furnish perhaps the best illustration of all the *Graptolitideæ*, of the lesser development of the cells at the base, and their gradual expansion above, until they reach the middle or upper part of the frond. Many of them diminish from the centre upwards, and rarely the cells are more developed above the centre, reversing the usual form, and leaving the narrower part at the base.

Phyllograptus typus.

Description.—Frond elliptical, elongate-ovate or lanceolate, broad-oval or obovate; margins ornamented by mucronate points; serratures closely arranged, about twenty-four, rarely twenty-two and sometimes twenty-six in an inch, usually obscure at the margins; axis or mid-rib broad, often crenulate or serrate; radicle usually short; frond robust.

This species assumes considerable variety of form; and from the examination of a few specimens of the extremes of the series one might be disposed to regard them as distinct species. After examining several hundred individuals however, I have not been able to find reliable characters in the form, or subordinate parts, to establish specific differences. The individuals figured represent the principal varieties noticed, though a greater number of forms might have been given. I have not thus far observed forms intermediate between the short broad ones and the more elongate oval ones; but it is not probable that larger collections will furnish such. The number of serratures in entire fronds varies in different individuals from twenty-five or twenty-eight to fifty on each side, depending on the size and form of the specimen. The smallest examined have about twenty-five on each side.

The specimens of this species examined are all so much compressed that the rectangular arrangement of the parts of the frond, as seen in *P. ilicifolius*, cannot be shown, the only evidence of this character being the serratures along the central axis, which are transverse to those of the two sides.

Locality and Formation.—Point Lévy; Hudson River Group

Collector.—J. Richardson.

PHYLLOGRAPTUS ILICIFOLIUS.

Description.—Frond apparently broadly oval or ovate, with the margin ornamented by mucronate points; mid-rib or axis broad, serrated; the extension of the serratures broken off in the separated laminæ of shale; radicle short. Serratures from thirty to thirty-two in the space of an inch, varying slightly with the proportionate length of the frond.

The form in reality however is that of two broadly oval or ovate leaves or fronds, joined rectangularly at their centres or by the longitudinal axis, and in a transverse section presenting a regular cruciform figure. The expansions of the two sides, which are laterally compressed, show distinct serratures or cells with projecting mucronate extensions. Those which are vertically compressed have their outer portions broken off in the separated laminæ of slate, and present the bases of the cells, which, having sometimes been filled and distended with mineral matter before imbedding, are very conspicuous. In a few instances the cells of the lateral portions are filled in the same manner, presenting the character of curving, conical tubes, with the broader extremity outwards.

The condition of preservation in several species examined is such as to render unavoidable any other conclusion as to their mode of growth than the one I have given above, however anomalous it may seem. This species differs from *P. typus* in its thicker substance, proportionally shorter and broader form, and more closely arranged serratures.

Locality and Formation.—Point Lêvy; Hudson River Group.

Collector.—J. Richardson.

PHYLLOGRAPTUS ANGUSTIFOLIUS.

Description.—Frond elongate-elliptical or elongate-lanceolate, closely serrated; serratures furnished with mucronate extensions, about twenty-four in the space of an inch; mid-rib broad, smooth; radicle scarcely preserved.

This species is readily distinguished from either of the preceding by its narrow and elongate form. The individuals examined are very numerous, but being for the most part upon slaty laminæ, which are extremely compressed, they preserve scarcely any substance; a mere outline with a more brilliant surface being almost the only remaining character by which they are recognized.

The individuals of this species are, in several specimens, equally abundant with those of *Phyllograptus typus.* The mucronate extensions upon the margins of this species are not so abrupt as in *P. typus* and *P. ilicifolius*, the substance of the cell margin being more extended along the mucronation. The number of serratures upon each side of the frond varies according to the size of the individual, being ordinarily from eleven or twelve to twenty-four, while in a single individual of nearly two inches in length there are forty-three or forty-four on each side. The mid-rib in this species though broad, like those of the preceding species, is not conspicuously serrate in any of the specimens examined. This feature however may have been obliterated by pressure.

Locality and Formation.—Point Lèvy; Hudson River Group.

Collector.—J. Richardson.

PHYLLOGRAPTUS SIMILIS.

Description.—Frond broad-oval; margins ornamented by slender, sub-mucronate serratures, which are closely arranged, being in the proportion of thirty-two to an inch, usually from thirteen to sixteen upon each side ; axis disjoined ; radicle unknown.

This species exhibits much variety of aspect. The more perfect forms are broadly oval, the diameters being about as six to seven. The central portion is open and free from any organic substance, as if there had originally been a cavity in the place of the longitudinal axis. In other specimens the parts are separated at one extremity, and appear like three or four branches closely joined at the other extremity, giving it the aspect of a four-branched frond. On examining numerous specimens they appear to have been originally arranged like the species of this genus already described, with perhaps this difference, that the margins of the axial portion were not closely united, or were quite disjoined along the centre. From the equal extremities of the frond, and the almost rectangular serratures, conjoined with the very obscure condition of the specimens, it has not been possible to determine whether the separation of the parts at the extremities has taken place at the base or the summit.

This species occurs associated with *G. Logani* and *G. quadribrachiatus.*

Locality and Formation.—Point Lévy ; Hudson River Group.

Collectors.—Sir W. E. Logan and James Hall.

Besides the forms described in the preceding pages, there are several others belonging to the genus *Graptolithus*, of which I have not specimens in sufficient perfection to furnish a proper description ; and there are others which, possessing some abnormal characters, I hesitate to describe as distinct species, until I shall have an opportunity of seeing more specimens. One of these, having the general character of *G. octobrachatus*, has but seven branchlets, three from one extremity of the vinculum and four from the outer, bifurcating as in the species named above. The branches, however, are more slender than in *G. octobrachiatus*, and it may prove to be a distinct species.

Another form having the general habit of *G. Logani* has but nine branchlets, four from one and five from the other side of the vincolum. The exterior side only is visible, and the branches being broken off a short distance from the vinculum, no opportunity is offered of examining the serratures. It seems quite probable that this may prove a distinct species.

A single fragment of a ramose form, with two branches like *G. ramosus*, of New York, has been observed, but I have not thought it desirable to give its characters at present.

Among other forms of the *Graptolitideæ*, there are at least three species of *Dictyonema*, which are of common occurrence, associated with the Graptolites of Point Lévy.

The genus *Dictyonema* was described in the Palæontology of New York, vol. 2, p. 174, from an examination of the broad flabelliform or sub-circular expansions of corneous reticulated fronds common in the shales of the Niagara group. These forms were described as having "the appearance and texture of Graptolites, to which they were doubtless closely allied," Further examinations have demonstrated the truth of this remark in the discovery of serratures, like those of *Graptolithus*, on the inner side of the branchlets of both *D. retiformis* and *D. gracilis*. The celluliferous side adhering more closely to the stone than the opposite, as in *Ratepora* and *Fenestella*, is much more rarely seen than the other. The mode of growth, though probably flabelliform in some species, is clearly funnel shaped in *D. retiformis*, the serratures being upon the inner side as in *Fenestella*.

The generic characters heretofore given may therefore be extended as follows.

DICTYONEMA.

Generic characters.—Frond consisting of flabelliform or funnel-shaped expansions, (circular from compression) composed of slender radiating branches, which frequently bifurcate as they recede from the base; branches and subdivisions united laterally by fine transverse dissepiments; exterior of branches strongly striated and often deeply indented; inner surface celluliferous or serrate, as in *Graptolithus*.*

The general aspect of the species of this genus is like that of *Fenestella*, both in the form of the fronds and the bifurcation of the

* A paper by J. W. Salter, Esq., Palæontologist of the Geological Survey of Great Britain, read before the American Association, for the advancement of Science, at the Montreal Meeting, 1857, describes a new genus of the Graptolite family under the name of *Graptopora*. Although having had no opportunity of examining this paper, it appears to me that the forms described are true *Dictyonema*.

branches. Some of the species have heretofore been referred to that genus, and others to *Gorgonia.* They may be known from either of these genera by the striated and serrated corneous skeleton, and absence of round ceilules, which latter character, with a calcareous frond, marks the *Fenestella.*

Since the essential characters of *Dictyonema,* with figures of two species, have been given long ago, and their similarity to Graptolites pointed out, I am disposed to retain the name, and to describe the Canadian species under that designation.

There are still two other types in this collection which seem to merit generic distinction. One of these consists of imperfect branching fronds, the smaller branchlets of which are often rigidly divergent from the main branch at an angle of about thirty-six degrees. In others the branchlets diverge in a similar manner, but are less rigid. Exterior of branches smooth, interior surface celluliferous. There are two or three forms of this type which I propose to designate as Dendograptus.

Another form consists of fronds which are strong stipes near the base, and become numerously and irregularly branched, ending in a great number of filiform branchlets, one side of which is serraed. The general aspect is that of a shrub or tree in miniature. For these forms I would propose the generic name of Thamnograptus.

There is also a single species approaching in character to that published in the Report of the Fourth Geological District of New York as *Filicites ?* The lateral branchlets are much longer, more lax and slender, being in this respect more nearly like *Filicites gracilis* of Shumard, (Geol. Report of Missouri, part 2, p. 208, pl. a. fig. 11) but the branchlets in the Canadian species are longer and more slender. They have all the same general plumose character, and from the well preserved corneous structure in the Canadian specimens, I regard them as belonging to the Graptolideæ, although the celluliferous or serrated margins have not been seen. For these forms of Canada, New York and Missouri, should they prove generically identical, I propose the name of Plumalina, making the *Filicites ?* cited above, the type of the genus with the name of *Plumalina plumaria,* while the western species will receive the name of *P. gracilis.*

The disk-like forms which are described in the Palaeontology of New York, vol. 1, p. 277, under the name of *Discophyllum,* are probably the disks of a species of *Graptolithus* with numerous branches. One specimen preserves a thick corneous substance, which is the exterior surface, while the other preserves the mould of the opposite side, the radiating impressions of which are crenulated. There are no evidences of branches extending beyond the margin of the disk.

We have now so many well-established forms in the family *Graptolitideæ*, that we have the means of comparison with other allied families among palæozoic fossils.

Although numerous species in this collection are shown to be of compound structure, or to consist of fronds composed of two or more branches, and many of them originating in, or proceeding from a disk of thickened corneous substance, yet it is not improbable that there are among true Graptolites simple stipes or stems, as all the species have been usually heretofore regarded. I am disposed to believe that those Graptolites where the stipe is serrated on the two sides (*Diplograpsus*) may have been simple from the base; and that the branching forms having both sides, or one side only of the branches serrated, may possibly also have been simple, or bearing no more than a single stipe from the radicle. The bifurcate appearance at the base of *G. bicornis* however, offers some objections to this view, and these too may have been compound, like those which have only one side serrated.

The numerous compound forms shown in this collection, and the great variety of combination in the mode of branching, induces the belief that all those with a single series of serratures have been originally composed of two, four, or more branches, either diverging from a radicle or connected by a vinculum from which the radicle has extended.

The *Phyllograptus*, although apparently an anomalous form, is not more so with our present knowledge of the Graptolites than *G. Logani* or *G. octobrachiatus* would have been considered a few years since.

It is not among the least interesting facts, that we should find the *Graptolitideæ* simulating in their mode of growth so many of the Palæozotic *Bryozoa*. We have *Fenestella* represented in *Dictyonema*; the ramose forms of *Retepora* in *Dendrograptus*; *Glauconome* and *Ichthyorachis* in *Plumalina*; while the spirally ascending forms figured by Barrande appear to simulate in their mode of growth the spiral forms of *Fenestella* or *Archimedes*.

The forms of Graptolites now known are so numerous as to deserve especial consideration in their relations to other groups or families of fossil or living forms. They have been referred to the *Radiata* and to the *Bryozoa*. They were all originally composed of a thin corneous film which enclosed the bodies of the animals inhabiting the cells, and formed the general canal or source of communication along the axis. The substance of the Graptolites was then unlike that of the *Radiata* of the same geological age; the sub-divisions are in twos, or some multiple of two, except in a few instances which appear to be abnormal developments; and when the sub-divisions are irregular there is far less similarity with *Radiata*.

From all Palæozoic *Bryozoa* the Graptolites differ essentially in the form and arrangement of the cellules, and the nature of the substance and structure of the skeleton; and simulate only the general forms of Bryozoan genera.

ARTICLE XVII.—ENTOMOLOGY, NO. 2. *By Wm. Couper, Toronto.*

The 2nd of April was a beautiful day, such as a person would select to enjoy a ramble in the neighbouring woods of Toronto—indeed, it was a naturalist's day—birds sang sweetly, and butterflies appeared in their innocent gambols through forest paths and open spots whereon the sun's rays produced warmth. Three species of *Vanessa* made their appearance on Friday; I captured specimens of two species, but the third I did not secure on account of its scarcity. It has long been known that the imago of the American *Vanessa antiopa* passes the winter in some sheltered place, in a semi-torpid state, but now I am of opinion that two additional species *V. progne* and *V. Interrogationes* do so likewise; probably it is natural to the few northern types of the genus, while in the same species in more genial southern latitudes, such instinct is very rarely developed. As butterflies are supposed to subsist only on the nectar of flowers, the non-entomologist may naturally enquire how do they receive nourishment when there are no flowers? During this month trees are also awakening from torpidity, and should there happen to be recent wounds on the south side of a maple or birch, the sap while ascending may be seen to ooze; to these wounds our April butterflies repair to nourish themselves. Their activity after remaining the whole winter in a torpid state, is really astonishing. For the first ten days they were flitting before us in the woods and elsewhere, but where did they go during the cold days that followed? Back to the semi-torpid state there to remain until sufficient warmth returned to cause the sap to flow again—hence the sudden appearance and re-appearance of our April butterflies.

It is my intention to describe species of micro-lepidoptera, when they can be satisfactorily traced from the larvæ, and I am induced to call the attention of my Canadian brother entomologists to a pretty little species which appears to be rather common in the vicinity of Toronto. The larva is at present unknown to me; however, it may be discovered from the description of the imago, its cocoon and exuvia:—

Head and face white, the former crowned with a tuft of ferruginous cilia; eyes black, and concealed above by white cilia; antennæ long, threadlike, and silvery; anterior wings mottled black and silver, the latter predominent at the base, with greyish cilia on the posterior margin, longest towards the apex; posterior wings silvery, densely surrounded with grey cilia; body and legs silvery. Exp. al. 3¼ lin.

When in repose, the wings are closed around the body; on the base of anterior wings there is a little black tuft, and a large one near the centre, surrounded anteriorly with a white lunule.

The cocoon of this moth is white, oblong, and longitudinally but slightly lined. From observations already made, it appears the larva select various places for its construction, some are found under bark of trees, others are attached to stones, but the greater number were upon grass and stems of clover. The color of the exuvia or pupa case is deep chestnut, and the joints of abdominal rings are visible to the naked eye. This pretty micro-lep belongs to the genus *Nepticula*, and probably is a new species. My specimens appeared in April. Cocoons of this moth containing pupa were found in the middle of May.

If leaves of basswood are examined in July and August they will be found mined by small white larvæ. Not unfrequently as many as four may be noticed in a single leaf. They occupy distinct cells that are at first small, but as the age and appetite of the larva increases, so likewise the cells. When about to change to the pupa state, each constructs a perfectly circular brown-colored cell, by uniting the upper and lower sections of the leaf together, and there remains till it becomes a perfect insect. I have failed to secure the imago from this larva last summer, but I hope to be more fortunate in my second attempt. I am strongly of opinion that it is lepidopterous, probably belonging to the genus *Nepticula*.

I trust that ere long, some clever lepidopterist will enter this field of study, which, as Mr. Stainton the English micro-lepidopterist says:—"Of all the groups of lepidoptera, perhaps none are more interesting than the *Tineina*, and few, if any, so far from being understood. The peculiarity of their forms in numerous instances, the gorgeousness of their coloring, the wonderful beauty of the pencilled markings of their wings, the fanciful and grotesque position in which many of them delight to stand, the variety and singularity of their transformations, all of these and other characteristics render them uncommonly attractive; while on the other hand, their minuteness, the pains taken and the expertness manifested by both larvæ and perfect insects in concealing themselves, or escaping if discovered, as well as the difficulty of obtaining uninjured specimens, have thrown difficulties in the way of the scientific student, if not insuperable, at least extremely perplexing and tantalizing."

