THE CANADIAN

RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF

THE NATURAL HISTORY SOCIETY OF MONTREAL,

AND REPLACING

THE CANADIAN NATURALIST.

VOL. IV, (1890-1891.)

MONTREAL:

PUBLISHED BY THE NATURAL HISTORY SOCIETY,

1891.

CONTENTS OF VOLUME IV.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. IV. JANUARY, 1890. NO. 1

On New Plants from the Erian and Carboniferous, and on the Characters and Affinities of Palæozoic Gymnosperms.

By Sir J. William Dawson, L.L.D., F.R.S.

In Palæo-botany it often happens that some specimen recently discovered opens up a multitude of new questions respecting former acquisitions. A noteworthy instance of this in my recent experience, has been the kind communication to me by Mr. R. D Lacoe of Pittston, Pennsylvania, of some specimens of Palæozoic Gymnosperms obtained by him in the Catskill and Carboniferous of Pennsylvania. One of these is a large slab containing a leafy and fruit-bearing branch or stem of a new plant allied to Cordaiteæ on the one hand and to Nœggerathiæ on the other, and remarkable for its exhibiting in connection parts usually found separately. Another is a set of specimens of certain peculiar organs of fructification referred by European palæo-botanists to the genus *Dolerophyllum*, allied to *Nœggerathia*, and which have not, so far as I am aware, been previously found in America. About the same time Mr. Francis Bain, of North River, Prince Edward Island, had placed in my hands some very interesting examples of the stems known as *Tyloden-dron,* which occur not infrequently in the Permian of that Island, and of which he has found the leaves and probably the fruit along with stems shewing markings and structure.

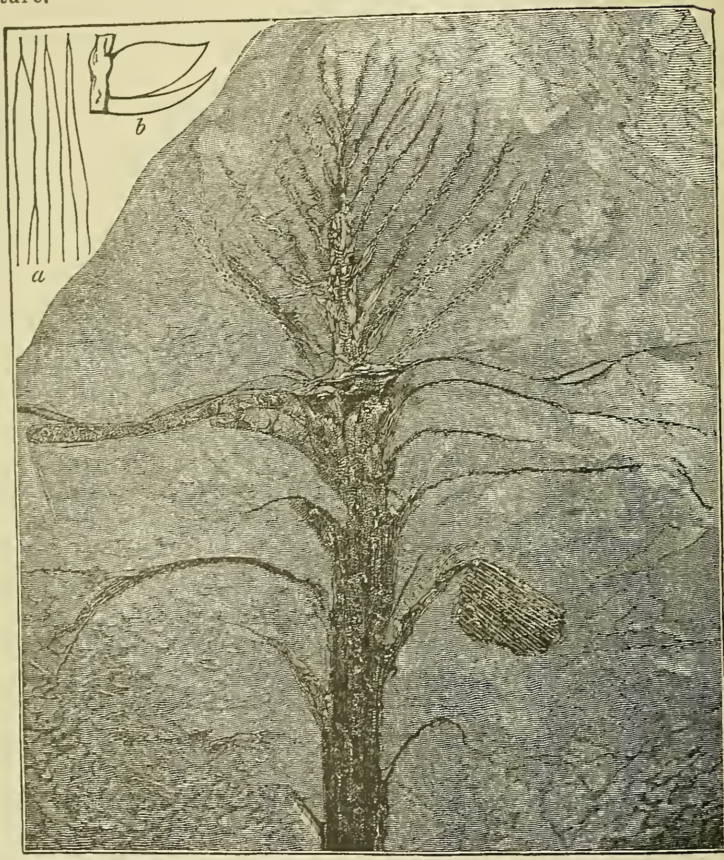


FIG. 1. Dictyo-cordaites, Lacoi—much reduced; (*a*) venation of leaf nat. size; (*b*) seed and bract, enlarged.

A short notice of Mr. Lacoe's remarkable specimen was sent at once to the American Journal of Science,[1] but the

[1] July, 1889.

questions raised by this and the other specimens demanded a more detailed investigation; and I now wish to base on this, and the other specimens above referred to, some general remarks on our present knowledge of Palæozoic Gymnosperms, and more especially on those of North America.

Mr. Lacoe's large specimen, for which I have proposed the generic name *Dictyo-cordaites* in reference to its peculiar netted venation, may be described as follows[1]:—

DICTYO-CORDAITES LACOI, Dawson. (Fig. 1)

The specimen is a branch or small stem $2\frac{1}{2}$ cm. in diameter and 46 cm. in total length. It is flattened and pyritised, and shows, under the microscope, only obscure indications of the minute structure, which would seem to have consisted of a pith surrounded by a fibrous envelope and a bark of no great thickness. It would appear, therefore, to be exogenous with a thin woody cylinder and large pith. The stem shows portions of about 15 leaves, which have been at least 16 cm. long and 3 to 4 cm. broad. They are spirally arranged and are decurrent, apparently by a broad base, on the stem. Their distal extremities are seen in a few cases, but in all seem injured by mechanical abrasion or decay. It seems most probable that they were truncate and uneven at their extremities. The stem is terminated by a cluster or compound corymb of spikes of which 20 are seen. They are slender, but seem to have been stiff and woody, and the largest are about 15 cm. in length. The peduncles are knotted and wavy in outline, as if dry and woody in texture when recent. In this they differ from most of the ordinary Antholites, but agree with my *A. Devonicus*,[2] and also with *A. rhabdocarpi* of the Carboniferous[3] which they resemble in the form and arrangement of the fruit. They have short

[1] I am indebted to Professor Penhallow, of McGill University, for his kind aid in the study of the specimen.

[2] Fossil Plants of Devonian and Upper Silurian, 1871, Plate XIX.

[3] Journal London Geological Society, 1867, Plate VII.

pointed bracts, and some of them bear oval fruits, but only a few of these remain, the greater part of them having apparently fallen off before the plant was fossilized. There may have been about 50 to 100 seeds or fruits on each peduncle, and they seem to have been spirally arranged. So far the characters do not differ from those of the genus *Cordaites*, except that in those plants the spikes of fructification are more usually lateral than terminal. Grand 'Eury, however, figures[1] one form of *Cordaicladus* in which they are terminal.

The most remarkable peculiarity, however, appears in the leaves, which instead of having the veins parallel, have them forking at a very acute angle, and slightly netted by the spreading branches of the veins uniting with the others near them. This allies the leaves with those of the provisional genus Nœggerathia, some of which have this peculiarity, as also certain modern Cycads of the genus *Zamia*, which Professor Penhallow has kindly pointed out to me. Leaves with forking veins and even anastomosing to a certain extent, are also known in certain fossils of the genera *Otozamites* and *Nœggerathiopsis*, &c., which are referred to Cycads, and the modern Cycadaceous genus *Stangeria* has forking veins. The present plant would seem to be a form of Cordaiteæ, tending to *Nœggerathia*, which most paleo-botanists believe to have been a gymnospermous genus allied to *Cordaites*. The affinities however, so far as can be judged, are nearer to the latter; and following the example of Grand 'Eury in his nomenclature of the genera, I would propose the name *Dictyo-cordaites* for the present genus, and the specific name *Lacoi*, in honor of its discoverer. I may add here that the general aspect of this plant must have been so near to that of a Carboniferous species of Cordaites, as restored many years ago in my Acadian geology,[2] that I reproduce the figure here.

[1] Flore Carboniferœ, Pl. XXV, Fig. 4.

[2] Second Edition, 1868, Page 458, figure 172.

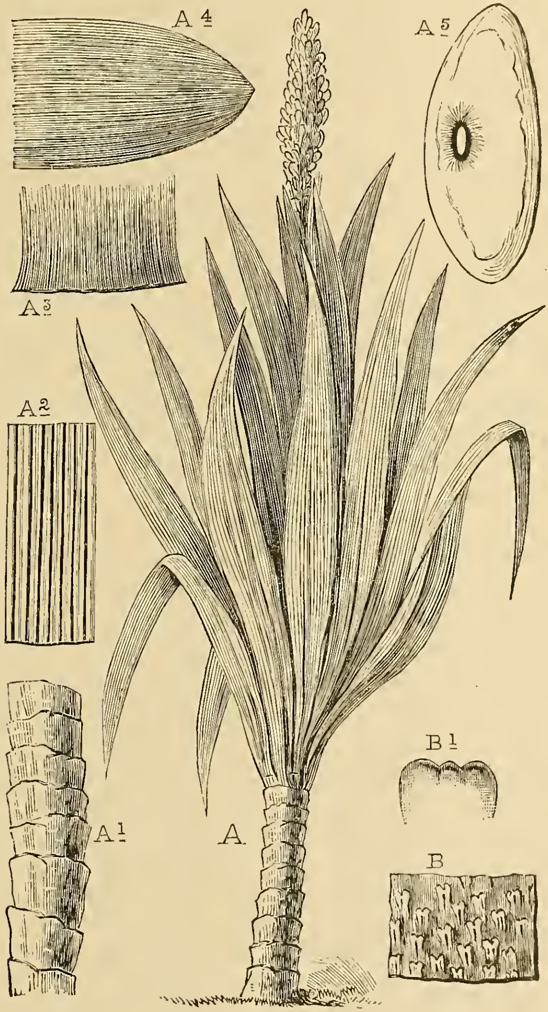


FIG. 2. Restoration of Cordaites borassifolia. (1) Stem, (2) leaf, (3, 4) base and point of leaf, (5) section of stem. B. Markings of Diplotegium, an allied type (from Acadian Geology.)

The specimen thus invites a comparison with the families of Cordaiteæ and Nœgerrathiæ in connection with allied genera and with a number of discoveries made in recent years with reference to the Gymnosperms of the Palæozoic.

Mr. Lacoe's specimen is flattened out on a slab of grey sandstone, and was collected by him in the Lower Catskill (Upper Devonian) of Meshoppen, Wyoming Co., Pennsylvania. Mr. Lacoe informs me that it is there associated with *Archæopteris minor* and *A. major*, Lesqx., and in neighbouring quarries half a mile distant and about fifty feet higher in the series, there are different species of Archæopteris, including one identified with *A. Hibernicus*, and a strobile apparently of *Lycopodites Richardsoni*, a form characteristic of the Upper Devonian of Perry in Maine. These beds have also afforded to Prof. White a species of Spirifer, and the *Stylonurus excelsior* of Hall.

I may add that I described, some years ago,[1] under the name *Nœggerathia Gilboensis*, a specimen from the collection of Mr. Lockwood of Gilboa, New York, and from the Cheming group, which was kindly communicated to me by Prof. Hall. It differs from the present species in the form of the leaves and also in the veins being simple and apparently of two orders. Its characters are as follows:—"Leaf rhombic-obovate, with a broad base. Nerves or radiating plicæ nine in number, not forked, and with fine striæ between them. Length $3\frac{2}{10}$ inches. Breadth $2\frac{1}{2}$ inches. It seems to have been bent in a conduplicate manner, and clasping or decurrent, on a stem or branch. The form tends to that of *Dolerophyllum*, though the species has been referred to *Nœggerathia*."

I may also add that the only undoubted Devonian Cordaites previously in my collections, is *C. Robbii* from the middle Devonian of St. John, New Brunswick. This is a long and broad parallel-sided leaf, pointed at the extremity, and clasping at the base, with parallel veins, and nearly akin to *C. borassifolia* of the Carboniferous. With it are found species

[1] Quarterly Journal Geological Society, 1871.

of *Antholithes*, and of *Cardiocarpon*, which may have belonged to it.[1] It would thus seem that so far as now known in America the typical Cordaites had precedence of the Nœggerathiæ, and of Dictyocordaites. My narrow-leaved species *C. angustifolia* is equally ancient with *C. Robbii*, but is of doubtful affinities.

Dolerophyllum, Saporta.

This genus was established by Saporta for certain densely leaved plants, having rounded leaves with radiating nerves and closely arranged in a spiral manner on the stem. The male inflorescence of these plants consists of a central disk, with cavities for the pollen, and surrounded with radiating fibres, while the seed is of large size and longitudinally striated, being the fruit usually known as *Rhabdocarpus*. It is likely that in America we have usually placed the leaves with ferns, as species of Cyclopteris. The fruits are known and have been described as Rhabdocarpi. One species, my *Rh. insignis* from Nova Scotia, is an inch and a half in length. Another, *Rh. oblongatus* of Fontaine, from Virginia, is nearly as large. Mr. Lacoe has found separately what is regarded as the male organ of fructification. One of his specimens is a nodule of clay ironstone from Illinois, and exhibits merely the central disk. Two others are flattened in shale and are from the Carboniferous of Pennsylvania. They are of different sizes, but may be of the same species. The larger of the two has a disk three quarters of an inch in diameter, and marked with pits and ridges in an irregularly radiating manner, while the border of radiating fibres is about half an inch in breadth, giving a total diameter of an inch and three quarters.

If we put together the leaves of some of the larger specias of *Cyclopteris*, the fruit of *Rhabdocarpus*, and these singular disks, we shall have all the principal parts of *Dolerophyllum* as restored by Saporta from actual specimens found in the

[1] Report on Devonian Plants of Canada, 1871.

coal measures of France.[1] I have not in my own collections any specimens proving this collocation of parts, but give it here on the authority of the French palæo-botanist. The structure of the stem of *Dolerophyllum* does not appear to be known, but its affinities would seem to be Cycadean, and the organs of fructification above described have some resemblance to the remarkable *Carpolithes horridus* of our Cretaceous of the North-west.[2] The species collected by Mr. Lacoe so closely resembles *D. Gospperti* of Saporta, that I hesitate to give it a specific name. It may, however, be distinguished by its longer marginal rays and larger pits on the disk, and may be provisionally named *D. Pennsylvanicum.*

Tylodendron, Weiss.

A very important class of fossils in connection with the subject of this paper is that included in the genus *Tylodendron* of Weiss, which are more characteristic of the upper than the lower members of the later Palæozoic. They are, however, closely allied to some of the forms included in the genus *Knorria,* which goes back to the Devonian. These stems are characterised by elongated ridges spirally arranged, and with a slight groove at one end. Some specimens also show distinct swellings or nodes of larger scars as if giving origin to whorls of smaller branches. They are most frequently sandstone casts, and the surface markings are not those of a true exterior surface, but of an inner cylinder showing the points of exit of bundles of fibres or vessels. These stems have received several names. They constitute the genera *Schizodendron* and *Angiodendron* of Eichwald, and the *Lepidodendron elongatum* of Brongniart is is apparently of this nature. It is difficult to distinguish them into good species, and the *T. speciosum* of Weiss covers most of the forms. Weiss has described the structure of the stem as consisting of a cellular pith surrounded with a

[1] Evolution des Plantes, Phænogames, p. 75.

[2] Trans. R. Socy. of Canada, Vol. I, p. 21, Pl. I., Fig. 3.

cylinder of porous discigerous fibres, with three rows of contiguous pores, and radially arranged. This is of course near to *Dadoxylon*. The stem and fruit have not hitherto been recognised in Europe.

These plants were first recognised in Prince Edward Island by the writer in 1870, and published in his report on the geology of the Island in 1871, under the generic name of *Knorria*. They are there stated to "resemble very closely the Permian stems to which Eichwald has given the name *Schizodendron*." They are also stated to show traces of woody tissue allied to that of Conifers, and are conjectured to have been branches of trees allied to that family. In that Report they are said to occur in the Permo-Carboniferous of Gallas Point, and also in beds referred to the Trias.

Additional specimens were subsequently collected by Mr. Bain of North River, Prince Edward Island, and were sent to me for examination. They are described in a paper published in the Canadian Naturalist in 1885 as follows:—

"Tylodendron was founded by Weiss to include stems with elongate, prominent leaf-bases of the character of those of Knorria, but bifurcate at the top. These stems or branches, are very characteristic of the Permian of Russia, Germany and France. They have been found by Weiss to show the character of Dadoxylon when the structures are preserved, and are therefore Coniferous; and it is now pretty generally believed that they are decorticated branches of Walchia. So far as European evidence extends, they are regarded as strictly Permian, and the species drawn by Mr. Bain is not distinguishable from *T. speciosum* of Weiss. In Prince Edward Island, I have figured (Report, Plate III Fig. 30) what seems to be the same species, though under *Knorria*; but my specimen may have been from the Middle Series, then called Lower Trias, but now regarded by Mr. Bain as Permian.[1]

[1] Mr. Bain informs me in a recent letter that he has found speci mens of Tylodendron in beds regarded by him as Triassic.