I procured an entomological curiosity from the woods, which serves to illustrate the parasitic family *Chalcididæ*; the specimen is worthy of notice as an interesting addition to my collection of insect architecture. It is a small branch of the common alder that had been last summer infested by a species of *Coccus*, which, while alive, were attacked by a micro-ichneumon-fly of the above family. The *Coccidæ* occupying the upper section of the branches, were of a whitish color, hence their detection with the naked eye. Knowing at the time that vegetable parasites are occasionally infested by other insects, led me to examine them with my pocket magnifier which soon revealed that some minute insect occupied the interior of each and every *Coccus*. The specimen is now in my possession about twelve days, and since, I have with pleasure, liberated an occasional issue of those eminently useful insects. For a little insight into their economy, as well as to point out the difference between the *Cynipidæ* and *Chalcididæ*, I quote the following from Harris, whose description will serve to determine them:—"Gall insects are often destroyed by little parasites belonging to the family *Chalcididæ*, and as these are liable to be mistaken for the former, especially when coming from the same gall, it may be well to point out the difference between them. The four winged gall-flies have rather long, straight threadlike and ascending antennæ; the fore-wings with a few veins, forming two triangular meshes, one of which is very small, and situated near the middle of the wing, the other mesh larger and near the the base; the hind body roundish but laterally compressed; and the piercer spiral or curved, and concealed. The *Chalcidians* have shorter, elbowed, and drooping antennæ, which are enlarged towards the end; a single vein, running from the shoulder near the outer margin of the fore-wing, uniting with this margin near the middle, and emitting thence, towards the disc of the wing, a short oblique branch, which is enlarg d or forked at the end; the hind body generally oval, pointed at the end in the females, and provided in this sex with a straight piercer, which is more or less visible beneath, and prominent at the extremity."

About a month ago, I picked up a specimen of *Helix albolabris.* Upon examining the shell, I discovered that the animal it contained had been consumed, and nothing remained but a number of larvæ attached to the interior. I took them to be coleopterous, as they appeared to the naked eye to resemble that of *Dermestidæ*—since then they have turned out to be *Diptera.* The form of antennæ classes it as a *Tachina*, but in general characters it resembles a minute species of parasitic *Sarcophaga*; it differs from *Tachina* in having its wing longitudinally folded when at rest. This is the first instance within my recollection of having found a dipterous parasite within a terrestrial mollusc.

I once had the pleasure of witnessing the stratagems of a little cuckoo fly; it was on the island opposite Toronto, where a large spider is found during summer, generally under stones, and in the sand. Nature has clothed this spider, as is invariably the case with insecta that conceal from their enemies, in colors resembling the sand it inhabits,—however, color does not protect this spider from all its enemies, particularly a sand wasp *Sphex Pennsylvanica*; indeed, these spiders constitute the principal food of the larvæ of these wasps. I observed one of the wasps running backwards, holding and dragging with its mandibles the body of a spider; it would occasionally drop it and reconnoitre, forming a series of circles, which were extended according to distance from centre, and although these round-about excursions were many times repeated, the wasp, with head down, like a dog on scent, arrived at the identical spot where its prey lay. Its manœuvres appeared strange to me; oft times it stood in an erect position with open mandibles, as if in defence, and well it might, for all this time it was followed by a small species of *Tachina* or cuckoo-fly, which despite the energy of the wasp to carry off its prey, managed to deposit its minute eggs in the body of the spider; it effected this either in hovering in a direct line over the head of the wasp while it was dragging the spider, or keeping within range of its compound eyes, and no sooner did the wasp leave it for a short time, than the little fly would return and deposit its eggs. The wasp was instinctively aware of the presence of an enemy, which accounts for the strange erect position in which it sometimes placed itself. Whether this fly is a parasite on the larvæ of the wasp, making the spider the means of conveying its eggs to the nest, or on the spider, I am not in possession of facts to shew; but there is a probability it is the spider, and, that as soon as parasitic larvæ make their appearance, the wasp drags the spiders containing them, out of its burrow or nest, to the surface sand where they effect their propagation.

On the 28th of April, when examining the bark of trees for mining beetles, I came in possession of a cluster of insect's eggs that are new to me. The following description of the form, &c., under the microscope, together with the locality may lead to the discovery of the parent. The number is about fifty, closely arranged in quincunx order. Cup-like in form; lower part attached to the bark, light brown; a ring near the margin is dark brown, and the margin white, surrounded with short bristles, of the same color, which give it a star-like appearance. The lid is semi-spherical, whitish on the disk, and surrounded with a dark brown ring. The form of the egg is more oblong than round, and something less than a line in length. They are attached to the interior bark of the maple; probably they are *Coleopterous.* "The eggs of insects are very variable in shape; most perhaps are oval or round; in some instances they are lenticular, in others somewhat conical; sometimes they are pediculated. Many when examined through the microscope closely resemble the shelly cases of echini, often called sea-eggs. All insects deposit their eggs upon or near the substances which are to furnish the future caterpillars, grubs, &c., with food. Consequently situations chosen, and the mode in which their safety is secured, are almost as diversified as the species are numerous."

It is generally the case that students in entomology overlook the small insects, even when they constitute material towards their particular order, under the idea that they are too minute either to do good or evil. This is a great mistake and one that arises from carelessness; he who rejects an insect because it is small, is no entomologist, and this he discovers when he happens to converse with the more advanced in the minutiæ of nature. In the Feb. number of the "Zoologist" (English) there is a communication from one of its correspondents, headed "*What there is beneath our Noses.*" He says:—"My wish is to draw the attention of all and sundry young men who have never bethought themselves about the subject, to the wonders which the road-sides, quiet lanes, woods, thickets, moors, or amongst whatsoever kind of scenery they may chance to be located, would yield them, if, instead of frittering away and spending their time without a single thought of seeing into nature, they would only lie in her lap for an odd half hour at a time, and recount to themselves a few of the many histories which even a couple of yard's square of a grassy bank furnishes. I feel convinced that one single experiment would astonish them at their ignorance. It startled me considerably, some few years ago, when I first heard of caterpillars taking up their quarters in leaves of grass, and that they were to be found everywhere for looking after; places where I had lain a thousand times, either resting after a days' hunting, or thrown myself down upon with a friend to enjoy our *otium cum dig.*, being tenanted by scores of larvæ mining and working out an existence in such narrow houses. Yet there they are sure enough, and abundant proofs have been shewn establishing the fact."

ARTICLE XVIII.—Geological Gleanings.

Geology of the Western States.—Western geology is making rapid progress, under the active exertions of many skilful explorers. In the Proceedings of the Academy of Natural Sciences, Philadelphia, we have a long report on the geology and fossils of Nebraska, so well known on account of the remarkably interesting mammaliferous tertiary-beds of the Mauvaises Terres. Messrs. Meek & Hayden, the authors, give the following summary of the structure of the region:—

General Section of the Geological Formations seen in and near the Black Hills (descending).

1*st*. Miocene beds consisting of whitish clays and sandstones of various thickness.

Cretaceous System.

No. 5. Of the Nebraska general section, with its usual characters and fossils—150 ft.

No. 4. Presenting its usual characters and containing its characteristic fossils,—150 ft.

No. 3. Usual fossils and composition,—150 to 200 feet.

No. 2. Usual lithological characters and fossils, with some new forms,—200 to 250 ft.

No. 1. Upper part yellowish and reddish sandstone, sometimes in heavy beds, passing down into alternations of yellowish, gray, bluish, and reddish laminated shale, with seams and layers of dark carbonaceous matter or impure lignite; beneath which there is a heavy bed of compact yellowish and reddish sandstone, with indistinct vegetable remains, and much fossil wood,—above beds variable at different places,—300 to 400 ft.

Then come alternations of light gray argillaceous grit, and rather soft sandstone, containing *Ammonites Henryi*, n. s. p., and a small oyster; also in bluish gray compact argillo-calcareous masses *Unio nucalis* n. s. p., and a small *Planorbis*, with other small univalves like *Paludina*.

Jurassic System.

A.—Layers of argillo-calcareous, somewhat gritty mass, containing *Belemnites densus*, n. s. p., *Ammonites cordiformis*, n. s. p., *Avicula (Monotis) tenuicostata*, n. s. p., *Arca (Cucullæa) inornata*, n. s. p.; passing down into a 6 or 8 foot bed light gray, or yellowish sandstone, with ripple marks and trails of marine worms,—50 to 80 ft.

B.—Light red argillo-calcareous gritty bed, with greenish seams, and nodules (sometimes wanting),—30 to 40 ft.

C.—Soft gray and dark brownish sandstone, passing down into about 8 feet of laminated shale of various colors, below which there is a 6 foot bed of sandstone similar to that above, containing *Avicula tenuicostata*, and trails of marine worms. Then comes 30 to 40 feet of bluish, or ash-colored argillaceous shale, with great numbers of *Lingula brevirostra*, n. s. p., and *Serpula*. Next we have a light-gray calcareous grit, containing columns of *Pentacrinus asteriscus*, n. s. p., *Avicula tenuicostata*, *Serpula*, &c., the more compact and calcareous portions often perforated by *Pholas?* The latter bed passes down into a light-yellowish gray sandstone, splitting into thin layers, and containing imperfect casts of *Mytilus* (*Modiola*) *Pecten*, *Trigonia*, and other bivalves, in considerable numbers. Whole 60 to 100 ft.

Carboniferous System.

D.—Brick-red, incoherent, argillo-calcareous, very fine slightly gritty material, containing great quantities of gypsum in the form of seams, layers, and irregular beds,—100 to 150 feet.

E.—Bluish and reddish gray, very hard gritty limestone, in which were found a smooth *spirifer* like *S. lineatus*, two or three species small *Pleurotomaria*, two species *Macrocheilus* and one or two species of *Bellerophon*. This bed is variable in thickness,—10 to 50 ft.

F.—Brick-red material, very similar to the bed D, excepting that it contains much less gypsum; passing down into a very hard compact concretionary sandstone,—250 to 300 ft.

G.—Hard, more or less gritty, yellowish and whitish limestone, containing *Productus*, *Spirifer*, *Euomphalus*, &c. &c., passing down into a light yellow calcareous grit; altogether 50 ft.

Carbon. System.	II.—Very hard reddish-gray limestone, containing *Syringopora*, *Productus*, *Terebratula*, &c. In the middle of this bed there is an 8 foot layer of very hard compact bluish limestone containing many crinoid remains, whole 50 ft.
Oldest Silurian.	I.—Potsdam sandstone, containing *Lingula*, *Obolus?* and fragments of *Trilobites*,—30 to 50 ft.

J.—Coarse feldspathic granite, forming mountain masses.
K.—Highly metamorphosed strata, standing vertical.

We have also received from the authors a paper by Messrs. Shumard & Swallow, describing a large number of new species of animal remains from the coal measures of Missouri and Kansas, and a paper by Prof. Swallow and Major Hawn on the Permian rocks referred to in our last number. It would appear from this paper that the Permian rocks of Kansas attain a thickness of 820 feet, and consist of Limestone, magnesian limestone, shales, and clays of various texture and colour, conglomerate, and gypsum. They are divisible into two subordinate groups, an upper and lower, and are wholly marine. Their distinct superposition on the coal measures, and the character of the fossils, would seem to leave little doubt that they are really of the age ascribed to them.

We learn that in Prof. Hall's Report on Iowa, soon to be published, evidence will be adduced of the existence of the latest member of the Palæozoic series in that state, and also in Illinois. Nothing affords a stronger evidence of the activity of geology in the West, than the nearly simultaneous discovery of this important fact by several observers.

In the same report, Prof. Hall notices the remarkable intercalation in the coal measures of the West of a bed of limestone higher than the true or underlying carboniferous limestone, and gradually thickening westward. He argues from this the prevalence of oceanic conditions throughout the far West, at a time when terrestrial conditions prevailed to the East:—

"The evidences of the existence of this ocean in the far west and south-west during the Coal period, amount to almost a proof that the conditions of that area which now constitutes a part of the continent, were never such as to admit of the production of coal plants, and the deposition of such materials as make up the Coal measures, at least during the latter part of the Coal period. In regard to the earlier part of that period, or the time in which the Lower Coal measures were formed, we have not, at present, as I conceive, the means of fully deciding what were the conditions in the central and south-western part of our continent."

"These facts, the result of so many observations, and coincident over so vast an area in the west, confirm conclusions drawn from other sources, that the dry land and land plants first appeared in the eastern part of the continent. Indeed we have good reason to believe that dry land existed in proximity to our present continent on the east from the earliest geological time, as shown in the vast accumulation of materials in the Laurentian and Huronian periods.

"The Potsdam sandstone, it is true, seems to be almost equally spread out over the entire breadth of the country, from the slopes of the Rocky Mountains, to the Atlantic; and judging from its augmenting thickness in many western localities, we may expect to find it, either in its normal condition or as a metamorphic rock, strongly developed in some parts of the Rocky Mountains. Subsequent to this period, however, every sedimentary formation indicates the proximity of land on the east. The great thickness of strata, coarse materials, and numerous fucoids of the Hudson River group in its eastern extension, indicate proximity to land, or the course of strong currents; while in the west the formation dies out in some inconspicuous fine shaly and calcareous beds, which, both in the nature and condition of the material and in the fossil contents, indicate great distance from land and a quiet ocean. The Clinton group, in like manner, in its coarse materials and abundant fucoids, points to a littoral condition of its area of deposition in the east; while it gradually diminishes in its western extension, and is finally altogether lost in that direction.

"In the sedimentary rocks of the Devonian period, including the Hamilton, Portage, Chemung and Catskill Mountain groups, we find in Canada and Eastern New York the first appearance of land plants, some of which closely resemble plants of the Coal period; and it was at that time that this peculiar vegetation began its existence on this continent, where we now find its remains in strata of these several groups.

"Notwithstanding this great accumulation of land-derived material with its marine shells, gradually decreasing westward as calcareous deposits increase—its numerous fucoids and land plants, the whole series has diminished to less than two hundred feet of marine sedimentary deposits in the Mississippi valley, and is there marked by marine fossils only.

"We cannot expect that the Coal formation, with its land-derived materials and its abundant land plants—far more abundant in the east than in the west—will prove an exception to this general rule; and when we find that these strata have a thickness of more than fourteen thousand feet in Nova Scotia, according to the measurements of Sir W. E. Logan; that the productive coal measures in Cape Breton are estimated by Mr. Brown to exceed ten thousand feet; and that in Pennsylvania, the coal measures, including the conglomerate, may be about eight thousand feet, and in the Missi-sippi valley one thousand feet,—we are forced to the conclusion already suggested of the ultimate disappearance of the coal measures in that direction.

"It would therefore appear, that from the earliest Silurian times, the Great West, or the region of the Rocky Mountains, has been an ocean, which successively received the finer sediments derived from eastern lands, or which produced within its own area the calcareous deposits, but ever an ocean, not only to the close of the Carboniferous period, but still later through the Permian, Jurassic and Cretaceous periods; showing apparently no evidences of dry land till about the beginning of the Cretaceous era, or perhaps a little earlier; while in later Tertiary periods, the continental fauna and flora have been remarkably developed over the same area.

"Thus while the older Palæozoic formations have been largely accumulated in the east, in successive beds, having altogether a thickness of several times the height of our highest mountains, they have greatly diminished in the west. At the same time, while the Post-palæozoic formations are very thin or often absent in the east, they have accumulated in vast amount along the line of the Rocky Mountains, from one end of the continent to the other."

These are hints of great general truths, of profound significance in geology: but a much larger induction of facts than we at present possess, is required to give them certainty; and they will be found to be liable to many local exceptions, even if fully established for the continent at large.

Canadian Geology.—Prof. Chapman introduces to us two new species of the genus *Asaphus*, found in the lower Silurian rocks of Upper Canada, and which he names *A. Canadensis* and *A. Halli.* (Canadian Journal, May.)

We are also indebted to Prof. Chapman for a very valuable paper on the Blow-pipe Assaying of Coals. The precise differences in the composition of coals have been too much neglected by geological observers; and a considerable amount of experience in assays and other examinations of this mineral, enables us to say that the methods recommended by Prof. Chapman will be found exceedingly valuable in circumstances in which trials on a larger scale cannot be made. We copy, for the benefit of students of this subject, Prof. Chapman's preliminary classification of the coals:—

"Without attending to minor distinctions or points of merely local value, we may arrange all varieties of coal, so far as regards practical purposes, under the following sub-divisions:

1. Anthracites.
2. Anthracitic or Dry Coals.
3. Caking or Fat Coals.
4. Cannel or Gas Coals.
5. Brown Coals or Lignites.

These varieties pass by almost insensible transitions into one another. Thus, the cannel coals are related to the lignites by the different kinds of jet, some of which are referable to the one, and some to the other sub-division. Between the caking and the cannel coals there are also various links; whilst the anthracite or dry coals, on the other hand—passing by excess of bitumen into the caking coals, and by a diminution of bituminous matter into the anthracites—serve to connect the first and third divisions. The typical or normal specimens of each of these five varieties, however, are sufficiently well marked.

1. *Anthracites.*—The true or normal anthracites possess a brilliant sub-metallic lustre, a degree of hardness varying from 3.0 to 3.25*, and a specific gravity of at least 1.33. A specimen from Pennsylvania gave 1.51; another specimen, 1.44; one from the department of the Isère in France, 1.56; and three from Wales yielded respectively 1.33, 1.37, 1.34. It should be stated, however, that many of the Welsh specimens belong strictly to the division of anthracitic coals, rather than to that of the true anthracites. The normal anthracites exhibit also a black or grayish-black streak; and all are good conductors of electricity. The

* Hausmann in his *Handbuch der Mineralogie*, gives 2.5 as the extreme hardness of all coals; but this is evidently erroneous, as many specimens, not only of anthracite, but of common and cannel coals, scratch calcareous spar.

latter character may be conveniently shewn by the method first pointed out by Von Kobell. A fragment placed in a solution of sulphate of copper (blue vitriol) in contact with a strip of zinc, will become quickly coated with a deposit of metallic copper: a phenomenon not exhibited in the case of common coal. Deducting ash and moisture, true anthracites present, as a mean, the following composition:—Carbon 92½, Hydrogen 3½, Oxygen (with trace of Nitrogen) 4. All yield an amount of coke equal to or exceeding 89 per cent. The coke is frequently pulverulent, never agglutinated.