The specimens were associated with branches of Walchia, leaves of *Cordaites Simplex*, *Trigonocarpa*, and also with trunks of *Dadoxylon* (*D. materiarium.*)

Since the publication of the paper referred to, Mr. Bain has made additional collections, more especially on St. Peter's Island and other places on the south side of Prince Edward Island, some of which have been sent to the Geological Survey at Ottawa, and others to the writer, along with drawings of specimens still in Mr. Bain's possession. These specimens show the internal structure of the pith and woody cylinder, and varieties in the external markings which may perhaps indicate distinct species; and along with the stems, Mr. Bain has found leafy branchlets and fruits of a peculiar form which, from their association, he regards as belonging to these plants.

The principal external differences in Mr. Bain's specimens, consist in greater or less size and distance apart of the long, projecting, spindle-shaped and furrowed ridges which mark the stems, and in the presence or absence of enlarged nodes marked with whorls of tubercles. This last difference may be specific, and appears to correspond with certain differences in the structure of the wood.

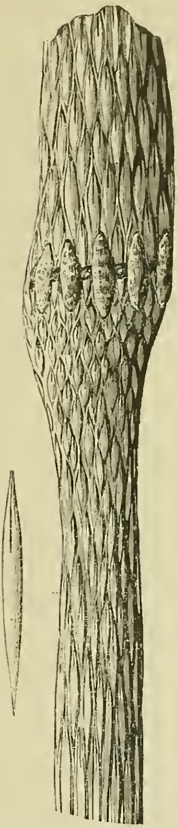


FIG. 3. Portion of stem of Tylodendron (from drawing by Mr. Bain.)

Several of the specimens showing structure, represent the pith-cylinder alone in a silicified state, and these specimens have the external markings as perfectly shown as in the sandstone casts, so that the supposed external markings of *Tylodendron* may in some cases belong to the outer surface of the pith-cylinders. The internal structure of these medullary cylinders shows, in some cases, the transverse diaphragms characteristic of Sternbergia. In other examples this is less pronounced or absent. The pith is composed of ordinary parenchymatous tissue, becoming more dense toward the outer surface, and especially in the prominences corresponding to the exterior ridges. In each of these there is also a vacant canal, and similar canals appear in a vertical position in the interior of the pith, as if there had been vessels dispersed through the pith and sending off bundles to the exterior prominences. In some specimens, shreds of woody tissue appear at the surface of the pith, and in others, in which the pith is not preserved, the woody cylinder shows its character somewhat perfectly. In the cross section it presents square meshes in radiating rows, not distinguishable from those of *Dadoxylon.* In the longitudinal section, however, the tissue is seen to be thin-walled, with very indistinct disks, which, so far as observed, appear to be in a single row, in which respect they differ somewhat from those observed by Weiss, which varied from one to three rows, and with frequent medullary rays, simple and composed of few cells superimposed, in which respect, as well as in the disks, they differ from those of *Dadoxylon materiarium* the species found with them in the Permian sandstones of Prince Edward Island. In the nodose specimens, the woody fibres are very small, and in the nodes, become tortuous and interlaced in the manner described by Williamson in the nodes of Calamites. In the non-nodose form the tissue is more open and very thin-walled. Nothing is known of the structure of the outer bark except impressions of its form with elongated leaf-bases different from the markings on the internal surfaces. (Fig. 4.) With reference to the latter it would seem that they

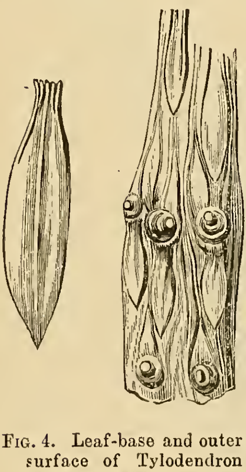


FIG. 4. Leaf-base and outer surface of Tylodendron with fruit scars. (Drawn by Mr. Bain.)

are not limited to the surface of the pith, but occur on the woody cylinder as well. Mr. Bain has observed in one instance, what seems to be an outer envelope which would indicate a thick bark, but its structures are crystalline, and it may be merely a concretionary covering.

The leaves and branchlets in fig. 5 have been found by Mr. Bain in such relation to the debris of Tylodendron, that he regards them as belonging to it. They certainly differ from those of any of the known species of *Walchia*,

FIG. 5. Leafy branch of Tylodendron and leaf enlarged. (Drawn by Mr. Bain.)

and more resemble those of the genus *Voltzia.* They have apparently three nerves, but the lateral ones may be resin-vessels.

Mr. Bain also finds at St. Peter's Island, with the branches and leaves of *Tylodendron*, the fruits or seeds represented in Fig. 6. They appear to be wedge-shaped and in fours, and an involucre similar to that in Fig. C. accompanies them, and is supposed to have belonged to them, or possibly to male flowers of the same species. Neither of these organs have been found actually attached to the branches. If these fruits belong to *Tylodendron* they would indicate taxine affinities, and they somewhat resemble the curious coniferous fruits from the Tertiary of Australia known as *Spondylostrobus.*

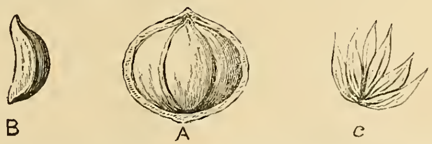


Fig. 6. Fruit and bracts of Tylodendron. (*a*) Fruit. (*b*) single seed, (*c*) bracts. (Drawn by Mr. Bain.)

Stems having the markings of *Tylodendron* occur in the Permo-Carboniferous of Cape John in Nova Scotia, and at that place there are also obscure Voltzia-like leaves somewhat resembling those of the Prince Edward Island specimens.

If we connect the trunks, branches, leaves and fruits above referred to, we can now extend the description given by Weiss much beyond that given to his *T. speciosum*, and should perhaps give a new name to the form from Prince Edward Island, more especially as it differs slightly both in markings and structure from that described by Weiss.

Tylodendron Baini, s.n.

Exterior of stem with elongated leaf-bases, truncate above, obtusely pointed below. Pith-cylinder and ligneous surface with elongate ridges pointed below and bifurcate above, differing in size and form on branches of different sizes. Branches or younger stems with nodes bearing a whorl of prominences projecting beyond the general surface.

Stem consisting of a pith-cylinder somewhat Sternbergian in structure, and formed of cellular tissue denser at the surface and with traces of detached vascular bundles. Woody cylinder with fibres having one row of pores and frequent medullary rays of few rows of cells superimposed.

Foliage borne spirally on pinnate (?) branchlets. Leaves elongate, oblong, acutely pointed, narrowed and decurrent at base, with a midrib and two side nerves, possibly resin ducts. Fruit borne laterally on the branches, and consisting of four large seeds, rounded without, and wedge-shaped within, so that in outline they have a semilunar form. They seem to have been enclosed in an involucre.

Should it prove that the nodose and non-nodose stems are specifically distinct, and that the leaves and fruit above described belong to the latter, the description of the stem will require a slight modification in that sense.

It would appear that in *Tylodendron* we have a gymnospermous type akin to the Taxineæ, and which was characteristic of the Permian, apparently extending also into the Triassic Period.

We may now turn to the consideration of what is known of Palæozoic gymnosperms allied to the forms above noticed, with the view of ascertaining their position in the classification, and clearing up some doubtful points arising from the fragmentary condition of our materials.

In the first part of the "Flore du Monde Primitif" (1820) Sternberg describes and figures, under the names *Flabellaria borassifolia* and *F. palmata*, two groups of leaves from the Coal Formation, both apparently referable to the species now known as *Cordaites borassifolia.* Leaves of this kind have since been found very abundantly in the Carboniferous in different parts of the world. To separate these plants from others of different type, Unger proposed the name of Cordaites, in honour of Corda, who had for the first time figured a somewhat perfect leafy branch (Beitrage 1845). Corda's specimen showed something of the structure of the stem which was described by him as having a ring of scalariform vessels surrounding a cellular pith, having that transversely marked surface known as *Sternbergia*, indicating diaphragms or partitions within. This apparently simple acrogenous structure induced both Unger and myself to regard the plant as allied to Lycopods, and it was placed with these in my Acadian Geology, and in my paper on the Fossil Plants of the Coal Formation of Nova Scotia.[1] It now appears, however, that Corda's figure must have represented only the inner ligneous zone, and this imperfectly.

The leaves in Sternberg's and Corda's specimens were large, parallel-sided and pointed, with closely placed parallel veins of two orders, and they were attached by a broad base to the stem. The leaves showed bundles of fibres in the veins and stomata in the epidermis.

Brongniart having the same objections with Unger to the name of *Flabellaria*, but acting independently, in 1849 designated the leaves of *Cordaites* by the name *Pychnophyllum*, but was induced by their peculiar form and structure to include them in the Gymnosperms with the allied family of *Nœggerathiæ*, and near to the Cycads.[2] He compares the leaves with those of *Dammara* and *Podocarpus* among the Conifers. Goldenberg and Weiss subsequently corroborated Brongniart's view by the discovery of spikes of fructification known as *Antholites* in association with *Cordaites*. Finally Grand 'Eury discovered in the coal field of St. Etienne in France, abundant and well preserved stems, leaves and fruits which have enabled the French palæo-botanists to reconstruct the whole plant and to discriminate several genera and species, constituting a gymnospermous family

[1] Journal of Geological Society.

[2] Tableaux de Genres.

which they designate *Cordaiteæ*, and which they regard as intermediate between *Cycadeæ* and *Taxineæ*.

As restored on the basis of the French specimens, the typical Cordaites are simple or branching arboreal plants with broad parallel-veined, more or less pointed, leaves attached by a wide base to the stem, and leaving simple transverse scars when removed. They bear spikes of nutlets, or large, naked seeds, each subtended by a bract, and which are usually lateral, though sometimes terminal. The stem has a thick bark, composed of cellular tissue with bundles of bast fibres, and the axis has an outer cylinder of porous tissue, in wedges, with medullary rays, and an inner cylinder of the slit-pored or transversely barred tissue, which I have in previous papers designated by the term pseudo-scalariform, to distinguish it from the true scalariform-tissue, from which it differs in having bars and pores only on two sides, and in the apparent pores being of the nature of transversely elongated discs. It is very common in palæozoic gymnosperms and exists in modern cycads. The pith is cellular with denser tabulæ opposite the nodes of the stem giving it the characters of the casts of pith known as *Sternbergia* or *Artisia*.

Leaves of Cordaites, spikes of fructification known as *Antholites*, now often called *Cordaianthus*, fruits of the kind formerly known as *Cardiocarpum*, but now usually named *Cordaicarpum*, occur somewhat plentifully from the Middle Erian to the Permian. If however, we are to regard, all the Cardiocarpa as seeds of Cordaites, it seems remarkable that the species of these fruits should be so numerous in comparison with those of the leaves and stems. In the Middle Erian of New Brunswick, I have recognised five species of *Cardiocarpum*, besides *Antholites* and *Trigonacarpa*, and in the Carboniferous of Nova Scotia, the disproportion, as compared with stems and leaves, is still very great. This might perhaps lead to the inference that many of the species of Cordaites belonged to the higher grounds, and that only waterborne seeds found their way into the aqueous deposits. This would also serve to account for the fact that while leaves of

Cordaites are locally very abundant, they are not so generally diffused geographically as the Sigillaria and Lepidodendra. The oldest species known to me is *C. Robbii* from the Middle Erian of New Brunswick, where it occurs with two species of Antholites—*A. devonicus* and *A. floridus*, —perhaps its male and female flowers, and with the species of Cardiocarpa already mentioned. I observe it has been stated that *C. Robbii* has been found in the Upper Silurian of Hainault.[1] The latest species known in Acadia is *C. Simplex* found in the Permian of Prince Edward Island and also in the newer Coal formation of Nova Scotia. *Antholites* and *Trigonocarpa* are found in the same beds, but no *Cardiocarpa.*

Stems of *Cordaites* showing structure have not yet been certainly recognised in this country. This leads, however, to the question whether such stems may not have been referred to other plants. I may mention more particularly those named *Dadoxylon*, (*Araucarioxylon*) and *Sigillaria.*

With a view of settling this question, I obtained through the kindness of the eminent French palæobotanist, M. Renault, specimens of the stems from St. Etienne referred by him to *Cordaites*. These I found to be of two types which may be distinguished as follows :—

(*a*) Silicified stem, associated with leaves of Cordaites proper (*C. borassifolia* or allied). This has a large cellular pith, which has, however, mostly disappeared, leaving a hollow cylinder occupied with structureless silica and vegetable debris. The pith has been nearly an inch in diameter and showed no distinct evidence of Sternbergia structure. The woody cylinder surrounding the pith was less than a quarter of an inch in thickness, and consisted of two layers. The inner of no great thickness, shows pseudo-scalariform tissue, while the outer layer, which is radially arranged, is composed of porous woody tissue, the pores or discs being sometimes in one row, and sometimes as many as three

[1] Ward, History of Palæo-botany.

rows, but not contiguous. There are medullary rays which are numerous, simple and of few tiers of cells superimposed. The cortical tissues have perished.

(*b*) The other stem is of smaller diameter with a strongly marked Sternbergia pith, an inner layer of indistinct pseudo-scalariform or spiral tissue and an outer layer, much thicker in proportion, and with wood-cells having three rows of contiguous hexagonal areoles with central slit pores. The medullary rays are simple. This second stem is not distinguishable from Dadoxylon of the type of *D. Brandlingii* or *D. materiarium.* The specimen itself shows no evidence that it belongs to *Cordaites.*

Setting aside, as probably Coniferous, the second specimen and assuming the stem (*a*) to be truly Cordaitean, it accords with one of the species of Dadoxylon described by me from the Erian of New York, namely *D. Clarkii*, which presents similar characters though with a somewhat thicker woody cylinder.[1] *D. Clarkii* was described as follows in 1882.

"The pith cylinder is large and shows ordinary cellular tissue. The medullary sheath or inner fibrous layer consists of pseudo-scalariform and reticulated fibres; but the most remarkable feature of this wood is the structure of the medullary rays, which are very frequent, but short and simple, sometimes having as few as four cells superimposed. This is a character not before observed in coniferous trees of so great age, and allies this Middle Erian form with some Carboniferous woods which have been supposed to belong to Cordaites or Sigillaria."

The resemblance of this peculiar stem to those of *Cordaites* and *Tylodendron*, above referred to is obvious.

I have noted and illustrated by characteristic examples, the fact that the erect ribbed trees found in the coal formation section at the South Joggins in Nova Scotia, often contain the remains of their axis, either calcified and standing erect within the tree, or fallen to the bottom in the form of mineral charcoal. The examination of a large number of

[1] Report on Erian Plants of Canada, Part II, 1882.

such axes has led me to the conclusion that there are two types of these erect trees, one with an axis of scalariform tissue only,[1] though with the outer radiating cylinder characteristic of *Diploxylon*, the other with a double axis of pseudo-scalariform tissue internally, and discigerous or multiporous tissue externally, of similar character to the stems of *Cordaiteæ*. Perhaps in accordance with this is the fact which I have also illustrated, that some so called *Sigillariæ* or *Favulariæ* of the type of *S. Elegans*, have somewhat broad parallel-veined leaves resembling those of Poacordaites.[2]

As characteristic examples of these trunks, I may refer to two which I have described in the Journal of the Geological Society.

(*a*) SIGILLARIA (Diploxylon.)