The comportment of anthracite before the blowpipe has not hitherto been given in detail. It is as follows: *Per se*, the assay quickly loses its metallic brilliancy. After continued ignition, small white specks of ash appear on its edges. In borax it dissolves very slowly, with constant escape of bubbles. It is not attacked by salt of phosphorus; the assay works to the top of the bead and slowly burns away. In carbonate of soda, it effervesces, scintillates, and turns rapidly in the bead; and the soda is gradually absorbed. In the bulb tube a little water is always given off, but without any trace of bituminous matter.

As regards their geological position, the true anthracites belong chiefly to the middle portion of the Palæozoic series, below the Carboniferous formation; or otherwise, they constitute the under portion of the coal measures. Frequently also, anthracites occur in the vicinity of erupted rocks, and amongst metamorphic strata, as manifest alterations of ordinary coal.

2.—*Anthracitic Coals.*—These are often confounded with the true anthracites, into which indeed, as already stated, they gradually merge. Normally, they differ from the true anthracites in being non-conductors of electricity, in burning more easily and with a very evident yellow flame, in yielding a small quantity of bituminous matter when heated in a tube closed at one end, and in furnishing an amount of coke below 80 per cent. The coke is also in general more or less agglutinated, although it never presents the fused, mamillated appearance of that obtained from caking coal. The mean composition, ash and moisture deducted, may be represented as follows:—Carbon 89½, Hydrogen 5, Oxygen (with trace of Nitrogen) 5½; or Carbon 89, Hydrogen 5, Oxygen (with trace of Nitrogen) 6.

3.—*Caking Coals.*—These are often termed, technically, "Fat Coals." They constitute the type-series of the coals, properly so called. All yield a fused and mamillated coke, varying in amount from 65 to 70 per cent. Sp. gr. = 1.27–1.32. Commonly mixed with thin layers of strongly soiling "mineral charcoal" or fibrous anthracite. Mean composition (ash and moisture excluded): Carbon 87.9, Hydrogen 5.1, Oxygen (with Nitrogen) 7.0.

4. *Cannel Coals.*—These coals, at least in normal specimens, do not fuse or "cake" in the fire. They give off a large amount of volatile matter, frequently more than half their weight; hence their popular name of "gas coals." They soil very slightly, or not at all. The coke obtained from them is sometimes fritted, and partially agglutinated, but never fused into globular, mamillated masses, like that obtained from the caking coals. It varies in amount from 30 to 60, or, in typical specimens, from 55 to 58 per cent. Mean composition (normal cannel): Carbon 80–85, Hydrogen 5.5, Oxygen (with Nitrogen) 9–12.3.

5. *Lignites or Brown Coals.*—These coals of Tertiary age, differ greatly from one another in external aspect. Some of the so-called jets—passing into the cannel coals—are black, lustrous, and non-soiling; whilst other varieties are brown, and of a ligniform or stratified structure; or, otherwise, earthy and loosely coherent. All, however, are partially soluble in caustic potash, communicating to it a dark brown colour. The coke—usually of a dull charcoal-like aspect, or in sharp-edged fragments retaining their original form—varies from 25 to 50 per cent. Its separate fragments are rarely agglutinated, except in the case of certain varieties (as the lignites of Cuba, and those from the fresh-water deposits of the Basse Alpes in France) which contain asphaltum. All the typical varieties of lignite, as pointed out by Cordier, continue to burn for some time, in the manner of "braise" or ignited wood, after the cessation of the flame occasioned by the combustion of their more volatile constituents; whereas with ordinary coal, ignition ceases on the flame going out. The mean composition of lignite may be represented by—Carbon 65–75; Hydrogen 5, Oxygen (with Nitrogen) 20–30.

All the different kinds of coal, enumerated above, contain a variable amount of moisture, and of inorganic matter or "ash." The moisture rarely exceeds 3 or 4 per cent., although in some samples of coal it is as high as 6 or 7, and even reaches 15 or 20 per cent. in certain lignites. The amount of ash is also necessarily a variable element. In good coals it is under 5, frequently indeed, under 2 per cent. On the other hand, it sometimes exceeds 8 or 10, and in bad samples even 15 or 20 per cent. The ash may be argillaceous, argillo-ferruginous, calcareous, or calcareo-ferruginous. The ferruginous ashes are always more or less red or tawny in color from the presence of sesqui-oxide of iron, derived from the iron pyrites ($Fe{\cdot}S^2$) originally present in the coal. If much pyrites be present, the coal is not available for furnace operations, gas making, engine use, &c., owing to the injurious effects of the disengaged sulphur. Calcareous ashes are more common in Secondary and Tertiary coals than in those of the Palæozoic Age.

Lower Carboniferous Coal-measures of British America.—A paper by Principal Dawson, giving an account of the present state of knowledge respecting these interesting beds and their fossils, was read before the Geological Society of London, at its meeting of April 28th. The following is from the Abstracts of Proceedings of the Society :

"Deposits indicating the existence of the Coal flora and its associated freshwater fauna at the beginning of the Carboniferous period, are well developed in Nova Scotia and New Brunswick, with a clearness and fulness of detail capable of throwing much light on the dawn of the terrestrial conditions of the Coal-period, and on the relations of these lower beds to the true coal-measures. This lower series comprises shales and sandstones (destitute of marine remains, but containing fossil plants, fishes, entomostraca, worm-tracks, ripple, and rain marks, sun-cracks, reptilian footprints, and erect trees) and great overlying marine limestones and gypsums. These are distinct from the true coal-measures by their position, mineral character, and fossil remains. In the western part of Nova Scotia (Horton, Windsor, &c.) the true (or Upper and Middle) Coal-measures are not developed; and here the Lower Carboniferous marine deposits attain their greatest thickness. The lower coal-measures (or Lower Carboniferous freshwater or estuarine deposits) have here a thickness of about 600 feet. These beds are traceable as far as the Shubenacadie and Stewiacke Rivers. They outcrop also on the south side of the Cobequid Mountains, where the marine portion is very thin, owing perhaps to the fact of these mountains having been land in the coal-period.

Along the northern side of the Cobequid Range the upper and middle coal-measures and the marine portion of the Lower Carboniferous series are of great thickness. The freshwater beds are absent here, though brought up on the northern side of the coal-trough of Cumberland, where, as well as in New Brunswick (Peticodiac River, &c.), they are remarkable for their highly bituminous composition, their well-preserved fish-remains, and the almost entire absence of plants. To the north, at the Bay of Chaleurs, the great calcareous conglomerate, with sandstone and shale, 2766 feet thick, described by Logan, and containing a few plant-remains, probably represent the Lower Coal-measures of Nova Scotia. In eastern Nova Scotia and Cape Breton the Middle Coal-measures are found at Caribou Cove and elsewhere; the marine limestones and gypsums, and the underlying sandstones and shales, are seen at Plaister Cove; also at Right's River, and St. Mary's River.

In Nova Scotia these older Coal-measures, as compared with the true coal-measures, are more calcareous, more rich in remains of fishes, and have fewer vegetable remains, and indications of terrestrial surfaces. They occur generally along the margins of the coal-areas, near their old shores; and, as might be expected under such circumstances, they are associated with or replaced by beds of conglomerate derived from the neighboring highlands of Devonian or Silurian rocks. When the conglomerates are absent, alternations of sandstones with sandy and calcareous shales occur, with frequent changes in character of the organic remains; the general aspect being that of muddy estuarine deposits, accumulated very slowly, and discoloured by decaying organic substances. The supply of sediment, and the growth and preservation of vegetable matter, appear to have been generally on a smaller scale in this early carboniferous period than subsequently. In those districts where the true coal-measures are least developed the lower series is most important; showing that the physical and vital conditions of the Coal-measures originated as early as those of the Mountain-limestone; and that locally these conditions may have been contemporaneous throughout the whole period; but that in some localities the estuary and swamp deposits first formed were completely submerged and covered by oceanic deposits, whilst in others early marine beds were elevated and subjected to the conditions of gradual subsidence and vegetable growths indicated in the great coal-measures of the South Joggins, Pictou and Sydney.

In Nova Scotia the Lower Coal-measures are characterized by a great preponderance of *Lepidodendra* (especially *L. elegans*) and *Poacites*, with few Ferns or Sigillariæ. The middle Coal-measures are rich in sigillariæ and Ferns, as well as *Lepidodendra.* The Upper Coal-measures especially abound in Conifers Calamites and Ferns. *Palæoniscus*, *Gyrolepis* or *Acrolepis*, *Centrodus*, *Rhizodus*, and *Ctenacanthus* are the chief fossil fishes of this Lower Carboniferous series. Unio-like shells are nearly the only remains of Molluscs.

ART. XIX.—*On the Existence of a Cave in the Trenton Limstone at the Côte St. Michel, on the Island of Montreal.* By GEORGE D. GIBB, M.D., M.A., F.G.S., Member of the Canadian Institute; corresponding Member of the Natural History Societies of Montreal, and of Boston, and of the Literary and Historical Society of Quebec.

A peculiar interest is at all times attached to the discovery of caverns, more especially to the paleontologist if they have contained an abundant harvest of organic remains; a large number of extinct fossil mammalia, at the present moment, would be unknown, but for the accidental opening into these caves. North America is preëminently celebrated for its remarkable caverns, among which the Mammoth cave in Kentucky and Weger's Cave in Virginia are well known. So far as I can learn, Canada possesses but few indeed. The neighbouring Provinces of New Brunswick, Nova Scotia and Newfoundland, have not as yet afforded any published evidence of their presence.

When a lad I made several ineffectual attempts to discover a cave said to exist in the Montreal mountain, and although foiled in my efforts, the impression remained on my mind that there was a cave somewhere on the Island or Montreal. That impression has recently become confirmed, by an interview with a friend in London, who, many years ago was actually inside of it.

Now, although it is by no means of such wonderful magnitude and proportions as those I have just mentioned, it still deserves to be placed upon record, so that it may be examined by some competent geologist, and a more accurate description of it published than this pretends to be.

The cave exists on the borders of a limestone ridge, running in a N. E. and S. W. direction which skirts a number of farms back of the main road at Côte St. Michel. Its dimensions are not very great, being some twenty-five yards or more in depth, with a width of two or more yards. The latter varies a good deal and is somewhat irregular, but the roof is considerably wider than the floor, which is covered with water to the depth of some feet. A part of the floor will permit of a footing, and when in the cave a person can stand upright with plenty of room to spare. The roof of the Cave is of limestone, lined with a coating of stalactitical carbonate of lime, but from which there do not project any stalactites; some portions of the floor however contain stalagmites, as my friend collected a few specimens. No bones of animals were found, possibly owing to the presence of the water. I would surmise their presence at the bottom, and possibly consolidated into a sort of breccia from the lime held in solution becoming deposited around them during super-saturation. This could be ascertained by pumping the water out of the cave.

It would seem from the description of the cave, as if its origin was due to upheavel from below, producing a dislocation of the stratum of limestone and the formation of a wide fissure. This can be determined by a careful examination.

The name of the farmer upon whose property is the cave, is forgotten; the cave is situated some six or eight acres back of his house in the limestone ridge, which here takes somewhat of the character of a hill, at the base of which is an opening leading into its interior. It was accidentally discovered some thirty years ago, on the occasion of a party of *habitans* going out hunting. The dog belonging to the party commenced to scratch at the spot which forms the entrance of the cave, and suddenly disappeared; he had fallen into it, and his cries brought the hunters to the hole in the ground, the opening was enlarged and the party entered the cave by crawling on their hands and feet. I can do no more in this short paper than to communicate the fact of the existence of the cave, and leave it to others residing in Montreal to make out its formation and precise locality.

The *route* which must be followed to reach the site of it, is along the Victoria and Papineau Roads, continuing till the Road of the Côte de la Visitation is arrived at; this must be followed till the chemin de ligne is reached, which partly traverses the Island. Half way up the Chemin de ligne is the Côte St. Michel, and on turning into the Road St. Michel in a N. E. direction for about half a mile more or less, is the farm in question containing this cave.

Although of small dimensions the discovery of the cave was at the time looked upon as someting very wonderful; it adds another to the many objects of interest which already abound in the vicinity of Montreal.

14 Queen Square, London, April, 1858.

ART. XXI.—*On the Theory of Igneous Rocks and Volcanos.* By T. Sterry Hunt, of the Geological Survey of Canada.

(Read before the Canadian Institute, 13th March, 1858.)

In a note in the American Journal of Science for January, 1858, I have ventured to put forward some speculations upon the chemistry of a cooling globe, such as the igneous theory supposes our earth to have been at an early period. Considering only the crust with which geology makes us acquainted, and the liquid and gaseous elements which now surround it, I have endeavored to show that we may attain to some idea of the chemical conditions of the cooling mass by conceiving these materials to again re-act upon each other under the influence of an intense heat. The quartz, which is present in such a great proportion in many rocks, would decompose the carbonates and sulphates, and aided by the presence of water, the chlorids both of the rocky strata and the sea, while the organic matters and the fossil carbon would be burned by the atmospheric oxygen. From these reactions would result a fused mass of silicates of alumina, alkalies, lime, magnesia, iron, etc., while all the carbon, sulphur and chlorine, in the form of acid gases, mixed with watery vapour, azote, and a probable excess of oxygen, would form an exceedingly dense atmosphere. When the cooling permitted condensation, an acid rain would fall upon the heated crust of the earth, decomposing the silicates, and giving rise to chlorids and sulphates of the various bases, while the separated silica would probably take the form of crystalline quartz.

In the next stage, the portions of the primitive crust not covered by the ocean, undergo a decomposition under the influence of the hot moist atmosphere charged with carbonic acid, and the feldspathic silicates are converted into clays with separation of an alkaline silicate, which, decomposed by the carbonic acid, finds its way to the sea in the form of alkaline bicarbonate, where, having first precipitated any dissolved sesquioxyds, it changes the dissolved lime-salts into bicarbonate, which precipitated chemically or separated by organic agencies, gives rise to limestones, the chlorid of calcium being at the same time replaced by common salt. The separation from the water of the ocean, of gypsum and sea-salt, and of the salts of potash, by the agency of marine plants, and by the formation of glauconite, are considerations foreign to our present study.

In this way we obtain a notion of the processes by which, from a primitive fused mass, may be generated the silicious, calcareous and argilaceous rocks which make up the greater part of the earth's crust, and we also understand the source of the salts of the ocean. But the question here arises whether this primitive crystalline rock, which probably approached to dolerite in its composition, is now anywhere visible upon the earth's surface. It is certain that the oldest known rocks are stratified deposits of limestone, clay and sands, generally in a highly altered condition, but these, as well as more recent strata, are penetrated by various injected rocks, such as granites, trachytes, syenites, porphyries, dolerites, phonolites, etc. These offer, in their mode of occurence, not less than their composition, so many analogies with the lavas of modern volcanos, that they are also universally supposed to be of igneous origin, and to owe their peculiarities to slow cooling under pressure. This conclusion being admitted, we proceed to inquire into the sources of these liquid masses, which, from the earliest known geological period up to the present day, have been from time to time ejected from below. They are generally regarded as evidences both of the igneous fusion of the interior of our planet, and of a direct communication between the surface and the fluid nucleus, which is supposed to be the source of the various ejected rocks.

These intrusive masses, however, offer very great diversities in their composition, from the highly silicious and feldspathic granites, eurites, and trachytes, in which lime, magnesia and iron are present in very small quantities, and in which potash is the predominant alkali, to those denser basic rocks, dolerite, diorite, hyperite, melaphyre, euphotide, trap and basalt; in these, lime, magnesia and iron-oxyd are abundant, and soda prevails over the potash. To account for these differences in the composition of the injected rocks, Phillips, and after him Durocher, suppose the interior fluid mass to have separated into a denser stratum of the basic silicates, upon which a lighter and more silicious portion floats like oil upon water, and that these two liquids, occasionally more or less modified by a partial crystalization and eliquation, or by a refusion, give rise to the principal varieties of silicious and basic rocks, while from the mingling of the two zones of liquid matter, intermediate rocks are formed. (Phillip's *Manual of Geology*, p. 556, and Durocher, *Annales des Mines*, 1857, vol. 1, p. 217.

An analogous view was suggested by Bunsen in his researches on the volcanic rocks of Iceland, and extended by Streng to similar rocks in Hungary and Armenia. These investigators suppose a trachytic and a pyroxenic magma of constant composition, representing respectively the two great divisions of rocks which we have just distinguished; and have endeavored to calculate from the amount of silica in any intermediate variety, the proportions in which these compounds must have been mingled to produce it, and consequently the proportions of alumina, lime, magnesia, iron-oxyd and alkalies which such a rock may be expected to contain. But the amounts thus calculated, as may be seen from Dr. Streng's results, do not always correspond with the results of analysis. (Streng, *Annales de Chimie et de Physique*, 3rd series, vol. 39, p. 52.) Besides there are varieties of intrusive rocks, such as the phonolites, which are highly basic, and yet contain but very small quantities of lime, magnesia and iron-oxyd, being essentially silicates of alumina and alkalies in part hydrated.

We may here remark that many of the so-called igneous rocks are often of undoubted sedimentary origin. It will scarcely be questioned that this is true of many granites, and it is certain that all the feldspathic rocks coming under the categories of hyperite, labradorite, euphotide, diorite, amphibolite, which make such so large a part of the Laurentian system in North America, are of sedimentary origin. They are here interstratified with limestones, dolomites, serpentines, crystalline schists and quartzites, which are often conglomerate. The same thing is true of similar feldspathic rocks in the altered Silurian strata of the Green Mountains. These metamorphic strata have been exposed to conditions which have rendered some of them quasi-fluid or plastic. Thus for example, crystalline limestone may be seen in positions which have led many observers to regard it as intrusive rock, although its general mode of occurrence leaves no doubt as to its sedimentary origin. We find in the Laurentian system that the limestones sometimes envelope the broken and contorted fragments of the beds of quartzite, with which they are often interstratified, and penetrate like a veritable trap into fissures in the quartzite and gneiss. A rock of sedimentary origin may then assume the conditions of a so-called igneous rock, and who shall say that any of the intrusive granites, dolerites, euphotides, and serpentines, have an origin distinct from the metamorphic strata of the same kind, which make up such vast portions of the older stratified formation? To suppose that each of these sedimentary rocks has also its representative among the ejected products of the central fire, seems a hypothesis not only unnecessary, but when we consider their varying composition, untenable.

We are next led to consider the nature of the agencies which have produced this plastic condition in various crystalline rocks. Certain facts, such as the presence of graphite in contact with carbonate of lime, and oxyd of iron, not less than the presence of alkaliferous silicates, like the feldspars in crystalline limestones, forbid us to admit the ordinary notion of the intervention of an intense heat such as would produce an igneous fusion, and lead us to consider the view first put forward by Poulett Scrope, * and since ably advocated by Scheerer and by Elie de Beaumont, of the intervention of water aided by fire, which they suppose may communicate a plasticity to rocks at a temperature far below that req ired for their igneous fusion. The presence of water in the lavas of modern volcanos led Mr. Scrope to speculate upon the effect which a small portion of this element might exert at an elevated temperature and under pressure, in giving a liquidity to masses of rock, and he extended this idea from proper volcanic rocks to granites.

Scheerer in his inquiry into the origin of granite has appealed to the evidence afforded us by the structure of this rock, that the the more fusible feldspars and mica crystallized before the almost infusible quartz. He also points to the existence in granite of what he has called pyrognomic minerals, such as allanite and gadolinite, which, when heated to low redness, undergo a peculiar and permanent molecular change, accompanied by an augmentation in density, and a change in chemical properties, a phenomenon completetly analogous to that offered by titanic acid and chromic oxyd in their change by ignition from a soluble to an insoluble condition. These facts seem to exclude the idea of igneous fusion, and point to some other cause of liquidity. The presence of natrolite as an integral part of the zircon-syenites of Norway, and of talc and chlorite and other hydrous minerals in many granites show that water was not excluded from the original granitic paste.

Scheerer appeals to the influence of small portions of carbon and sulphur in greatly reducing the fusing point of iron. He alludes to the experiments of Schafhautl and Wholer, which show

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* See Journal of Geol. Society of London, vol. xii. p. 326.

that quartz and apophylite may be dissolved by heated water under pressure and recrystallized on cooling. He recalls the aqueous fusion of many hydrated salts, and finally suggests that the presence of a small amount of water, perhaps five or ten per cent., may suffice at a temperature which may approach that of redness, to give to a granitic mass a liquidity, partaking at once of the characters of an igneous and an aqueous fusion.

This ingenious hypothesis, sustained by Scheerer in his discussion with Durocher, * is strongly confirmed by the late experiments of Daubrée. He found that common glass, a silicate of lime and alkali, when exposed to a temperature of 400° C., in presence of its own volume of water, swelled up and was transformed into an aggregate of crystals of wollastonite, the alkali with the excess of silica separating, and a great part of the latter crystallizing in the form of quartz. When the glass contained oxyd of iron, the wollastonite was replaced by crystals of diopside. Obsidian in the same manner yielded crystals of feldspar, and was converted into a mass like trachyte. In the experiments upon vitreous alkaliferous matters, the process of nature in the metamorphosis of sediments is reversed, but Daubrée found still farther that kaolin, when exposed to a heat of 400° C. in the presence of a soluble alkaline silicate, is converted into crystalline feldspar, while the excess of silica separates in the form of quartz. He found natural feldspar and diopside to be extremely stable in the presence of alkaline solutions. These beautiful results were communicated to the French Academy of Sciences on the 16th of November last, and as the author well remarked, enable us to understand the part which water may play in giving origin to crystalline minerals in lavas and intrusive rocks. The swelling-up of the glass also shows that water gives a mobility to the particles of the glass at a temperature far below that of its igneous fusion.

I had already shown in the Report of the Geological Survey of Canada for 1856, p. 479, that the reaction between alkaline silicates and the carbonates of lime, magnesia and iron at a temperature of 100° C. gives rise to silicates of these bases, and enables us to explain their production from a mixture of carbonates and quartz,

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* Note.—See for the arguments on the two sides, Bulletin of the Geo Soc. of France, Second series, vol. iv., p.p. 468, 1018; vi. 644; vii., 276 viii., 500; also, Elie de Beaumont, Ibid, vol, iv., p. 1312. See also the recent microscopical observations of Mr. Sorby, confirming the theory of the aqueous-igneous origin of granitic.—*L. E. & D. Phil.Mag.*, Feb.1858.

in the presence of a solution of alkaline carbonate. I there also suggested that the silicates of alumina in sedimentary rocks may combine with alkaline silicates to form feldspars and mica, and that it would be possible to crystallize these minerals from hot alkaline solutions in sealed tubes. In this way I explained the occurrence of these silicates in altered fossiliferous strata. My conjectures are now confirmed by the experiments of Daubrée, which serve to complete the demonstration of my theory of the normal metamorphism of sedimentary rocks by the interposition of heated alkaline solutions.

But to return to the question of intrusive rocks: Calculations based on the increasing temperature of the earth's crust as we descend, lead to the belief that at depth of about twenty-five miles the heat must be sufficient for the igneous fusion of basalt. The recent observations of Hopkins, however, show that the melting points of various bodies, such as wax, sulphur and resin are greatly and progressively raised by pressure, so that from analogy we may conclude that the interior portions of the earth are, although ignited, solid from great pressure. This conclusion accords with the mathematical deductions of Mr. Hopkins, who, from the precession of the equinoxes, calculates the solid crust of the earth to have a thickness of 800 or 1,000 miles. Similar investigations by Mr. Hennessey however assign 600 miles as the maximum thickness of the crust. The region of liquid fire being thus removed so far from the earth's surface, Mr. Hopkins, suggests the existence of lakes or limited basins of molten matter which serve to feed the volcanos.

Now the mode of formation of the primitive molten crust of the earth would naturally exclude all combined or intermingled water, while all the sedimentary rocks are necessarily permeated by this liquid, and consequently in a condition to be rendered semi-fluid by the application of heat as supposed in the theory of Scrope and Scheerer. If now we admit that all igneous rocks, ancient plutonic masses, as well as modern lavas, have their origin in the liquefaction of sedimentary strata, we at once explain the diversities in their composition. We can also understand why the products of volcanos in different regions are so unlike, and why the lavas at the same volcano vary at different periods. We find an explanation of the water and carbonic acid which are such constant accompaniments of volcanic action, as well as the hydrochloric acid, sulphuretted hydrogen and sulphuric acid, which are so abundantly evolved by certain volcanos. The reaction between silica and carbonates must give rise to carbonic acid, and the decomposition of sea-salt in saliferous strata by silica in the presence of water, will generate hydrochloric acid, while gypsum in the same way will evolve its sulphur in the form of sulphurous acid mixed with oxygen. The presence of fossil plants in the melting strata would generate carburretted hydrogen gases, whose reducing action would convert the sulphurous acid into sulphuretted hydrogen; or the reducing agency of the carbonaceous matters might give rise to sulphuret of calcium which would be in its turn decomposed by carbonic acid or otherwise. The intervention of carbonaceous matters in volcanic phenomenon is indicated by the recent investigations of Deville, who has found carburetted hydrogen in the gaseous emanations of Etna and the lagoons of Tuscany. The ammonia and the nitrogen of the volcanos are also in many cases probably derived from organic matters in the strata decomposed by subterranean heat. The carburetted hydrogen and bitumen evolved from mud volcanos, like those of the Crimea and of Bakou, and the carbonized remains of plants in the *moya* of Quito, and in the volcanic matters of the Island of Ascension, not less than the infusiorial remains fround by Ehrenberg in the ejected matters of most volcanos, all go to show that fossiliferous sediments are very generally implicated in volcanic phenomena; It is to Sir John F. W. Herschel that we owe, so far as I am aware, the first suggestions of the theory of volcanic action which I have here brought forward. In a letter to Sir Charles Lyell, dated February 20, 1836, (Proceedings Geol. Soc. London, vol. 11, p. 448), he maintains that with the accumulation of sediment the isothermal lines in the earth's crust must rise, so that strata buried deep enough will be crystallized and metamorphosed, and eventually be raised, with their included water, to the melting point. This will give rise to evolutions of gases and vapours, earthquakes, volcanic explosions, etc. all of which results must, according to known laws, follow from the fact of a high central temperature; while from the mechanical subversion of the equilibrium of pressure, following upon the transfer of sediments, while the yielding surface reposes upon a mass of matter partly liquid and partly solid, we may explain the phenomena of elevation and subsidence. Such is a summary of the views put forward more than twenty years since by this eminent philosopher, which, although they have passed almost unnoticed by geologists, seem to me to furnish a simple and comprehensive explanation of several of the most difficult problems of chemical and dynamical geology.

To sum up in a few words the views here advanced. We conceive that the earth's solid crust of anhydrous and primitive igneous rock is everywhere deeply concealed beneath its own ruins, which form a great mass of sedimentary strata permeated by water As heat from beneath invades these sediments, it produces in them that change which constitutes normal metamorphism. These rocks at a sufficient depth are necessarily in a state of igneo-aqueous fusion, and then in the event of fracture of the overlying strata, may rise among them, taking the form of eruptive rocks. Where the nature of the sediments is such as to generate great amounts of elastic fluids by their fusion, earthquakes and volcanic eruptions may result, and these, other things being equal, will be most likely to occur under the more recent formations.

ART. XXII.—*Agassiz' Contributions to the Natural History of the United States.* (Vols. 1 & 2. Boston.)

Anything from so great an authority as Professor Agassiz, commands the attention of naturalists; and especially an elaborate work like the present, giving matured views on leading subjects in Zoology. For this reason we propose to devote some pages to a sketch of the contents of these volumes. The work, it is true, has had a circulation unexampled in the case of such a book, and we are glad to see several Canadian names on the subscription list; but many of our young Naturalists may not have had access to it, and it is too elaborate and scientific to reach the mass of readers.

The first volume is in great part occupied with investigations of general principles; and chiefly with those concerned in classification, considered in its widest sense as the attempt of the human mind to explore the plans of construction adopted in nature and to represent them systematically.

The first topic under this head is the unity of plan in nature, and its origin from an all pervading Intelligence. Unity, design, and creative power, as evidenced in nature, are no new ideas. From the time of the Hebrew lawgiver downward, they have been articles of faith with all true philosophers, and in more modern times have been popularly expounded in a multitude of works, from Paley down to Hugh Miller and McCosh. It might indeed, in this period of the world's history, seem superfluous to devote a large portion of a scientific work to such a subject, had not some late writers, with that same eccentricity which occasionally brings up a strong and wordy opponent of the Coperincan system in astronomy, attempted to maintain the introduction of organic forms in a way different from the "Miracle of Creation." In this part of the subject, therefore, we find little that is new in itself, but a sort of cumulative argument, gathering into one a vast number of considerations illustrated by facts familiar to the writer, and all bearing on the doctrine that nature is not God; but that in studying what we call nature we have before us the works of a Supreme intelligent creator. Coming from a man so thoroughly versed in his subject, and supported as it is by a vast mass of illustrative facts, the conclusion tells with irresistible force. Most strenuously and boldly does Agassiz assert this great result, in which science, rising above her favourite ideas of recurring cycles and unchanging law, finds herself in direct relation with the great First Cause.

The argument on this subject is spread over a great number of heads, but they may in effect be reduced to the following:—

1. The idea of type or pattern in nature, as distinguished from that of mere individual adaptation, the construction of creatures intended for similar uses on different types, and the persistence of the same type through many subordinate varieties of structure, the simultaneous existence of the most diversified types in identical circumstances and the converse of this, the persistence of all the leading types through the whole sequence of geological ages, the wide geographical distribution of some types and the narrow range of others, the special resemblances in details of structure that occur in animals otherwise quite different, the order of succession of types in geological time. These and many other considerations founded on types in nature, prove a thinking Agent, just as similar considerations in reference to the various styles of architecture, would effectually answer any one who should attribute these, like the columns of basalt, or the stalactites of a cavern, to merely physical agencies.

2. The relations of animals to each other and to the world around them. Among these are the relative sizes of animals, and the relations of size to the media in which animals exist; the adaptation of animals in their structure and habits to the world in which they live and its various conditions; the relations of animals with each other as mutually dependent; the mutual

dependence of the animal and the plant; the relations of parasites to animals. Under all these and other heads, we have the old argument of Paley against the accidental origin of the watch or its production by physical agencies, vastly augmented by the great additional stores of fact since collected by naturalists.

3. The permanency of species in nature and the changes through which the individuals of the species pass. Here we have immutability of structure associated with continued succession of individuals, and that succession often complicated by a series of changes, as in the egg, the caterpillar, the chrysalis, and the butterfly, and some even more marvellous than this. Further, we have these changes in the individual, presenting a singular parallelism with the gradations of rank which our minds invariably recognise in distinct species, and on the other hand with the grand succession of species in geological time; so that in the great march of creation, in the ephemeral life of the individual animal, and in the ideas of order in nature which arise within our minds, we have a resemblance indicating at once the planning Creator and the fact that our own minds are created in his image.

4. The union of the whole animal kingdom in one great system, dividing in a regular manner into subordinate groups, and the persistence of this, whether we regard widely separated geographical areas, or the lapse of geological time, indicate thought; and, when we consider the vastness and intricacy of the subject, thought which the most gifted naturalists are ready to admit transcends the powers of man.

We have preferred thus to group, however imperfectly, some of the leading considerations adduced by our author, to avoid confusing the reader with too numerous heads; but we shall give as a specimen of the treatment of the subject, the details of the argument on one of the points least familiar to the general reader, the doctrine of "*prophetic types.*"

PROPHETIC TYPES AMONG ANIMALS.

"We have seen in the preceding paragraph, how the embryonic conditions of higher representatives of certain types, called into existence at a later time, are typified, as it were, in representatives of the same types, which have existed at an earlier period. These relations, now they are satisfactorily known, may also be considered as exemplifying, as it were, in the diversity of animals of an earlier period, the pattern upon which the phases of the developement of other animals of a later period were to be established. They appear now, like a prophecy in those earlier times, of an order of things not possible with the earlier combinations then prevailing in the animal kingdom, but exhibiting in a later period, in a striking manner, the antecedent consideration of every step in the gradation of animals.

This is, however, by no means the only, nor even the most remarkable case, of such prophetic connections between facts of different dates.

Recent investigations in Palæontology have led to the discovery of relations between animals of past ages and those now living, which were not even suspected by the founders of that science. It has, for instance, been noticed, that certain types which are frequently prominent among the representatives of past ages, combine in their structure, peculiarities which at later periods are only observed separately in different, distinct types. Sauriod Fishes before Reptiles, Pterodactyles before Birds, Ichthyosauri before Dolphins, etc.

There are entire families, among the representatives of older periods, of nearly every class of animals, which, in the state of their perfect development exemplify such prophetic relations, and afford, within the limits of the animal kingdom, at least, the most unexpected evidence, that the plan of the whole creation had been maturely considered long before it was executed. Such types, I have for some time past, been in the habit of calling *prophetic types.* The Sauroid Fishes of the past geological ages, are an example of this kind. These Fishes, which have preceded the appearance of Reptiles, present a combination of ichthyic and reptilian characters, not to be found in the true members of this class, which form its bulk at present. The Pterodactyles which have preceded the class of Birds, and the Ichthyosauri which have preceded the appearance of the Cetacea,* are other examples of such prophetic types. These cases suffice for the present, to show that there is a real difference between *embryonic* types and *prophetic* types. Embryonic types are in a measure also prophetic types, but they exemplify only the pecularities of development of the higher representatives of their own types;

* In the text the author is made to say *Crustacea* instead of *Cetacea*; and we observe other typographical errors, which the publisher should endeavour to avoid in succeeding volumes.

while prophetic types exemplify structural combinations observed at a later period, in two or several distinct types, and are, moreover, not necessarily embryonic in their character, as for example, the Monkeys in comparison to Man; while they may be so, as in the case of the Pinnate, Plantigrade, and Digitigrade Carnivora, or still more so in the case of the pedunculated Crinoids.