The most characteristic example is a trunk rooted in an under-clay in the Joggins section and existing as a sand cast 12 feet in height. This tree was discovered and carefully removed by Mr. Albert J. Hill, who found the interior of the cast a calcified axis extending throughout its length and showing well preserved structure. The structure is described as follows:—[3]

"The axis is about 6 centimetres in its greatest diameter, and consists of a central pith cylinder and two concentric coats of scalariform tissue. The pith cylinder is replaced by sandstone, and is about one centimetre in diameter. The inner cylinder of scalariform tissue is perfectly continuous, not radiated, and about one millimetre in thickness. Its vessels are somewhat crushed, but have been of large diameter. Its outer surface, which readily separates from that of the outer cylinder, is striated longitudinally. The outer cylinder, which constitutes by much the largest part of the whole, is also composed of scalariform tissue;

[1] Journal Geological Society of London.

[2] Acadian Geology.

[3] Journal Geological Society of London, Vol. xxxiii., 1877.

but this is radially arranged, with the individual cells quadrangular in cross-section. The cross-bars are similar on all the sides, and usually simple and straight, but sometimes branching or slightly reticulated. The wall intervening between the bars has extremely delicate longitudinal waving lines of ligneous lining, in the manner first described by Williamson,[1] as occurring in the scalariforn tissue of certain Lepidodendra. (Fig. 4.) A few small radiating spaces, partially occupied with pyrites, obscurely represent the medullary rays, which must have been very feebly developed. The radiating bundles passing to the leaves run nearly horizontally; but their structure is very imperfectly preserved. The stem being old and probably long deprived of its leaves, they may have been partially disorganized before it was fossilized. The outer surface of the axis is striated longitudinally, and in some places marked with impressions of tortuous fibres, apparently those of the inner bark. In the cross-section, where weathered, it shows concentric rings; but under the microscope these appear rather as bands of compressed tissue than as proper lines of growth. They are about twenty in number. Though apparently of very lax tissue, the wood of the outer cylinder may, in consequence of the strength of the vertical rods and transverse bars of ligneous lining, have been of considerable firmness, which would indeed seem to have been implied in the manner of its preservation within the hollow bark."

This stem is evidently that of a *Sigillaria* of the *Diploxylon* type, with a slender woody axis wholly of scalariform tissue and a thick inner bark, probably mostly of cellular tissue of a lax and easily decomposed character, but probably also with bundles of fibres. This was protected and strengthened externally by an outer bark of sclerenchymatous cells, now converted into coal.

[1] Monthly Microscopical Journal, August, 1860.

(*b*) SIGILLARIA (Favularia ?)

This example was furnished by another erect tree, about a foot in diameter, and which I took down with care and examined its contents. It was described and figured in the journal of the Geological Society of London.[1] It presented the following parts:—

(*a.*) A coaly outer bark, no doubt originally composed of dense sclerenchyma.

(*b.*) A cylinder of sandstone, representing the inner bark entirely removed by decay.

(*c.*) A ligneous axis composed of wood-cells, the inner with two rows of contiguous bordered pores on their radial surfaces, the outer with only one. The medullary rays short, frequent, and of one row of cells or sometimes partly with two rows. Diagonal bundles of pseudo-scalariform tissue traversed this cylinder, no doubt leading to the leaves.

(*d.*) An inner cylinder of pseudo-scalariform tissue similar to that in the inner cylinder of the axis in Cordaites and in Cycads.

(*e.*) A medulla or pith, consisting of a hollow cylinder of cellular tissue sending off at intervals thin diaphragms toward the interior, giving it a Sternbergia structure.

This type of Sigillarian stem is obviously of far higher grade than the former, and would justify the inference that it belonged to a gymnospermous plant. The structures of the stem correspond with that of others in which the axis exists only as fragments in the base of the once hollow stump. Some of these, however, conform to the type of multiporous wood-cell seen in *Poroxylon.* If the foliage was like that of *Sigillaria elegans*, and the spikes of fructification of the nature of *Antholithes*, these parts might be referred to *Cordaiteæ*, though the stem was ribbed in the manner of *Sigillaria.* I may add here that I have shown[2] that some *Sigillariæ* of the *Favularia* type, divided at top into small

[1] Vols. xxvi. and xxvii., 1870 and 1871.

[2] Journal Geological Society, Vol. xxii., also Acadian Geology.

branches without ribs and with leaf scars very different in form from those of the trunk.

The question now arises whether these different trunks can belong to one genus, or even to one family; whether, in short, we may not have been confounding very different types, of trees under the name of *Sigillariæ?* The first of the above types, that of *Diploxylon*, corresponds with the structure of undoubted *Sigillariæ*, as illustrated by Williamson and other British palæobotanists, and conforms so closely to that of *Lepidodendron* that we can scarcely doubt the close affinity of this particular type with the Lycopodiaceous Acrogens.

On the other hand, so many of the erect ribbed trees at the South Joggins have afforded tissues of a much higher type that we cannot doubt the existence there of trees similar in external characters to the ordinary *Sigillariæ*, yet with internal structures conforming rather to the type of *Cordaiteæ*. In these circumstances, while we must admit the Gymnospermous affinities of the latter family, we must wait for further information before being able to define its precise relations to the Sigillariæ on the one hand, and the Conifers on the other.

I have referred above to Sternbergia piths. These are usually sandstone casts, but in some instances shreds of the enveloping tissues remain. In a few instances the internal structure is preserved. Where the latter occurs it is seen to be cellular, arranged in tubulæ in the manner which I have explained as occurring in the young pith of the Balsam Fir and in the stem of *Cecropia peltata*. Such piths I have described as occurring in large and well preserved stems of *Dadoxylon* of different species from the Middle Devonian to the Permian. The large size of the pith would seem to indicate that the young branches were very thick, in which case they could not have resembled those of *Walchia* or *Araucarites*, which otherwise might be supposed to represent the foliage of these trees, unless, indeed, there were thick branches bearing slender branchlets, or unless, as Williamson has affirmed to have been the case in some other Coniferous trees, the pith increased in size with the growth of the stem or branch. There are, however, Sternbergiæ which have not belonged to *Dadoxylon.* I have figured[1] specimens which show, attached to them, multiporous tissue like that of *Poroxylon* or *Dictyoxylon.* Others are enveloped with scalariform tissue like that of *Lepidodendron* or *Lepidofloios.* This fact was long ago observed by Corda. Others show pseudo-scalariform and discigerous tissue like those of *Cordaites*, or of the peculiar type of supposed Sigillaroid trees above referred to. Thus it is apparent that the Sternbergia piths belonged to a number of trees ranging from Gymnosperms of high type to Acrogens. I may remark here that the true *Calamodendra*, of which *Calamites approximatus* is a type, in so far as the medullary cylinder is concerned, are really internal casts of pith cavities, originally surrounded by a thick woody envelope showing psuedo-scalariform and discigerous tissue, and, therefore, not very dissimilar from that of *Cordaites.* Williamson has shown, however, that the medullary rays and other structures were different, and the stems of *Calamodendra* were jointed in relation to the support of whorls of organs. If these *Calamodendra* were really Acrogens allied to *Calamites*, they present the same curious resemblance to Gymnosperms which we see in another form in one of the types of Sigillaria, and warn us that the structures of stems and the character of fructification may not have been correlated in the Carboniferous in the same manner as in modern stems.

Doubts of this kind are further justified by the consideration of the stems known as *Poroxylon*, *Medullosa*, *Cycadeoxylon*, *Colpoxylon*, *Lyginodendron*, *Kaloxylon* and *Heterangium*, several of which have recently been described in great detail by Williamson and by Renault. These have a true medulla, surrounded by a cylinder of discigerous or reticulated tissue, arranged radially and traversed by medullary rays. Such characteristics would well suit a gymnosper-

[1] Journal Geol. Society, 1871.

mous standing, but, on the other hand, there are specimens which, as Williamson has shown, unite such structures with foliage referred to ferns of the genus *Sphenopteris*.[1] Williamson suggests that inasmuch as the living *Stangeria* among the Cycads combines an exogenous stem with fern-like leaves, the same may have been the case in the Carboniferous. If so, the problem as to their position can be determined in each case only by the discovery of their fructification.