Another combination is also frequently observed among animals, when a series exhibits such a succession as exemplifies a natural gradation, without immediate or necessary reference to either embryonic development or succession in time, as the Chambered Cephalopods. Such types I call *progressive types.*

Again a distinction ought to be made between prophetic types proper and what I would call *synthetic types*, though both are more or less blended in nature. Prophetic types proper, are those which in their structural complications lean towards other combinations fully realized in a later period, while synthetic types, are those which combine, in a well balanced measure, features of several types occurring as distinct, only at a later time. Sauroid Fishes and Ichthyosauri are more distinctly synthetic than prophetic types, while Pterodactyles have more the character of prophetic types; so are also Echinocrinus with reference to Echini, Pentremites with reference to Asterioids, and Pentacrinus with reference to Comatula. Full illustrations of these different cases will yet be needed to render obvious the importance of such comparisons, and I shall not fail, in the course of this work, to present ample details upon this subject. Enough, however, has already been said to show, that the character of these relations among animals of past ages, compared with those of later periods or of the present day, exhibits more strikingly than any other feature of the animal kingdom, the thoughtful connection which unites all living beings, through all ages, into one great system, intimately linked together from beginning to end."

Another example may be taken from a section giving the views of Agassiz, on the much debated question of the date of succession of fossil animals in its relations to their grade in nature.

PARALLELISM BETWEEN THE GEOLOGICAL SUCCESSION OF ANIMALS AND PLANTS AND THEIR PRESENT RELATIVE STANDING.

"The total absence of the highest representatives of the animal kingdom in the oldest deposits forming part of the crust of our globe, has naturally led to the very general belief, that the animals which have existed during the earliest period of the history of our earth were inferior to those now living, nay, that there is a natural gradation from the oldest and lowest animals to the highest now in existence. To some extent this is true; but it is certainly not true that all animals form one simple series from the earliest times, during which only the lowest types of animals would have been represented, to the last period, when Man appeared at the head of the animal creation. It has already been shown (Sect. VII.) that representatives of all the great types of the animal kingdom have existed from the beginning of the creation of organized beings. It is therefore not in the successive appearance of the great branches of the animal kingdom, that we may expect to trace a parallelism between their succession in geological times and their relative standing at present. Nor can any such correspondence be observed between the appearance of classes, at least not among Radiata, Mollusks, and Articulata, as their respective classes seem to have been introduced simultaneously upon our earth, with perhaps the sole exception of the Insects, which are not known to have existed before the Carboniferous period. Among Vertebrata, however, there appears already a certain coincidence, even within the limits of the classes, between the time of their introduction, and the rank their representatives hold, in comparison to one another. But upon this point more hereafter.

It is only within the limits of the different orders of each class, that the parallelism between the succession of their representatives in past ages and their respective rank, in the present period, is decidedly characteristic. But if this is true, it must be at the same time obvious to what extent the recognition of this correspondence may be influenced by the state of our knowledge of the true affinities and natural gradation of living animals, and that until our classifications have become the correct expression of these natural relations, even the most striking coincidence with the succession of their representatives in past ages may be entirely overlooked. On that account it would be presumptuous on my part to pretend, that I could illustrate this proposition, through the whole animal kingdom, as such an attempt would involve the assertion that I know all these relations, or that where there exists a discrepancy between the classification and the succession of animals, the classification must be incorrect, or the relationship of the fossils incorrectly appreciated, I shall therefore limit myself here to a general comparison, which may, however, be sufficient to show, that the improvements which have been introduced n our systems, upon purely zoological grounds, have nevertheless tended to render more apparent the coincidence between the relative standing among living animals and the order of succession of their representatives in past ages. I have lately attempted to show, that the order of Halcyonoids, among Polyps, is superior to that of Actinoids; that, in this class, compound communities constitute a higher degree of development, when contrasted with the characters and mode of existence of single Polyps, as exhibited by the Actinia; that top-budding is superior to lateral budding; and that the type of Madrepores, with their top-animal, or at least with a definite and limited number of tentacles, is superior to all other Actinoids. If this be so, the prevalence of Actinoids in older geological formations, to the exclusion of Halcyonoids, the prevalence of *Rugosa* and *Tabulata* in the oldests deposits, the later prevalence of Astræoids, and the very late introduction of Madrepores, would already exhibit a correspondence between the rank of the living Polyps and the representatives of that class in past ages, though we may hardly expect a very close coincidence in this respect between animals the structure of which is so simple.

The gradation among the orders of Echinoderms is perfectly plain. Lowest stand the Crinoids, next the Asterioids, next the Echinoids, and highest the Holothurioids. Ever since this class has been circumscribed within its natural limits, this succession has been considered as expressing their natural relative standing, and modern investigations respecting their anatomy and embryology, however extensive, have not led to any important change in their classification, as far as the estimation of their rank is concerned. This is also precisely the order in which the representatives of this class have successively been introduced upon earth in past geological ages. Among the oldest formations we find pedunculated Crinoids only, and this order remains prominent for a long series of successive periods; next come free Crinoids and Asterioids; next Echinoids, the successive appearance of which since the triasic period to the present day, coincides also with the gradation of their subdivisons, as determined by their structure; and it was not until the present period, that the highest Echinoderms, the Holothurioids, have assumed a prominent position in their class.

Among Acephala there is not any more uncertainty respecting the relative rank of their living representatives, than among Echinoderms. Every zoologist acknowledges the inferiority of the Bryozoa and the Brachiopods when compared with the Lamellibranchiata, and among these the inferiority of the Monomyaria in comparison with the Dimyaria would hardly be denied. Now if any fact is well established in Palæontology, it is the earlier appearance and prevalence of Bryozoa and Brachiopods in the oldest geological formations, and their extraordinary development for a long succession of ages, until Lamellibranchiata assume the ascendency which they maintain to the fullest extent at present. A closer comparison of the different families of these orders might further show how close this correspondence is through all ages.

Of Gasteropoda I have nothing special to say, as every palæontologist is aware how imperfectly their remains have been investigated in comparison with what has been done for the fossils of other classes. Yet the Pulmonata are known to be of more recent origin than the Branchifera, and among these the Siphonostomata to have appeared later than the Holostomata, and this exhibits already a general coincidence between their succession in time and their respective rank.

Our present knowledge of the anatomy of the Nautilus, for which science is indebted to the skill of Owen, may satisfy everybody that among Cephalopods the Tetrabranchiata are inferior to the Dibranchiata; and it is not too much to say, that one of the first points a collector of fossils may ascertain for himself, is the exclusive prevalence of the representatives of the first of these types in the oldest formations, and the later appearance, about the middle geological ages, of representatives of the other type which at present is the most widely distributed.

Of Worms, nothing can be said of importance with reference to our inquiry; but the Crustacea exhibit, again, the most striking coincidence. Without entering into details, it appears from the classification of Milne-Edwards that Decapods, Stomapods, Amphipods, and Isopods constitute the higher orders, while Branchiopods, Entomostraca, Trilobites, and the parasitic types, constitute, with Limulus, the lower orders of this class. In the classification of Dana, his first type embraces Decapods and Stomapods, the second Amphipods and Isopods, the third Entomostraca, including Branchiopods, the fourth Cirripedia, and the fifth Rotatoria. Both acknowledge in the main the same gradation; though they differ greatly in the combination of the leading groups, and also the exclusion by Milne-Edwards of some types, as the Rotifera, which Burmeister first, then Dana and Leydig, unite justly, as I believe, with the Crustacea. This gradation now presents the most perfect coincidence with the order of succession of Crustacea in past geological ages, even down to their subdivisions into minor groups. Trilobites and Entomostraca are the only representatives of the class in palæozoic rocks; in the middle geological ages appear a variety of Shrimps, among which the Macrouran Decapods are prominent, and later only the Brachyoura, which are the most numerous in our days.

The fragmentary knowledge we possess of the fossil Insects, does not justify us, yet, in expecting to ascertain with any degree of precision, the character of their succession through all geological formations, though much valuable information has already been obtained respecting the entomological faunæ of several geological periods.

The order of succession of Vertebrata in past ages, exhibits features in many respects differing greatly from the Articulata, Mollusks, and Radiata. Among these we find their respective classes appearing simultaneously in the oldest periods of the history of our earth. Not so with the Vertebrata, for though Fishes may be as old as any of the lower classes, Reptiles, Birds, and Mammalia are introduced successively in the order of their relative rank in their type. Again, the earliest representatives of these classes do not always seem to be the lowest; on the contrary, they are to a certain extent, and in a certain sense, the highest, in as far as they embody characters, which, in later periods, appear separately in higher classes, (See Sect. 26,) to the exclusion of what henceforth constitutes the special character of the lower class. For instance, the oldest Fishes known, partake of the characters, which, at a later time, are exclusively found in Reptiles, and no longer belong to the Fishes of the present day. It may be said, that the earliest Fishes are rather the oldest representatives of the type of Vertebrata than of the class of Fishes, and that this class assumes only its proper characters after the introduction of the class of Reptiles upon earth. Similar relations may be traced betweens the Reptiles and the classes of Birds and Mammalia, which they precede. I need only allude here to the resemblance of the Pterodactyli and the Birds, and to that of Ichthyosauri and certain Cetacea. Yet, through all these intricate relations, there runs an evident tendency towards the production of higher and higher types, until at last, Man crowns the whole series. Seen as it were at a distance, so that the mind can take a general survey of the whole, and perceive the connection of the successive steps, without being bewildered by the details, such a series appears like the development of a great conception, expressed in such harmonious proportions, that every link appears necessary to the full comprehension of its meaning, and yet, so independent and perfect in itself, that it might be mistaken for a complete whole, and again, so intimately connected with the preceding and following members of the series, that one might be viewed as flowing out of the other. What is universally acknowledged as characteristic of the highest conceptions as genius, is here displayed in a fulness, a richness, a magnificence, an amplitude, a perfection of details, a complication of relations, which baffle our skill and our most persevering efforts to appreciate all its beauties. Who can look upon such series, coinciding to such an extent, and not read in them the successive manifestations of a thought, expressed at different times, in ever new forms, and yet tending to the same end, onwards to the coming of Man, whose advent is already prophesied in the first appearance of the earliest Fishes!

The relative standing of plants presents a somewhat different character from that of animals. Their great types are not built upon so strictly different plans of structure; they exhibit, therefore, a more uniform gradation from their lowest to their highest types, which are not personified in one highest plant, as the highest animals are in Man.

Again, Zoology is more advanced respecting the limitation of the most comprehensive general divisions, than Botany, while Botany is in advance respecting the limitation and characteristics of families and genera. There is, on that account, more diversity of opinion among botanists respecting the number, and the relative rank of the primary divisions of the vegetable kingdom, than among zoologists respecting the great branches of the animal kingdom. While most writers agree in admitting among plants, such primary groups as Acotyledones, Monocotyledones, and Dicotyledones, under these or other names, others would separate the Gymnosperms from the Dicotyledones.

It appears to me, that this point in the classification of the living plants cannot be fully understood without a thorough acquaintance with the fossils and their distribution in the successive geological formations, and that this case exhibits one of the most striking examples of the influence classification may have upon our appreciation of the gradation of organized beings in the course of time. As long as Gymnosperms stand among Dicotyledones, no relation can be traced between the relative standing of living plants and the order of succession of their representatives in past ages. On the contrary, let the true affinity of Gymnosperms with Ferns, Equisetaceæ, and especially with Lycopodiaceæ be fully appreciated, and at once we see how the vegetable kingdom has been successively introduced upon earth, in an order which coincides with the relative position its primary divisions bear to one another, in respect to their rank, as determined by the complication of their structure. Truly, the Gymnosperms, with their imperfect flower, their open carpels, supporting their polyembryonic seeds in their axis, are more nearly allied to the anathic Acrophytes, with their innumerable spores, than to either the Monocotyledones or Dicotyledones; and, if the vegetable kingdom constitutes a graduated series beginning with Cryptogams, followed by Gymnosperms, and ending with Monocotyledones and Dicotyledones, have we not in that series the most striking coincidence with the order of succession of Cryptogams, in the oldest geological formations, especially with the Ferns-Equisetaceæ, and Lycopodiaceæ of the Carboniferous period, followed by the Gymnosperms of the Trias and Jura and the Monocotyledones of the same formation and the late development of Dicotyledones? Here, as everywhere, there is but one order, one plan in nature."

The discussions to which we have referred, are all regarded by our author as introductions to the classification of animals; a most just and noble view, since when classification sinks to be a mere matter of arbitrary naming or even a convenient arrangement of structures, it foregoes its highest aims. We now know that there is in nature plan and system, depending upon the arrangements of the Creator, and appreciable to our minds. This plan, in so far as we have yet attained to its comprehension, marks the true relations of animals and plants as products of a thinking mind, and relates not only to structures but to embryonic development, habits, geographical and geological distributions. Classification in nature thus rises from its minute facts and structures, to a great philosophical system of the universe.

"It may appear strange that I should have included the preceding disquisition in that part of my work which is headed Classification. Yet, it has been done deliberately. In the beginning of this chapter, I have already stated that Classification seems to me to rest upon too narrow a foundation when it is chiefly based upon structure. Animals are linked together as closely by their mode of development, by their relative standing in their respective classes, by the order in which they have made their appearance upon earth, by their geographical distribution, and generally by their connection with the world in which they live, as by their anatomy. All these relations should, therefore, be fully expressed in a natural classification; and though structure furnishes the most direct indication of some of these relations, always appreciable under every circumstance, other considerations should not be neglected, which may complete our insight into the general plan of creation.

In characterizing the great branches of the animal kingdom, it is not enough to indicate the plan of their structure, in all its peculiarities; there are possibilities of execution which are at once suggested to the exclusion of others, and which should also be considered, and so fully analyzed, that the various modes in which such a plan may be carried out shall at once be made apparent. The range and character of the general homologies of each type should also be illustrated, as well as the general conditions of existence of its representatives. In characterizing classes, it ought to be shown why such groups constitute a class and not merely an order, or a family; and to do this satisfactorily, it is indispensable to trace the special homologies of all the systems of organs which are developed in them. It is not less important to ascertain the foundation of all the subordinate divisions of each class; to know how they differ, what constitutes orders, what families, what genera, and upon what characteristics species are based in every natural division."

To be concluded in our next Number.

ART. XXIII.—*Coal in Canada. The Bowmanville Discovery.*

The thing that we cannot have, is always that which we most desire, and the more richly we are endowed otherwise, the more earnestly do we long for the one object that may have been withheld. So it would seem to be with the Canadian public in the matter of coal. All the riches of the earth and of the hills and of the deep beneath, have been thrown into its lap, except this; and like the child whose toys are all valueless because mamma cannot give it the moon to play with in its own hand, it turns its eyes away from all its other treasures, and cries for coal. Then when any clever pretender, or simple practical man misled by indications which he does not understand, for a time deludes it with the fancy that it possesses the much coveted combustible, it rails at the stupid Geological Survey which has failed to make the discovery, and snaps its fingers at the geologists, whose spectral "theories" have—like the ghosts that guard hidden treasure—hitherto scared it from the prize.

We are far from desiring to insinuate that in Canada the public mind is in such matters behind that of other countries; and it is cheering to know that many intelligent men are fully aware of the real position of this country in its geological resources. It is however very disheartening to scientific men, to find on the periodical recurrence of delusive mining schemes or unexpected practical facts, how very little even the more literary portion of the people are leavened with scientific truth. We write and lecture, and finally suppose that men have at least some general appreciation of that which we teach; but on a sudden we find ourselves quite mistaken, and the public ready to give ear to any statement, no matter how much at variance with the facts established by long and patient enquiry. The best use to be made of such unpleasant discoveries of popular ignorance, is to take advantage of the excitement which they occasion, in order to diffuse better ideas.

The latest of these professed discoveries is that of coal at Bowmanville, C. W., a town of about 4000 inhabitants, 43 miles distant from Toronto. A practical miner acquainted with the digging of coal, and therefore supposed to know more of its whereabout than the geologists and such unpractical persons, has made his way to this place. He assures a proprietor there that there is coal on his property, though situated on Lower Silurian rocks, and these rocks overlaid by no one knew how much tertiary clay and sand. A glance at the geological reports scattered broadcast over the country, would have shown that the occurrence of coal there is in the last degree improbable. But miners are supposed to have a wonderful penetration in such matters. Without taking any competent advice, a bore is made, and, wonderful to relate, at the depth of 150 feet, coal or something like it is found. Specimens are now sent to a learned professor in Toronto, who damps the ardour of the enthusiastic by assuring them, that it is only compact bitumen, like that often found in small quantities in the "Utica shale" which is believed to be the rock of the locality, and by giving a great many geological reasons why the occurrence of coal there should be considered not absolutely impossible, but contrary to all known facts.

But the enterprise is not to be quashed in this summary manner. The bore-hole is again appealed to, and now produces actual veritable coal, not only like coal and burning like coal, but having all the characteristics of true coal-measure coal, and showing its vegetable structures. The mineral is further stated to be found under clay and sand having the aspect of the ordinary tertiary clays and sands of Upper Canada, and showing none of the characteristics of coal measures either in mineral character or fossils. These and other further statements render the reality of the discovery still more inprobable; but gentlemen who cannot distinguish ordinary calcareous clay from fire clay, who suppose that fire clay often or ever forms the roof of coal seams, and who believe that fetid exhalations and inflammable gases escaping from wells are infallible indications of the presence of coal, are not likely to be easily staggered by geological evidence.

Accordingly their faith only becomes established by the growing improbability, and we find them at the date of our latest information sending a deputation to Toronto to solicit aid from the Government toward prosecuting the discovery, and their friends in the newspaper press chuckling over the "nuts" which they have given the geologists to crack. The one wise proposal which the believers in this discovery make, is that the Director of the Geological Survey should be requested to examine the locality. This however should have been done at the first. Sir W. E. Logan is always ready to give any information in his power; and is not disposed, as his reports show, to treat with scepticism or contempt any statement of a valuable discovery however improbable. In the present state of the matter, it is hardly likely that anything he will be able to state, on the evidence of surface indications, will satisfy the public; and a shaft may have to be sunk, at an expense of several hundreds of pounds, to find out that there has been a mistake or a fraud at the bottom of the matter instead of a seam of coal. We do not say that this will be the certain result; there are, as we shall show in the sequel, certain geological possibilities of the occurrence of coal at Bowmanville, but no indications of these appear in the statements which have been made, and all the facts before us at present point to the conclusion that the very common trick of secretly supplying the bore-hole with the materials afterwards obtained from it, has been practised by some interested or mischievous person. We give this opinion on the facts which have reached us up to the 1st of June, and we are glad to observe that the Government have very properly thrown the onus of opening the deposit on the proprietors and people of the locality.

Having pursued the narrative thus far, we proceed to give a few plain statements as to the actual condition of the question. Does Canada contain workable coal? Many persons are of opinion that geologists, and more particularly those of the Survey, have arrived at the conclusion that coal cannot possibly be found in this country. This is entirely a mistake. To maintain such a sweeping negative would be mere presumption, such as no really scientific man could be guilty of. All that we assert is embodied in the expression of Prof. Chapman, that "all known facts are opposed to the idea" that coal occurs here, and therefore that any reported discovery should be regarded with distrust and carefully scrutinized. Let us look for a moment at a general statement of the evidence on which this view rests.

It has been ascertained that nearly all the valuable coal seams known, exist in the coal-measures of a particular geological system—the carboniferous—readily distinguishable by its relations to other systems of rocks and by its characteristic fossils. In some of the formations overlying or newer than this coal series *par excellence*, beds of coal have been found, as for instance in the Triassic series at Richmond, Virginia, in the tertiary of Western America; but these are exceptional cases, and the mineral is for the most part different from the coal of the carboniferous system or differs in its accompanying fossils. In the formations older than the carboniferous system no workable coal has been found, and these formations have now been so extensively explored as to render it probable that they are quite destitute of the mineral; though still, geologists do not assert this as a positive conclusion, but merely as the negative result likely to be reached when all the facts are known, and in the meantime as a useful warning against imprudent speculation.

Now in relation to Canada, the whole province so far as known—

except a small district in Gaspé—rests on rocks older than the carboniferous system. This great general fact is a most important one practically, and has already saved much ruinous expenditure. It is a fact to be insisted on with this view; and has been so insisted on by the head of the Survey; but he has not overstepped the bounds of certainty in the matter, and has in each case of supposed coal discovery, stated merely the facts and principles bearing on that case, without indulging in rash general statements. We may take for example, and as a further illustration of the subject, the following from the report of 1849-50. It refers to the supposed discovery of coal at Bay St. Paul and Murray Bay.

"Wherever workable seams of coal have yet been found on the face of the globe, the evidences connected with them prove beyond a doubt, that their origin is due to great accumulations of vegetable matter, which has been converted into a mineral condition. The vegetable structure is detected in the mineral by microscopic examination, and as might be expected, the strata associated with coal beds are profusely stored with fossil plants; even where the seams are too thin to be workable, or so thin as to be readily passed over without great attention, the vegetable remains disseminated in the masses of rock dividing the seams, are still in vast abundance. In the section of the Nova Scotia coal rocks, at the Joggins, for example, as detailed in the report transmitted to the Government in 1844, it will be found that in a thickness approaching 15,000 feet, seventy-six coal seams occur with a total thickness of no more than forty-four feet, and that for thousands of feet in some parts, no coal seam is met with over three inches; there are yet comparatively few layers of the rock that are wholly free from vegetable remains, and the substance of these remains, however thin the leaf or small the fragment, being generally converted into coal, the mineral—from the multitude of grains of it disseminated through great thicknesses of the strata—frequently gives a peculiar character to the stone as one of its constituents. The same thing is observable in other carboniferous localities, both in America and Europe, and it appears quite reasonable to suppose, that if coal seams were discovered of an older date than those which constitute the present known great magazines of fossil fuel, the vegetable growth that would be required to give them an approach to a workable thickness, would afford the means of an extensive distribution of remains in the strata with which they were associated. The formations of Bay St. Paul and Murray Bay however show no carbonized vegetable remains whatever, and the only plants they presented at all, were a very few obscure fucoids, the forms of which were replaced by peroxyd of iron. The bitumen of the limestone may possibly be derived from the soft tissues and gelatine of the marine animal remains which have been buried in the deposit, and supporting this opinion, indurated bitumen has been found in the interior of some of the fossil testacea, of the same limestone at Beauport; but the calcareous material of the harder part of such remains, so predominates over the carbon of the softer, that coal seams could not be expected as the result of the mixture.

"There being not the remotest doubt whatever of the geological age of the limestone of Bay St. Paul, supposing the specimens were really derived from the strata, and that the species of plants should at the same time be ascertained to be identical with some of those of the carboniferous period, it would prove that all evidence up to the present time has been imperfect, and that the flora of this period is of hitherto unsuspected antiquity. But even in such a case, or supposing the plants were different in species from those of the true coal era, the paucity of vegetable remains being such that scarcely a trace of them is found in so great and so clear a development of the strata as occurs at Cap au Rets, the probability, amounting almost to certainty, would be, that the specimens were derived from some local patch so thin and circumscribed, as to be altogether worthless in an economic point of view."

All Sir William's early reputation as a geologist was gained in the coal-fields, no more competent mining surveyor for coal could be found, and no one would be more rejoiced at the opportunity of reporting on a coal-field in Canada. But for this very reason, he is too cautious to hazard any conjecture as to the probability of the occurrence of fossil fuel in a country where facts palpable to the geologist, have inscribed everywhere a negation of its presence.

Not having this public responsibility weighing upon us, we may venture to mention certain possibilities as to the occurrence of coal in Canada, which would furnish the only means of accounting for the Bowmanville discovery should it prove a reality. The fundamental rocks of Canada are as we have said below the carboniferous, and therefore unlikely to contain workable coal. But Canada may in this respect prove an exception to other countries.

There may have been a land flora and the accumulation of coal at an earlier period than we have elsewhere ascertained these phenomena to exist. Unfortunately however no indication of this exists except the discovery, by Sir W. E. Logan, of a bed of coal one inch thick, in the Devonian rocks of Gaspé, associated with a few vegetable fossils. This is in itself a rare and interesting geological fact, and the beds in which it occurs are those which are next below the true carboniferous series.

Secondly, the coal measures approach Canada somewhat closely both on the East and West. In the peninsulas of Canada West, and of Gaspé, we have the Devonian series, the next below the carboniferous. To these succeed respectively the coal-fields of Michigan and New Brunswick, which on the West and East occur just beyond the limits of Canada. In those parts of the province which thus approach nearest to the carboniferous system, it is barely possible that outliers of these carboniferous districts, as yet unobserved, may extend within our limits. The Bowmanville locality is however too far distant from the Western coal-fields to give any likelihood to such a view in this case.

Again it sometimes occurs that locally certain members of the geological series are wanting, and the coal-measures may thus rest directly on beds far older than themselves. For instance at Bowmanville a small and hitherto unobserved independent coal-field, may rest unconformably on the Utica slates. But then in such cases the coal never occurs alone, but in company with shales and sandstones containing fossil plants, and usually also with limestones containing fossils quite distinct from those of the underlying Silurian and Devonian rocks. Coal sometimes even occurs on unstratified or altered rocks, as granite or gneiss; but in those cases it still has its characteristic accompaniments, and it must be observed that such rocks are of all geological ages, many granites being even newer than the true coal formation. A curious misapplication of this fact has we observe been made by one of our contemporaries; but we have determined not to attempt any exposure of the multitudinous errors that are showered upon the public on every side from the press, as these would already in the Bowmanville case, require nearly a whole volume of the *Naturalist* for their full illustration and explanation. If in the Bowmanville case any evidence of the characteristic accompaniments of coal had been adduced, all geologists would at once have admitted the credibility of the statement, without any cavil as to its resting on very old rocks. They cannot do this merely on the assertion of an unknown person, against whose statements all the facts, even those said to be ascertained by his own borings, militate.

Farther, in the transference of materials over the surface, in the so called drift period, fragments of coal derived from distant coal-fields may have been mixed with the superficial tertiary deposits. In coal districts it is not uncommon thus to find loose coal in places where it does not occur in situ. Various circumstances make such an occurrence unlikely in the drift of Canada; and as it must be very limited and exceptional, and could not *a priori* be anticipated, the discovery of such drift-coal in a deep bore-hole is in the highest degree improbable.

Lastly, it is not uncommon to find in the tertiary superficial beds themselves, consolidated peat and imperfect coal (*brown coal*), a substance which exists largely in such deposits in the West and North of America. Such material though not likely to occur in workable quantity, might be of some economic importance. The Bowmanville mineral is however evidently not of this kind.

These exceptional cases taken together, give scarcely a shadow of a hope of coal in Canada, and none of them applies to the Bowmanville case, as it stands at present. We must therefore in the meantime regard this case as beyond the pale of ordinary geological facts, and as either a fraud, a mistake, or a singularly exceptional occurrence only to be explained by further explorations of the locality.

With respect to the mineral itself, it would seem that specimens sent to Prof. Chapman had the aspect of compact bitumen, but other specimens sent to the same geologist and to this city, are true coal, having the aspect, properties and structure of rich bituminous coal of the true coal formation. The writer has submitted small fragments—prepared in a manner which he has applied to numerous specimens of coal from other localities—to microscopic examination, and finds that they afford three distinct kinds of vegetable structure, all found in ordinary coal, and one of them the scalariform tissue characteristic of sigillariæ and ferns. The substance is therefore true coal, formed from the remains of land plants, and not distinguishable from that of the carboniferous system.*

* To prevent farther mistake, it is necessary to add that, since this article went to press, the writer has seen some additional specimens said to be from Bowmanville, some of which are not coal, but appear to be charred wood saturated with some bituminous substance.

With regard to the geological position assigned to the coal of Bowmanville, it appears from the latest statements to be, not the Silurian rocks of the country, but the tertiary clays and sands. This we need hardly say excludes a number of the ways of accounting for it above stated, and almost shuts us up to the conclusion that if a real discovery at all, the coal is a boulder or layer of boulders of coal transported from a distance, no doubt a very unlikely mode of occurrence, when we take into account the usual direction of Canadian tertiary drift from the N. E., and the absence of any known coal within a reasonable distance in that direction. The following is given in a Hamilton newspaper as an authoritative statement of the beds passed through, and it corresponds very nearly with a manuscript boring journal which we have seen, and which was furnished by one of the persons employed.

"A shaft of 60 or 65 feet was sunk last November, then boring for about 90 feet deeper before reaching the coal. The materials were, beginning at the surface.

"1. Fine clay, about 25 feet.

"2. Large boulders, 7 or 8 feet.

"3. Fine clay, 30 feet.

"4. Clean washed lake sand, 20 feet.

"5. Fire-clay, 30 or 40 feet.

"6. The remainder of the distance—nearly 50 feet, a kind of hard pan fire-clay, gravel, stones, and a mixture of clay and sand.

"7. One foot or foot and a-half of a hard substance—rock of some kind, I could not say what on account of sand and clay falling in from the sides, but I drew up small pieces of coarse red sandstone.

"8. Six feet or six feet and a-half of coal."

This section is followed by the very *naïve* remark that it shows "no material which ought according to existing theories to be found above coal." This is quite true, inasmuch as the tertiary sands and clays may, like the green sod, cover anything; but it would be quite a different thing to say that they are the materials usually or ever found immediately above a coal seam. On the contrary the occurrence of coal like that sent from Bowmanville, in situ, immediately under or in the bottom of such a mass, without any of the usual shales, under-clays, ironstones, or sandstones accompanying the mineral, or any of the fossils of the formation, would if possible be more extraordinary than its occurrence in the

Silurian rocks themselves. Prof. Chapman further informs us, in a letter published in a Toronto paper, that the clays are not coal measure fire-clays, but the ordinary tertiary clays, and that the red sandstone of the boring section is merely a boulder of syenite, and the ironstones, said to be found, iron pyrites. Were it not that we are aware of the many uncertainties of such explorations, and of the probability that the parties concerned may misrepresent their own case, we should thus, on the evidence adduced by themselves, be disposed to regard the whole affair as an absurd practical joke. Prof. Chapman we observe has boldly taken this ground, but as in such cases all possibilities should be fully allowed for, and as we cannot perceive in the published accounts any indication on the part of the persons reporting the discovery, of that familiarity with the structure of coal-measures and the operation of boring for that mineral, which could alone give value to their testimony, we are willing to take the most charitable view possible, and even to suppose that, contrary to all probability, they may have, by a rare and marvellous accident, discovered coal in circumstances hitherto unheard of, and therefore beyond all rational anticipation.

In concluding this article it may be useful to group together a few general statements which may serve to prevent misapprehension on the subject.

First. Geologists do not assert that no coal can exist in Canada. They only maintain that all the facts hitherto known to them afford no indication that it does occur.

Secondly. The occurrence of coal in any locality or geological formation not known to contain the mineral, would not effect theoretical geology. It would only extend the amount of facts available for the construction of the theory of the science.

Thirdly. Geologists thus hold no "theory" depending on the non-occurrence of coal in Canada or in the Lower Silurian rocks; and in respect to the latter they would be very glad to obtain so interesting a fact as the evidence of terrestrial vegetation in that period.

Fourthly. Should coal be found in any part of the Silurian district of Canada, the fact would be one of those comparatively rare cases to be accounted for in some of the ways stated above; but geologists will be slow to credit it unless accompanied by evidence of the presence of some of the usual accompaniments of coal, either in its ordinary relations, or in some other of the more rare circumstances above stated.*

Fifthly. Boring operations are so very liable to fraud error, or that they cannot be considered as establishing any fact otherwise improbable, without the further evidence of such inspection as can be made by actually opening up the deposit, or of corroborative facts obtained from surface indications. It is principally the entire want of such facts, and the substitution of irrelevent statements, in the reports now before the public, that causes us at present to doubt, what otherwise would be a most welcome discovery whether in a scientific or practical point of view.

J. W. D.

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* As the ordinary accompaniments of coal have been several times referred to in this article, we give below a characteristic example, being the beds accompanying the main coal of the S. Joggins in Nova Scotia.

	ft.	in.
Shale, gray, passing into black. Modiola in lower part,......	0	6
Shale, calcareo-bituminous. Modiola, Cypris, Fish-scales,....	0	10
Coal and bituminous shale. Poacites, Sigillaria, Spirorbis, Fish-scales, Cypris,....................................	0	8
Underclay. Rootlets of Stigmaria,..........................	3	9
Sandstone, gray. Rootlets,..................................	4	6
Shale and sandstone,..	8	0
•Underclay, hard and sandy below. Roots and rootlets of Stigmaria,...	1	6
Coal impure. Full of Poacites,............................	0	1
Shale and argillaceous sandstone. Plants with Spirorbis, rain-marks?...	7	0
Sandstone and arenaceous shale. Erect Calemites in five feet of upper part; an erect coaly tree passes through these beds and the sandstone below,...............................	8	0
Sandstone, gray. Erect coaly tree as above,................	7	0
•Shale, gray. Roots of coaly tree spread in this bed, ...	4	0
Sandstone, gray,..	4	0
Shale, gray. Prostrate and erect Sigillaria and Lepidodendron, Poacites, Asterophyllites, Ferns, Modiola, Spirorbis on surface of fossil plants, Stigmaria and rootlets,.................	0	6
COAL, *main seam*, worked by the General Mining Association,..	3	6
Shale or underclay. Thins out in working to N.E.,...........	1	6
COAL, worked with main seam,................................	I	6
•Underclay and shale with bands of sandstone,..............	20	0
•Sandstone and clay. Stigmaria stools; on the surface of this bed a thin film of coaly matter [*Coal Mine Pier here.*].....	2	6
Sendstone and shale. Irregular beds,........................	5	0
Shale, gray, with bands of sandstone and ironstone,..........	4	0

	ft.	in.
Sandstone, gray. Two erect stumps. one of them a Sigillaria with Stigmaria roots, erect Calamites....................	2	0
*Shale, gray and Ironstone. Roots and rootlets of erect stumps,	6	6
Coal, impure. Much Poacites,..............................	0	0½
Shale, gray,..............................	0	11½
Coal and bituminous shale. Prostrate trunks and mineral charcoal, ...	0	0½
*Sandstone with clay parting. Stigmaria rootlets and prostrate Sigillaria above the clay parting,....................	3	6
Sandstone and shales with ironstone,......................	12	0
Ironstone-band. Sigillaria, Favularia, Poacites, Ferns, &c.; Spirorbis attached to many of these plants,................	0	3
*Underclays. Rootlets of Stigmaria and carbonized plants,...	2	0
Coal, impure,..	0	1
*Sandstone, Argillaceous. Stools and rootlets of Stigmaria,..	2	6
*Sandstone alternating with shales. In one bed, Stigmaria stools and an erect tree. In another Ulodendron and other trees, prostrate, with Spirorbis attached,..................	10	0
*Shale, gray, passing downwards into underclay. Poacites, Lepidophylla, &c.; an erect tree, Stigmaria rootlets in lower part, ...	3	10
Coal,..	0	3
*Underclay. Rootlets,......................................	0	5
COAL and bituminous shale, in several alternations. Lepidodendron, Ulodendron, Poacites, Lepidophylla. (This is called the Queen's Vein.)......................................	1	9
*Shale, gray. Poacites in upper part. In lower part an underclay with remains of erect stumps,......................	4	4
Coal,..	1	0
*Underclay, black, bituminous, slickensided, resting on hard arenaceous understone. Stools and rootlets of Stigmaria,...	3	0

The remainder of this section, one of the most distinct in the world, may be found in Sir W. E. Logan's first report; and with full illustrations of its fossils, in "Acadian Geology," and in the Journal of the Geological Society of London, 1853.