In Bertrand and Renault's recent elaborate memoir on *Poroxylon*, these botanists have shown that this genus possesses an exogenous stem of some complexity. It has a distinct pith, not Sternbergian, with gum canals, an inner or centripetal layer at first in distinct bundles of scalariform and punctated fibres, a true radiating woody zone of multiporous fibres, with numerous medullary rays, and a cambium layer, two layers of inner bark, and an outer suberous bark. The leaves are petiolate and simple, and have a single vascular bundle at base, forking in the blade, in the manner of *Nœggerathia*. From these and other more minute characters in the distribution of the tissues, the authors conclude that *Poroxylon* may be placed between the Dyploxyloid *Sigillariæ* and the Cycads, as probably a low Gymnospermous type. They refer to three species of Poroxylon—*P. Edvardsii*, *P. Boyseti* and *P. Stephanensis*.

Medullosa of Cotta presents several thick woody cylinders twisted together, and with detached star-shaped or radiating bundles of fibres in the pith. The woody tissue of *Medullosa* is said to resemble that of *Palæoxylon*, which is, however, a subgenus of *Dadoxylon*, and allied to the Conifers.

Colpoxylon has a thin woody cylinder and much thicker bark than the preceding, and simple bundles in the pith.

Cycadeoxylon has several concentric circles of fibrous tissue, with cellular tissue between them, somewhat in the manner of Gnetaceæ, and with no fibrous bundles in the

[1] Transactions Royal Society.

pith. My *Dadoxylon annulatum* shows structures approaching to this last.

Renault has constituted a new genus (May, 1889) under the name *Ptychoxylon*, in which the wedges of the woody cylinder extended inwards, and are then bent so as to simulate internal woody layers.

All these stems are regarded as probably gymnospermous, and with the different types of *Dadoxylon*, the *Cordaites* and *Tylodendron*, serve to give some account of the trees from which the multiform nutlets and seeds of the Carboniferous and Erian were derived.

The genus *Nœggerathia*, like that of *Flabellaria* (*Cordaites*), dates from the time of Sternberg, and his *N. foliosa* is the original type, to which, however, a somewhat miscellaneous group of species has been added by subsequent authors. Some of these, instead of the pinnate leaves of the original species, have simple leaves spirally arranged and decurrent on the stem. This is the case, for example, with *N. flabellata* of Lindley and Hutton, which, on this and other grounds, has been placed with some other species by Schimper[1] in a new genus *Psygmophyllum*, while Saporta[2] places them in his genus *Ginkgophyllum*, supposing them to be akin to the modern Ginkgo or *Salisburia.*

These two types of Nœggerathæ agree with one another, and differ from *Cordaites* in the flabellate form and forking venation of the leaves. The nearest approach to the *Cordaites* is that of the leaf of *N. flabellata* to that of *C. patulus* Grand Eury.[3] Saporta states that the ordinary Nœggerathiæ (*N. foliosa*) bear their fructification on the surface of modified leaves, and he is inclined to place them near to the Cycads. On the other hand, he regards the second type (*N. flabellata, &c.*) as more nearly allied to the taxine Conifers, though their fructification is not certainly known. Lacoe's specimen, now under consideration, would, how-

[1] Palæontologie Vegetale.

[2] Evolution de Monde Vegetal.

[3] Saporta *l. c.*

ever, go to show that a plant with Nœggerathoid leaves might have a fructification similar to that of *Cordaites.*

It has further become a question with palæobotanists to what extent some of the broad, flabellate and rounded leaves referred to *Cyclopteris* and other genera of ferns, may belong to gymnospermous plants of the nature of Nœggerathia. Of these leaves those already referred to of the genus *Dolerophyllum* seem certainly to be Gymnospermous. The peculiar fan-shaped leaves described by Newberry under the name *Whittleseya,*[1] and of which one species occurs in the coal formation of Nova Scotia, belong apparently to the same category. The singular unilateral leaves, or fronds, of which my *Nœggerathia dispar* from Nova Scotia was the type, and which Fontaine has recently separated in his genus *Saportea,*[2] may also be gymnospermous. Less certain is the reference by Saporta to this group of the genus *Cannophyllites* of Brongniart, and of the large and beautiful Erian and Lower Carboniferous fronds of my genus *Megalopteris.*[3]

I have already referred to the numerous Gymnospermous seeds known in the Palæozoic, and belonging to the genera *Trigonocarpum, Cardiocarpum, Rhabdocarpus,* etc.

The structure of many of these has been illustrated by Hooker, C. Brongniart, Williamson and myself, and they are unquestionably allied to the seeds of *Cycadeæ* and *Taxineæ.* When the vast abundance of these seeds on certain beds is considered, and the fact that Schimper catalogues 67 species, while recent discoveries would nearly double that number, it becomes evident that plants of this grade must have borne a very important part in the palæozoic vegetation, and we have reason to suspect that many stems and leaves now of uncertain affinities will be found to have been of this class.

We may now tabulate as follows the principal Gymnospermous groups which may be represented in the Palæozoic:—

[1] Lesquereux " Coal Flora."

[2] " Permian Flora."

[3] " Evolution du Monde Vegetal.

1. *Sigillariæ* and *Calamodendreæ*.
    - Favularia, (in part)?
    - Sigillaria proper, (in part)?
    - Calamodendron, (in part)?
2. *Cycadeæ*.
    - Rhiptozamites.[1]
3. *Nœggerathiæ*.
    - Nœggerathia.
    - Poroxylon.
    - Dolerophyllum.
    - Whittleseya.
    - Saportea.
    - Medullosa?
    - Colpoxylon?
    - Ptychoxylon.
4. *Cordaiteæ*.
    - Dictyocordaites.
    - Cordaites.
    - Dorycordaites.
    - Poacordaites.
5. *Taxineæ*.
    - Psygmophyllum.
    - Baiera?[1]
    - Ginkgophyllum.
    - Tylodendron.
    - Walchia, Voltzia, etc.
    - Dadoxylon.
6. Coniferæ.

It would thus appear:

1. That the nearest structural affinities of the Palæozoic gymnosperms with the higher Cryptogams lead toward all the groups of Acrogens, viz.: Sigillariæ, Calamiteæ, Lepidodendreæ and Ferns.

2. That the present dominant groups of Coniferæ proper and Cycadaceæ are absent or slenderly represented in the Palæozoic.

3. That the dominant Palæozoic families are the Nœggerathiæ, Cordaiteæ and Taxineæ, and that these occupied a prominent and important place, and culminated in the Palæozoic and early Mesozoic periods.

[1] Permian of Russia, Schmalhausen.

4. The two former families, did they now exist, would supply connecting links between the Coniferæ and Cycadeæ, and between the latter and the Acrogens.

On an Expedition down the Begh-ula or Anderson River.

By Mr. R. MacFarlane, Chief Factor, Hudson Bay Company.

Introductory.

In 1857, Mr. MacFarlane carried out an exploratory expedition from Fort Good Hope on the Mackenzie River, to the Anderson River, and down that river, returning by a different route to Fort Good Hope. A report on this expedition was made by him to the late Mr. James Anderson, then in charge of Mackenzie River district, for the Hudson Bay Company. This report was not written for publication, but a copy of it was handed to me about a year ago by Mr. J. Anderson, son of the late Chief Factor. As the report contained much information respecting a region of which scarcely anything is known, I applied to Mr. MacFarlane for his permission to have it printed. This permission Mr. MacFarlane kindly accorded, and the narrative is here given as written by him in the year of the exploration, with the omission merely of some portions of the original, bearing upon the fur trade and business of the Company.

Mr. MacFarlane's services to science in the extreme northern portions of the continent are well known, and his report of his journey to the Anderson River, gives further evidences of close and accurate observation, which would be creditable as the result of an expedition undertaken for scientific purposes, instead of primarily in the interests of the fur trade.

The region traversed lies to the east of the Mackenzie and to the north of Great Bear Lake, within the Arctic circle. A short notice of the Anderson or Begh-ula river is to be found in Sir J. Richardson's *Journal of a Boat Voyage* (Vol. I., p. 265), and a brief description of the country in its vicinity is given by Abbé Petitot, in the *Bulletin de la Société de Géographie*, (Vol. X., p. 173). The map accompanying the article of Abbé Petitot, is the best available of the region in question and may be consulted in following Mr. MacFarlane's route. His course was northward and eastward from Fort Good Hope to the Lockhart River, thence down that river and the Anderson (of which it is a tributary), nearly to the Arctic coast, where he was turned back by the Eskimo. He then returned southward by land, and after examining an additional portion of the Anderson, above the mouth of the Lockhart, together with another tributary named the Ross, he struck across in a westward direction to the Peau de Lièvre or Hare-skin River by which he returned to Fort Good Hope.