OBITUARY.

JAMES BARNSTON, M. D.

Since the last number of the *Naturalist* was issued, the most active member of its Editing Committee, and one of the principal and most valued contributors to its columns, has passed to his rest. On Thursday the 20th May last, Prof. James Barnston, M.D., after a long and severe illness, breathed his last, at his residence in Little St. James Street, in this city. The deceased was the eldest son of George Barnston, Esquire, Chief Factor of the Hon. Hudson's Bay Company. He was born at Norway House, in the Territories of that Company, on the 3rd July, 1831 ; and, consequently, at the time of his death, had not completed his twenty-seventh year. He began his studies at Red River Settlement in 1840, and remained there for a period of five years. He was then removed to Canada, where his education was principally of a private nature; but he early distinguished himself by his thirst for knowledge, and especially pursued with assiduity those preparatory studies suited for the learned and honorable profession it was his intention to enter; and of which, had his life been spared, he would have become a distinguished ornament. In 1847 he went to Edinburgh, and entered upon the study of Medicine at the University there. He went through the usual course, and in 1851 passed the final examination for his degree with the greatest credit. Being then under age, he did not receive his diploma till the following year. During the third year of his course he filled the post of House-Surgeon to the Royal Maternity Hospital; an office which he resigned on passing his examination. He subsequently became assistant to a Physician in extensive practice in the town of Selkirk and adjacent country; but on receiving his diploma in the Spring of 1852, he went to the continent, with the view of "walking" the Hospitals there, acquiring additional knowledge of his profession, and completing his medical studies. He remained there over a year, principally in Paris and Vienna, and received the highest certificates from the Medical Directors of the

Hospitals where he attended. In October, 1853, he returned to Canada, and commenced practice in Montreal; and, consequently, at the time of his death he had been upwards of four years a Physician in our city.—We have said that he graduated at Edinburgh, before his twenty-first year, with the highest honors. During his stay at the University he carried of several prizes, two of which were for Botany, one of his favorite studies. In Medical Science, Midwifery was the particular branch to which he devoted himself. He made it indeed, to some extent, a special duty. In the year 1857 he was appointed to the newly-established chair of Botany in McGill College; and had nearly completed his first course of lectures when prostrated by illness. His class-lectures were distinguished by an intimate knowledge of his subject, clearness of illustration, and appreciation of the difficulties of learners, which gave earnest of the highest success as a teacher of this delightful branch of natural science. During his studies in Scotland, he made a large collection of Botanical Specimens; and it was his delight, when time and opportunity offered, to add to and increase this from the great variety to be found on the Mountain, and in the vicinity of Montreal. He had commenced a detailed catalogue of Canadian plants, which it is hoped may be sufficiently advanced to be in part, at least, published; and which would have given him a high place in American Botany.—Dr. Barnston held until the time of his death the office of Curator and Librarian to the Natural History Society. He was one of its most valued members, and foremost and most active friends. He read many interesting papers, and delivered many delightful, and instructive lectures, before its members; and among those of his own age, whom he has left behind, we fear the Society will find few upon whom his mantle will fall.—In private life, the Doctor was quiet, unassuming and gentle. There was something about him which provoked to love; and to those with whom he was intimate, he was a friend indeed. For a young man, who had so lately entered upon the practice of a profession numbering so many old and honored members, he enjoyed a large share of the public patronage; and his devoted attention at the bed-sides of his patients, and the uniform kindness and gentleness which characterized his treatment of them, would in time have assuredly gained him an extensive practice. A constitution naturally delicate, and ardent devotion to his scientific and professional pursuits, conspired to invite and hasten the inroads of disease; but, unwilling to abandon his cherished fields of usefulness and study, he held out to the last, and worked until the night had come. He then resigned himself meekly to the will of God. His sufferings at times were very severe; but he bore them with resignation; and his end was peace. He was a member of the Church of England; and was cheered by the prayers of its Priests, and received at their hands the Holy Communion shortly before his last hour came. He leaves behind him a young wife, to whom he had been married scarcely a year, and an infant daughter. It were vain in us to attempt to console them under their sad bereavement. But God tempers the wind to the shorn lamb. The husband and the father is not lost, but gone before. He cannot return to us; but if we strive, and watch and pray, we shall assuredly go to him:—

> "'Tis sweet, as year by year we lose
> Friends out of sight, in faith to muse
> How grows in Paradise our store.
>
> "Then pass ye mourners cheerly on,
> Through prayer unto the tomb,
> Still, as ye watch life's falling leaf,
> Gathering from every loss and grief
> Hope of new spring and endless home."

Dr. Barnston's remains were interred on the Monday following his decease. The Principal, many of the Professors and Students of McGill College, the Dean and a large number of the Medical Faculty, and a great concourse of friends, followed him to the grave. He sleeps in a quiet nook in our new Cemetery—on the side of that Mountain he has so often traversed, in order to gather fresh specimens of plants and flowers, to illustrate and adorn the science he loved so well.

A. N. R.

ANNUAL MEETING OF THE NATURAL HISTORY SOCIETY.

At the Annual General Meeting of the Natural History Society of Montreal, held on Tuesday evening, May 15th, 1858,—

Present:—Principal Dawson, President, in the chair; Doctors Wright, Fenwick, Jones, Fraser, Craik, Hingston, and Kolmeyer; and W. H. A. Davies, H. Rose, T. M. Taylor, E. Murphy, Jno. Leeming, Jos. T. Dutton, Hen. Bouker, A. N. Rennie, D. Robertson, Esqrs.

The Report of last Annual Meeting of the Society was read over and confirmed.

The Reports of the Council, Curator and Librarian, and Treasurer, were presented,—(they will be found below.)

On motion of Mr. Davies, seconded by Mr. Leeming, it was ordered, That the Report of the Council, with those of the Curator and Treasurer, be received and printed under the direction of the Council.

The meeting then proceeded to the election of officers for the ensuing year, and

Messrs. Rose and Murphy were appointed Secretaries.

The election of Officers by ballot resulted as follows:

Principal DAWSON, *President*, elected unanimously.

Rev. A. DE SOLA, LL.D.,............... 1st. *Vice-President*.

The Anglican Lord Bishop of Montreal,..2d. "

E. BILLINGS, Esq.,.....................3d. "

Dr. HINGSTON, ...*Corresponding Secretary*.

JNO. LEEMING, Esq.,.....*Recording Secretary*.

JAS. FERRIER, Jun., Esq., *Treasurer*.

Dr. FENWICK, ...*Curator and Librarian*.

W. S. M. D'URBAIN,.....*Sub-Curator*.

COUNCIL:

Dr. JONES. Dr. FRASER. A. N. RENNIE, Esq.
W. H. A. DAVIES, Esq. W. CHAPMAN, Esq.

It was then moved by Mr. Murphy, seconded by Mr. Rose,

That the Secretaries be added to the Publishing Committee, which was carried unanimously.

Mr. Taylor, moved, seconded by Mr. Robertson,

That the thanks of the Society are hereby given to the retiring Office-bearers and Council for their valuable and efficient services during the past year. Carried unanimously.

After some conversation on the subject, it was moved by Mr Taylor, seconded by Mr. Rose,

That the Council be authorised to sell the building in the possession of the Society, for such sum as they can obtain not less than two thousand pounds, clear of brokerage and seignorial dues, and that the details of the arrangement be left with them,—which was carried.

The meeting then broke up.

Annual Report of the Council of the Natural History Society of Montreal, for the year ending May 18th, 1858.

The Council of the Natural History Society have the honor to lay before the members, the following Report of the condition and proceedings of the Society during the past year, along with some suggestions for the consideration of their successors in office.

The Council have much pleasure in noting that the past year has been one of marked interest to the students of natural history in this city. In the month of August last, we had the honor and pleasure of giving a hearty welcome to "The American Association for the Advancement of Science," which met for the first time in this city and province. This meeting has been the most noteworthy event which has ever happened in the history of the Society. Mainly through the efforts of the Society was this meeting brought about. In conjunction with influential citizens of Montreal, you invited the Association to meet here in the year 1857. This invitation having been cordially accepted, your Council, co-operating with the Local Committee of the "Association," made every effort to provide suitable accommodation for its several meetings, and for the hospitable entertainment of its members. These efforts, the Council are happy to report, were eminently successful. In the most prompt and cordial manner the Court House, with its halls and rooms, so admirably adapted for the purposes of the "Association," was put at the disposal of the Local Committee. The City Council also freely granted the use of the City Hall to your Society, for the public entertainment of our guests.

In accordance with the resolution of the Society, a portion of the funds granted by the Legislature for the reception of the "Association," was appropriated for a public Conversazione in the City Hall. This meeting was held on Thursday, Aug. 13, 1857, and was attended by about 800 of our fellow-citizens, who welcomed with much satisfaction the officers and members of the "Association." Considering our inexperience in the management of such large assemblies, it was yet most gratifying to witness the general excellency of the arrangements, and the complete success of the entertainment. For the interest of the meeting your Council were successful in obtaining for exhibition the celebrated Indian curiosities and pictures, the property of Paul Kane, Esq., who, with a liberality worthy of all praise, placed these valuable objects freely at our disposal.

The Council feel that they not only express their own sentiments, but also those of every member of this Society, when they state that the opportunity which this scientific convention afforded them of meeting with so many gentlemen of scientific celebrity, was in the highest degree gratifying, and an honor which they highly appreciate. We had then amongst us the distinguished representatives of the Geological and Linnean Societies of Britain, together with the savans of the United States and Canada, vying with each other in the exposition of their scientific discoveries. Many valuable papers were read, and facts of interest and value elicited in discussion, in the various sections into which the Association was distributed. In the more popular departments of geology and ethnology the citizens generally took a deep and appreciating interest. In the various sections it was also gratifying to note the cordial reception and honorable position accorded to the representatives of Canadian science. May we not indulge the hope that a Canadian Scientific Associaion may soon be organized, and take an honorable place alongside of similar institutions in Europe and America?

Your Council have good reason to believe that this most successful meeting of the "American Association" has awakened an interest in scientific pursuits, both in this city and in the province at large, which will yet prove most beneficial in its results. Your Society has, undoubtedly, reaped much advantage from this event. Its zealous members have been greatly cheered, its numbers considerably increased, and hopes have been awakened, that it will yet occupy a higher position of scientific eminence than that to which it has yet attained.

The Council report with regret that their sanguine expectations of being able to proceed with the erection of a new and more commodious building than that which the Society now occupies have been frustrated. In the report of last year it was announced that a site had been obtained, on very liberal terms, from the Governors of McGill College, that plans had been prepared for the building, that contributions to a considerable amount had been subscribed, and that we only waited a favorable offer for the purchase of the present building to commence operations. This last and indispensible step to further progress has, contrary to their expectations, not yet been carried into effect. In these circumstances the Society must wait a more favorable season for the prosecution of this good project. Your Council are equally of opinion with their predecessors, that the premises now occupied are most unsuitable in many important particulars, either for a museum, library, or lecture room, and that no great improvement can be expected in any of these departments until a building erected for their special use has been obtained. The Council would earnestly commend this matter to the immediate consideration of their successors.

Your Council have also to report that petitions have again this year been presented to His Excellency the Governor General, and to both Houses of the Legislature, urging them, from public and national considerations, to grant a more liberal sum of money to the Society for scientific purposes, than we have hitherto received. It may be confidently said that there is no scientific institution in the country so comprehensive in its aims as ours is, possessing a larger collection of scientific objects than our museum contains, or publishing transactions on natural history of greater scientific value than are to be found in our Journal—these facts, we therefore think, entitle us to some more marked consideration at the hands of the Legislature than we have yet obtained. We deem it at least but justice that this, the oldest and not the least honorble of the incorporated institutions of the country, should be placed upon an equal footing as regards public support with the Canadian Institute of Toronto. Hitherto we have been left mainly to our own efforts and resources in arranging and furnishing our museum and library; and the building we now occupy, together with our valuable collections in zoology, geology, and ethnology, testify to the liberality of our members and friends. But it is now felt that if the Society is to take that place which the rapid progress of modern science demands, large additions *must* be made to its museum and library, and some method adopted to keep alive a public interest in its proceedings. This last desirable object the Council think would be best attained by the publication and gratituous distribution of our transactions among the members. Preceding Councils have advised and attempted this, but as yet without success. With our limited income such a step has hitherto been quite impossible. It is therefore to be hoped that the prayer of our just and reasonable petition to His Excellency the Governor and to the Legislature will meet with a favorable response.

LECTURES.

Your Council have much pleasure in reporting that the series of Lectures, in accordance with the Somerville bequest, have been of much interest this season, and been generally well attended. The gentlemen who have lectured with so much acceptance are all members of your Society, and are entitled to your thanks for their zeal on its behalf. The Council deem that it would be an improvement, did your funds permit, to invite some of the distinguished naturalists of Britain, the United States, or Canada West, to take part in these lectures. They would commend this matter to the consideration of their successors, hoping that means may be found to carry it into effect.

The subjects of the lectures are as follows:—

Things to be observed in Canada and especially in Montreal and its vicinity, by Principal Dawson, the President, 25th February.

Scripture Botany, by the Rev. A. DeSola, LL.D., 4th March.

On the Alkalies, by T. S. Hunt, Esq., 8th March.

Marine Algæ, by the Rev. A. F. Kemp, 18th March.

The Boracic Acid Springs of Italy, by Mr. Dutton, 25th March.

MUSEUM.

The Council have much pleasure in reporting that the Museum has undergone a thorough review and re-arrangement, under the able superintendence of Mr. W. S. M. D'Urban, for some time our sub-curator. The departments of Ornithology and Mammalia have been carefully classified, and many new specimens added. Upon each object the specific name has been placed; and the divisions of genera, family and class, have been noted and labelled. The Ethnological collection has also been judiciously arranged and described. The valuable collection of Minerals and Fossils, which had hitherto been in much confusion, has likewise been revised and classified by the careful hands of Mr. D'Urban. In the department of Entomology many new species and some new genera have been added to the collection by the sub-curator; and the Council would specially note, in this connection, the valuable cases of classified British Lepidoptera which Mr. D'Urban has presented to the Society. This gift is of no small scientific value, pertaining as it does to a department in which the Museum was very defective. Mr. D'Urban having retired from the service of your Society, the Council cannot permit this opportunity to pass without stating their high estimate of the value of his laborious, zealous and efficient services, especially in preparing the Society's collections for the meeting of the "American Association," as well as for public exhibition and scientific use. The Council would recommend that some skilled naturalist be occasionally employed to overlook the collection, to attend to its preservation, and to add new specimens to the genera that are yet only partially or not at all represented in the Museum.

The contributions which have been sent to the Museum, and for which the thanks of the Society have been awarded to the donors, will be found at the end of this report.

LIBRARY.

The Library Committee have reported to the Council that no great additions have been made to the Library during the past year. The 2 vols. of the "Contributions to the Natural History of the United States," by L. Agassiz, and "Blodgett's Climatology," have been purchased; and several books and papers of value presented to the Society, by Authors and Societies, a list of which will be found below. The Committee have carefully classified the volumes, and labelled the departments, so that the works we possess may be readily referred to. There is no department of the Society's collection in which the Council feel so little satisfaction as that of the Library. Its progress has not at all kept pace with the advancement of knowledge. While it contains some ancient volumes of much value, and several modern works of scientific note, it is still extremely defective in books of recent publication, without which it is scarcely entitled to the name of a Scientific Library. The Council hope that means may ere long be found to supply this manifest defect, and to make your Library worthy of its name.

THE CANADIAN NATURALIST AND GEOLOGIST, AND PROCEEDINGS OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

The Committee appointed to edit this journal report to the Council that a second volume has been successfully completed, which, as regards matter, illustrations and printing, admits of most favourable comparison with any similar publication.

In this volume will be found not only original articles on subjects of Natural History, but also articles of scientific value and novelty, extracted from the journals of Europe and America. The desire of the Editors has been to assist young naturalists in their studies, and to awaken an interest in the pursuits of Natural Science in this country, in which they believe they have not altogether been unsuccessful. Such was the design of Mr. Billings, its original projector and editor, and they would recommend that the same plan be pursued in succeeding volumes.

The Editors deem that Mr. B. Dawson, the publisher, is entitled to the thanks of the Society for his liberality and readiness in furnishing all necessary illustrations for the articles, and also in contributing to the Society several copies for exchange, and distribution among learned Societies. They have pleasure in reporting that the circulation of the magazine is already considerable and encouraging; they would, however, urge upon all interested in the advancement of Canadian Science the importance of so increasing the subscription-list as to place the Journal on a self-supporting and even a profitable basis.

The second volume, just completed, contains twenty-nine original papers pertaining to the various departments of Natural History, all of which have been contributed by gentlemen connected with the Society. The valuable Meteorological tables of Professor Smallwood, of St. Martin, are also published monthly. These, with the Selected Articles, Reviews of Scientific Publications, Proceedings of Societies, and Miscellaneous Intelligence, make this magazine a work not only of periodical but also of permanent value.

The *third* volume now in progress, of which the *second* number has been issued, will contain, in addition to the usual matter, the Meteorological Observations of Prof. Hall, of Montreal; and, from the experience acquired during the past year, the Editors trust that the third volume will be even more interesting and valuable than its predecessors.

The "Canadian Naturalist" is now a good vehicle for the publication of investigations and discoveries in the Natural History of Canada. It has a wide circulation in Canada, the United States and Europe. The Committee are therefore in a position to invite communications from those engaged in scientific pursuits, Short statements of interesting facts will be equally acceptable to the Editors as more elaborate papers.

The Committee beg to draw the Society's particular attention to the fact, that this Journal of admitted value to science, although edited by its members, is not published at the cost or risk of the Society; but is entirely supported by its own subscribers, and issued at the risk of the publisher. The members of the Society have therefore no special privilege in regard to it, and can only obtain it on payment of the full subscription price, over and above their annual subscription to the Society. This is a state of things which your Committee cannot regard as satisfactory. The Committee are decidedly of opinion that it would be most beneficial to the Society, were each member to receive a copy of the Journal gratuitously, on the payment of his annual subscription. Nothing they conceive would more materially promote the interests of the Society or the advancement of that department of science with which it is identified than this. They therefore deeply regret that the Society's funds will not admit of such a desirable object being immediately carried into effect. They cannot help comparing their condition, in this respect, with that of the Canadian Institute of Toronto. That Society has been able, by a liberal annual parliamentary grant, to give its Journal gratuitously to its members and to circulate it widely among the scientific institutions of America and Europe; whereas our Society, older, and equally devoted to the advancement of Canadian science, has hitherto been all but left to its own resources. It is therefore to be hoped that the Legislative aid for which we have again applied, will this year be granted, so that we may be able to assume our just position as a Canadian Scientific Institution. The publication of our Journal for circulation among our members, and for distribution as a vehicle of scientific research among learned societies, is one of the chief objects, on account of which we have again urged our petition upon the Legislature. Your Council are of opinion that this is a step of the utmost importance to the future welfare of the Society, and would recommend that it be prosecuted with perseverance and energy by their successors.

The Council would further notice, that, during the past year the monthly meetings of the Society have been regularly held, and sustained with some spirit. At each meeting one hour has been devoted to business, and the remainder of the evening to the reading of scientific papers and to discussions on topics of natural history.

As most of these papers have been or will be published in the Journal, it is unnecessary further to refer to them here. The Council trust that the next year will be one of even greater activity and zeal than the past. A wide field of investigation is open in this province to the students of natural science. Some departments have not yet been touched, and many are but partially treated. This Society offers to the lovers of nature a happy stimulant to exertion, together with the fellowship of kindred minds, and a medium through which discoveries may be communicated to the world.

Report of the Curator and Librarian.

The Curator has reason to congratulate the Society upon the marked improvements in the general appearance and actual value of the Collections in its Museum and Library. This will be adjudged from the following report of Mr. W. S. D'Urban, Sub-Curator, whose services to the Society can now be fully appreciated :—

REPORT OF THE SUB-CURATOR.

Prof. James Barnston, M.D., Curator :

Sir,—In compliance with your request, that I would draw up a short statement of the arrangements effected by me in the Museum of the Society during the time I had the care of the collections, I beg to submit the following brief summary of them.

In the first room to the left, on the second floor, I have assembled all the Vertebrate Animals, with the exception of the Birds. The Canadian Mammalia are cased separately, and are classified and named. A few foreign specimens, belonging to such orders as are not represented in Canada, are also cased and stand next to those of this country. Such specimens as are of too great size for the cases occupy the middle of the floor. This room also contains two large cabinets of specimens illustrating Comparative Anatomy, two cabinets of Reptiles (Canadian and Foreign), and one case of Foreign Fish. The walls are hung with Deer's Heads and Antlers, and various parts of Vertebrated Animals are disposed in the remaining vacant portions of the room.

The room adjoining the last has the side on the right entirely devoted to the Invertebrata. There are here displayed twelve cases of Insects systematically arranged, one large case of Crustacea, one of Echinodermata, and one of Polypi, whilst various fine specimens of Corals are exhibited on the walls and underneath the cases. Two other sides and the centre are occupied by ten flat cases on tressels, respectively devoted to Miscellaneous Objects, Pottery, Objects of Historical Interest, Articles of Clothing of various nations, Objects of Interest from Battle-fields, North American Antiquities, Roman Antiquities from Pompeii, Vegetable Substances, Coins, Medals and Medallions. The walls above are hung with the weapons of different races of men, and various other Ethnological specimens. On the remaining side of the room stands the large cabinet containing the fine Botanical Collection, and round it are hung various Vegetable substances.

The long room on the other side of the passage, opposite the Mammalian Room, contains the collection of Mounted Birds, three sides being devoted to North American species, the whole of which are grouped under their respective families and orders, and to each specimen is attached a printed label indicating its scientific and English name; to which I have added, whenever practicable, its sex, locality, &c. The fourth side is allotted to Birds from various parts of the world, of which there is a large collection, as yet only partially arranged. There is also a case containing a small collection of Foreign Nests and Eggs. In the centre of the room are two long table-cases: one contains a considerable collection of Foreign Shells, arranged under their proper families; and the other, when the specimens are numerous enough, will be filled with Canadian and American species.

In the Curator's room, adjoining the Bird Room, is placed a large chest for Bird-skins, collections of Insects, &c., for which there is no available space in other parts of the Museum.

The room on the ground floor opposite the Library contains the whole of the extensive collection of Minerals, as well as those of Fossils and Geological specimens, all of which have been cleaned and neatly arranged.

It will thus be seen that every branch of Natural History is more or less fully represented in the Museum. My aim has been to exhibit as prominently as possible everything which might tend to illustrate Canadian Natural History, and to arrange the specimens in such a manner as would give a clear idea of their scientific classification. The shortness of the time allotted me, the number of subjects to be attended to, and the small means at my disposal, will I trust be taken into consideration and admitted as some excuse that these objects have not been carried out as successfully as could have been wished; and I am glad that I can report the collections in, at least, tolerable order and good preservation.

I have the honor to be, Sir,
Your obedient servant,
WILLIAM STEWART M. D'URBAN,
Sub-Curator.

Montreal, May 10th, 1858.

The Curator may observe here, that a considerable number of Birds, some of our smaller Mammalia, as well as numerous Reptiles, Insects, Mollusks, &c., have been added to the Museum during the past year, besides the articles contained in the subjoined list of donations; a portion of which were presented by the Sub-Curator, and the remainder acquired by purchase.

The following list of Donations to the Museum and to the Library, is respectfully submitted.

JAMES BARNSTON, M.D.,
Librarian and Curator.

Montreal, 18th May, 1858.

DONATIONS TO THE LIBRARY, 1857–58.

Statutes of Canada, 1857; in French and English; 8vo., half-calf; two copies.
Journal of the Legislative Assembly, with Appendices; 10 vols., 8vo., half-calf.
Maps appended to Report of the Commissioner of Crown Lands, 4to., half-calf.
Table des Statuts Provinciaux en force dans le Bas Canada, 1857; 8vo., half-calf; 2 copies.
Report of the Canada Geological Survey for the years 1853-54-55-56; 8vo., cloth; 2 copies.
Journal and Transactions of the Board of Agriculture of U. C.; No. 4, Vol. 1.
Report of the Commissioners of Crown Lands of Canada for 1856, 8vo.
Bombay Magnetical and Meteorological Observations, 1854-55, 4to., bd., ... H. E. I C.
Report of the Superintendant of the U. S. Coast Survey for 1855; 4to., cloth, } Geo. F. Houghton, Vermont.

Smithsonian Institution Reports for 1855 and 1856; 2 vols., 8vo., cloth. Smithsonian Contributions to Knowledge, Vol. IX.; 4to., cloth.	Smithsonian Institution.
Annual Report of the Board of Regents of the Smithsonian Institution, Washington, U. S., 1855-56, 1 vol.	
Patent Office Reports for 1853-54-55; 8vo., cloth; 6 vols.	U. States Patent Office.
Fourth Annual Report of the Sec'y. of the Massachusetts Board of Agriculture; 8vo, cloth. Report of Commissioners on the Artificial Propagation of Fish; pamphlet. 14th Annual Report relating to the Registry and Returns of Births, Marriages, Deaths, &c., in Massachusetts for 1855.	C. L. Flint, Secretary to the Massachusetts Board of Agriculture, Boston.
Catalogue of the N. Y. State Library 1856, Maps, Manuscripts, &c.; 8vo., half-calf, Annual Reports of the Trustees of the N. Y. State Library for 1855-56-57, 17th Annual Report of the Regents of the University of the State of N. Y., 1857; 8vo., cloth. Eighth, Ninth and Tenth Annual Reports of the Regents of the University of N. Y. on the condition of the State Cabinet of Nat. Hist., &c. A Report of the Navy Department of the U. States on American Coals, 1844. Various Pamphlets.	The Regents of the University of the State of New York.
Report of the Sanitary Commissioners on the Epidemic Yellow Fever of 1853, 8vo. Proceedings of the New Orleans Academy of Sciences. Vol. 1, No. 1. Constitution and By-laws " " " Annual Address read before the " " by Prof. J. L. Riddell, 1856. Report of the Special Committee of " " on the importance of a Geological Scientific Survey of the State of Louisiana. Papers relating to the Coal-field on the Upper Machita River. A Sketch of General Jackson, by himself.	New Orleans Academy of Sciences.

Bulletin of the Geographical and Statistical Society of New York, 2 vols.

Address to Natural History Society of New York, pamphlet.

Reports I. and II. Geological Survey of Missouri, U. S., by Prof. J. C. Swallow, State Geologist, 1 vol.

Catalogue of the Human Crania in the Collection of the Academy of Natural Sciences of Philadelphia, by A. Meigs, M. D., Librarian, 1 vol.

Proceedings of the Academy of Natural Sciences of Philadelphia from pages 17 to 72.

The Canadian Journal of Industry, Science, and Art, conducted by the Editing Committee of the Canadian Institute, Toronto.

The Journal of Education for U. C. Vols. 2, 3, 4, 5; 4to. Correspondence on the Subject of the School Law for Upper Canada. Annual Reports of the Model and Common Schools in U. C. for 1848 and '49.	Rev. E. Ryerson, D.D.

Lower Canada Journal of Education, French and English, 2 vols.; presented by the Hon. J. O. Chauveau.

Agassiz's Contributions to the Natural History of the United States of America; 2 vols., 4to. cloth.

Binney's Terrestrial Mollusks and Shells of the United States; 3 vols., 8vo. half-calf. — Dr. Gould, in accordance with will of author.

Blodget's Climatology of the U. S., imp., 8vo........ B. Dawson.

The Canada Educational Directory and Calendar for 1857-8.

Catalogue de la Collection Envoyee du Canada a l'Exposition de Paris, 1855; 12mo.
Letter of Chief Engineer in reply to Resol. of Council for information respecting Water Works.
Report of the City Surveyor of Montreal, 1853.
Les Servantes de Dieu en Canada. — L. A. H. Latour.

Hind's Essay on the Insects and Diseases injurious to the Wheat Crops, 8vo. cloth; 3 copies.

Annals of the Lyceum of Nat. Hist. of N. Y. Vol. 5, and part of Vol. 6. — Lyceum of Nat. Hist., N. Y.

Transactions of the Academy of Sciences, St. Louis. No. 1. — Acad. Sciences, St. Louis.

Report on Strychnia, by Lewis H. Steiner, M.D.; pamph. The Author.

Address delivered before the Am. Assoc'n for the advancement of Learning at Montreal, 1857, by Hon Charles Mondelet...................... The Author.

Natural History in its Educational Aspects, by J. W. Dawson.................................. The Author.

On the occurrence of Natro-boro-calcite with Glauber Salts in the Gypsum of Nova Scotia, by Prof. Henry How............................... The Author.

Report on the Artificial Propagation of Fish......... H. Wheatland.

Address at the Opening of the 103rd Session of the Society for the encouragement of Arts, Manufactures and Commerce, by Col. W. H. Sykes, 1856.

Notes sur les Registres de Notre Dame de Quebec.

Annual Announcement of Jefferson Med. College, Philadelphia, 1857-8.

Proceedings upon the Dedication of Plummer Hall at Salem, Oct. 6, 1857.

A Geological Map of Wisconsin, by J. A. Lapham... The Author.

Illustrated Map of British Guiana, mounted with roller. W.S.M. D'Urban.

Remains of Domestic Animals discovered among the Post-Pliocene fossils, by Prof. F. S. Holmes, Charleston, S. C.

DONATIONS TO THE MUSEUM.

A Box containing a large quantity of Tertiary Fossils, Talcohuano Bay, Chili, S. A.
A Box containing Fossils from supposed Coal measures. Aranco Bay, Chili; and a specimen of the Coal.

Two Fossil Trilobites; Belleville, C. W............J. H. Merchell, Esq.

Collection of Interesting Relics, numbering 29 specimens, from Sebastopol and other localities in the Crimea..............................Dr. Gibb.

Snake (in Spirits) from heights of Inkerman.........J. T. Dutton, Esq.

Skeleton of Common Rat........................Dr. Fenwick.

2 Specimens of Cancer Sayii, Sable Island ....Prof. Dawson.

3 Specimens of Clypeaster, Nova Scotia,............ " "

Collection of British Birds' Eggs ....
Egg of Rhea Americana..........................
Gar-fish of the Atlantic, in spirits .... — Philip Holland, Esq.

Chinese Lady's Shoes ....
2 Bamboo Jars inscribed with Chinese Characters ... — Capt. Brown, of Bark *Emily*.

7 Cases British Lepidoptera, containing upwards of 400 species, named and arranged. "Pepper-pot" Bowl used by Natives of Demerara.	W. S. M. D'Urban.
A valuable collection of Rocks and Minerals from the volcanic regions of Italy	Geo. Platt, Esq.

REPORT OF THE FINANCE COMMITTEE.

The Special Committee appointed to report on the Finance operations of the Society for the year ending 18th May, 1858; beg to state that they have examined the Treasurer's Book and vouchers, (a recapitulation of which will be found annexed), and find that the general statement is much larger than usual, owing to the government grant and disbursements on account of the meeting of the American Association in this city in August of last year.

The amount received from subscribers during the past year is somewhat larger than the previous one, but not near so much as your Committee think ought to be obtained from our citizens, if a right appreciation of the great benefits the Society does and will confer was more generally felt, and they recommend renewed exertions on the part of the Society to bring its claims before the public, and especially do they desire to express their hope that this Society will be placed on the same footing as regards Parliamentary aid as its respected "younger sister" in Toronto, which is enabled to place its periodical in the hands of every one of its members in return for their subscription to the Society. If your Society could obtain similar favor from the Government, and be thus enabled to place its "bi-monthly Canadian Naturalist" in the hands of each of its members, it is not too much to expect that their number might readily be trebled, its efficiency very largely increased, and the Society placed on a footing which its antecedents and present prospects, justify your Committee in predicting would be alike honorable to the city, and greatly conducive to the promotion of the objects for which it was instituted.

Your Committee would draw attention to the very large amount paid for advertising and printing, and recommend rigid retrenchment in those items.

Your Committee believe that with an increased revenue for the coming year, arising from additional membership, as well as an additional grant from Government, with greater economy in advertising, &c., the fiscal affairs of your Society will continue to improve, and cease to be a source of anxiety to your officers, and permit them to avail themselves of purchases for its legitimate objects, which they regret to learn have, in some cases, been impracticable for want of necessary funds.

The whole nevertheless respectfully submitted.

Wm. Edmonstone,
James Ferrier, Jr.,
John Leeming.