Mr. MacFarlane has also furnished me with an additional short general description of the Barren Grounds, to the east of the Anderson River, between that river and Franklin Bay, crossed by him four times in 1862 to 1865 for the purpose of collecting birds, eggs, etc., for the Smithsonian Institution.

Some fossils collected by Mr. MacFarlane in the course of these expeditions are described by Meek in his paper, published in the *Transactions of the Chicago Academy of Science*, (Vol. I., p. 75). These are referred to in my *Notes to Accompany a Geological Map of the Northern Portion of the Dominion of Canada*, (Annual Report Geol. Surv. Can., 1886., p. 30R,) but Mr. MacFarlane's valuable observations were not then available for reference in connection with the compilation of the map. It would now appear from them, that between the Mackenzie River and Franklin Bay, the Devonian and probably also the Cretaceous rocks, came further south than was supposed, covering a portion of the region coloured as Archæan on the map.

George M. Dawson.

On the afternoon of June 4th, 1857, accompanied by Jerome St. George, *dit* Laporte, and four Indians, I started from Fort Good Hope for Canoe Lake, carrying with us such further necessaries as were required, and we reached that place about noon of the 8th.

In proceeding thither we pursued a northerly course, and on the 5th came to a lake called "Loon Lake," along which we continued, camping that night at its northern end. It is about twelve miles in length, with a breadth of from two to five miles. On the 6th we encamped on the west side of a larger lake, and next day crossed a smaller and halted at the southern end of another, in size equal to "Loon Lake," to which I gave the name of Chief Trader Murray. These lakes, together with a chain of from forty to fifty small ponds or sheets of water, varying in extent from one-eighth to two miles, lie in a flat or valley formed by two ridges of rising ground running parallel with each other, and extending on the southward from within a short distance of the Mackenzie (the country thence being undulating) to Murray Lake, where they subside into a series of gentle hills or eminences, to Canoe Lake. The country appeared to be well timbered in every direction with pines, juniper, several species of willow, and a few small groves of poplar and birch. Marshy plains and swamps occurred at intervals, and the soil, where not composed of moss or vegetable mould, consisted of a thin layer of dark loam, with a whitish clay or reddish sand underneath. Ice was still as firm as ever on the larger lakes, and wild fowl were exceedingly numerous wherever water appeared. On the west side of "Lac Rory" (where we camped June 6) several fossils similar to those found in the limestone forming the Ramparts on the Mackenzie [Devonian] were picked up. The beach was shingly and no rock *in sitû* could be discovered in that quarter.

Canoe Lake is larger than any of the above and is of a triangular form, with high banks and hilly ground tolerably wooded in its vicinity. At its northeast end we found the Iroquois, who had the canoes and everything in excellent order. Finding that the river issuing from the lake was too insignificant to admit of being navigated by canoes even of the smallest size, I determined on making a portage to a part of it lower down, where the Indians informed us it was sufficiently deep. Till noon of the 9th was accordingly spent in doing so, and during the remainder of that day and till the afternoon of the next: we toiled in a river from one to ten yards wide, extremely tortuous in its course, with the navigation impeded by immense quantities of drift-wood. We had considerable difficulty in getting on. The wood had to be cut and afterwards removed before we could proceed. On the afternoon of the 10th it was found utterly impracticable to make any further progress. The drift-wood was in such large piles as would occupy more time for its removal than we could spare. Another portage was therefore decided on. Several Indians who had joined us on our route hither were sent on ahead, with all the 'pieces,' to the junction of this river (called the Iroquois after my steersman) with that coming from a lake known as the "La Porte," and lying three days' march to the north-east of Good Hope, and we made a portage of six miles with the canoes to a part of the Iroquois, on which we launched them. Finding it deeper and clearer of drift-wood we reached its mouth early next day. The Iroquois flows through a flat plain, bounded on both sides by two ridges of ground composed of sand and fragmentary rock, and well covered with pine and willow. The driftwood on this river is doubtless the accumulation of many years. Its course is so very tortuous that any floating wood easily gets jammed between the growing trees on both banks, and thus forms into large piles, so that very little of it ever reaches its mouth.

Halting for an hour, we then embarked the 'pieces' and commenced the descent of Lockhart River (I have named it after a friend and brother officer), finding it much broader and deeper than the Iroquois and the adjacent country better timbered. The river varies in breadth from 50 to 300 yards, the greater breadth occurring near its mouth, where it receives the waters of three small rivers, two of them coming from the westward and the third from the east. A strong head wind greatly retarded us in descending it. This was, however, effected by noon of the 13th, when the Begh-ula River was reached.

The formation of the banks of the Lockhart for some distance after we fell upon it, consisted of a bituminous coal, resting on a bed of limestone, with an upper layer of vegetable mould covering a bed of from two to ten feet of clay, underneath which the carboniferous stratum appeared. Lower down, the formation was perceived to be stratified shale and the beach sandy, and near its debouchement the banks were composed of a dark blue and gravel-mixed clay. The banks were high and sloping and in parts steep; a few small islands and sandy *battures* occurred, and the current was smooth and swift, broken only by a few shallows which form rapids at a lower stage of the water.

Rabbits were in great numbers, as well as geese, ducks and swans. Two out of seven black bears were shot, six reindeer fired at and missed, and an otter, a beaver, a mink and two wolves were seen. The surrounding country is doubtless a fine tract for fur-bearing animals, and I believe but little hunted owing to its distance from Good Hope, the Hare Indian country being situated more to the southward. The Lockhart is said to be navigable from its source and only broken by a few not very formidable rapids in its upper portion.

The Begh-ula, or Anderson River, was found to be drifting thick and the beach lined with ice. Perceiving a fire on the opposite side of the river, we crossed over with much difficulty and there found an assemblage of some fifteen or eighteen Indians, mostly Bâtard Loucheux belonging to Fort Good Hope. From these we ascertained that the river had only broken up the previous day. I therefore got up my tent, the pickets of which could not be driven home, and employed the remainder of the 13th in engaging some Indians required to make up our complement, as well as in making other necessary arrangements.

It was a party of these Indians who paid a visit to the Esquimaux of this river in April last. They informed us, that on that occasion they had a rather narrow escape with their lives from a large party of western Esquimaux who had come there for the purpose of trade, and it was only through the interposition of the former, whom they found very friendly, that they were permitted to return. On coming to a halt shortly after parting with the Esquimaux the Indians discovered that one of their number was missing, who, strange to say, had not since been heard of. But more of him anon.

On the 14th June we embarked on Anderson River in two canoes, our party numbering ten in all. The general appearance of the country, to the lodges of the Upper Esquimaux, which were reached about noon of the 15th, differed materially from that previously passed. The banks of the river were higher and of a more hilly character, and had a considerable sloping tendency upward, the summits of these hills occasionally presenting a smooth rounded surface covered with moss and dwarf willow, and the slopes with timber of a medium size. In some parts also, on the east side, the summits were perfectly flat, with a few clumps of tall willow. The banks on the left generally consisted of a succession of small hills, intersected by several valleys, through which small streams made their way. The course of the river was pretty direct, chiefly in a northerly direction. Its breadth varied from 500 to 1500 yards, with abundance of water for loaded craft. Very few sandy *battures* or islands occurred.

Some time before reaching the Esquimaux lodges, we were joined at intervals by fifteen of these people, who had been employed hunting reindeer on the slopes and summits of the river banks. They rarely hunt at any distance beyond, probably from fear of being attacked by hostile Indians. When an Esquimaux succeeds in killing a deer, he drags the animal as it falls to the water's edge, into which it is plunged. The hunter then inserts an arrow into the carcass, so that on its floating past the lodges it may be taken possession of for the benefit of the party by whom it has been killed.

On landing at the chief's encampment I immediately marked out a line on the beach, and directed my interpreter to inform him that if the Esquimaux, in accordance with messages previously sent through Indians, wished to open up and maintain a friendly intercourse with us, it would be expected of them to respect such arrangements as we should deem necessary for that purpose, one of which consisted in not attempting to cross the said line. To this they at once agreed and accordingly ranged themselves beyond it. A small present of tobacco, a commodity of which they seemed inordinately fond, having been made to each person assembled, the objects of the expedition were then entered into and discussed at great length, evidently to the satisfaction of the Esquimaux, who expressed much pleasure at our visit to their lands. They regretted not having been apprized of our visit at an early period of last season so as to have had a large collection of furs against our arrival, but promised faithfully to exert themselves during the ensuing winter. They also informed us that they have two sources of trade—the first with their brethren to the westward, and the other with some Indians whom they were occasionally in the habit of meeting on their hunting excursions up the river, and that the remuneration received for their furs was too trifling to stimulate exertion among them, although foxes were in great numbers on their lands.

The Esquimaux of Anderson River are certainly fine specimens of the race—tall and well formed, active in their movements, lively in their conversation, good-humored, with smiling open countenances, and affable, though, it must be confessed, rather troublesome in their deportment. Their clothing consisted of trowsers of deerskin, with the hair side next the body, shirts of the same material, and an outer shirt or coat, with the hair outside, having a hood fringed with the fur of the wolf or wolverine attached; boots or shoes of sealskin, water-tight and neatly made. The crowns of their heads were closely cropped, and the front hair in a line with the forehead. A few of them also sported tolerable mustaches and imperials. The dress of the women differed only in being ornamented with beads, and in their having a short tail appending to the hind part of their shirt or coat, which was tied in front. The lofty top and side hair knots, so fashionable among the Esquimaux of the Mackenzie and Cape Bathurst, prevailed here, and in my opinion did not at all tend to improve their appearance. The women are decidedly better looking and cleaner in their habits and persons, so far as I had an opportunity of judging, than the generality of Indian women in the North. Their cheeks were red and rosy, the expression of the face always amiable, and their behaviour in perfect accordance with the latter quality. The kayaks and oomiaks are precisely similar to those in use among other tribes of Esquimaux, and their arms comprised a bow and quiver of arrows—iron, bone and ivory pointed—a spear, a long and short knife, and a long prong which they use in darting at wild fowl. There were eight lodges at this place. The covering consisted of half-dressed sealskins mounted on poles placed upright in a slanting position, the interior being covered with deerskins and robes for sleeping. The kettles we saw were of sheet iron and copper, the former large and the latter of various sizes, and had evidently been traded from our Indians. The knives were mostly of English manufacture, but the larger beads were different from those used for the trade of the "R" District. The chief "Pabina" had a common gun and horn with some powder and ball, which he told us he had received from one of the Good Hope Indians who visited the Esquimaux last spring. The gun was marked "Barnett, 1854."

Finding the Esquimaux so very friendly, I somewhat relaxed my demeanour towards them, and accordingly permitted several of them to cross the barrier referred to, at the same time directing the crews to prevent any attempts at pilfering; they however presumed on this occasion, doubtless encouraged to do so by the fear which the Indians evidently had of them, and which from their natural acuteness they clearly perceived. One of them (a Coast Esquimaux) went so far as to steal a silver fox which I had shortly before traded from him, I was at the time occupied in talking to the chief at some distance from the canoes, but on being made aware of the theft, immediately made up to the fellow, wrenched the skin out of his hand and warned them all not to attempt anything of the kind again. This fellow helped himself to the fox in presence of the Indians, not one of whom attempted to prevent him, I could already see that the Esquimaux looked upon them with contempt, invariably addressing them as "nonga," which, in their language, signifies "spittle." Even Laporte was favored with this mark of their esteem.

On making enquiries of them regarding Captain McClure's despatches, I could obtain no satisfaction; they all denied having seen or heard of any such having been delivered to the Esquimaux, but from the change which the countenances of several of them underwent during the examination, and other causes, I had every reason to suspect that they knew something about them. These Esquimaux are exceedingly fond of written or printed paper, and it has been no uncommon thing with the Indians to exchange their debt bills with them for arrows, &c. It may therefore readily be presumed that McClure's despatches have been cut up, and may thus be, in minute portions, in possession of a great number of Esquimaux.[1] From the inability of Laporte on this and every subsequent occasion to make himself thoroughly understood by the Indians who acted as Esquimaux interpreters, I could not ascertain the origin of this fondness for written paper, or whether they attributed any medicinal or other virtue in its possession.

After a stay of some hours, we again started, embarking the chief in Laporte's canoe so as to facilitate our intercourse with the Esquimaux lower down. Most of his men also wished to accompany us, but as they would have proved a source of much annoyance, I peremptorily ordered them to return. Two Coast Esquimaux were allowed to follow. Until we camped at half-past 10 p.m., we saw several small parties from whom we traded a few fox skins; the women put off to us in their boats, and on receiving the

[1] An account of the discovery of McClure's despatches in 1862, will be found in Hargrave's "Red River," published in 1871.

customary present of tobacco, thanked us and immediately returned, as did also the men, with a few exceptions. These were not permitted to encamp with us, but camped on the opposite side of the river, where they sat up till next morning.

Our encampment lay at the foot of a high hill, moss covered and entirely destitute of wood, its face steep and intersected by small clefts or hollows. These hills occasionally form bends of the river. The banks on the left were, as usual, rather better timbered, the breadth of the river more uniform, the current smoother, and the beach sandy, stony and muddy at intervals. The country was almost entirely covered with snow, and the shores thickly lined with ice, the latter clearly proving that the river had broken up but very recently.

Resuming our course early next morning (16th June) we put ashore at 11 a.m., at a large encampment of Esquimaux under "Dowlas," the head chief of this river (they are governed by two chiefs), who received us very kindly; his conduct then and afterwards was in perfect keeping with this reception. This fine old man labored under an affection of the thorax, which prevented him from making himself heard at any distance; he appeared, however, to possess considerable influence over his people, and we had therefore little or no trouble while we remained at his place. I was here informed that with the exception of a few lodges about two miles below, no more Esquimaux would be seen until we got near the coast, which was still at some distance; and that these Esquimaux were not, in the words of the chief, "too good." Understanding from my interpreters that they were Anderson River Esquimaux and under the command of Dowlas, and also that they had some furs in their possession, I saw no reason to prevent us from going not only down to them, but as instructed, to the mouth of the river, especially as he volunteered to accompany us for the purpose of exercising his authority in our favor. On the contrary, from their being of Dowlas' party, I expected to find them as easy to deal with as the others, and therefore decided on proceeding.

The lodges (5) above alluded to were reached about 1 p.m. We halted for dinner, and here, as wherever we landed, we were treated to several dances performed to a low monotonous song chanted by the women. The utmost harmony existed among this interesting people, who appeared to feel much affection for their children. We saw very few old people and they seemed to be well taken care of. The married women are all very slightly tatooed, and the men wore the usual mouth ornaments. The oomiaks are taken up the river by means of a line made of walrus hide, hauled by three or four women and as many dogs. We met several boats thus hauled *en route* for above. A large *Inconnue* (*Salmo Mackensii*) and white-fish, both of excellent quality, were here traded. The first-named fish, together with carp, loche, herring, jack, blue and white-fish abound in this river. The Esquimaux use nets made of deer sinews for taking them. Small herds of reindeer were seen browsing on both banks and venison was everywhere in great abundance, in fact, deer were to be had when required.

After leaving last night's encampment, we found the country barer as we advanced and but thinly wooded, willow being more abundant than pine. Two great bends occurred, across which the Esquimaux make a portage when ascending the river. In one spot we observed a bed of shale similar to, but more friable, than that on Lockhart River. From that time until 9 p.m., when it was found necessary to abandon the canoes, the river gradually increased in breadth with longer reaches and a slow current. The immediate banks were at intervals low and muddy, and extended for some distance in an undulating plain to the base of the hilly ground which now ran parallel with the river. Wood at first appeared in clumps, but the country latterly was quite barren, the ground was covered with snow, the weather cold, and not a stick of drift-wood to be seen.

About 8 o'clock we arrived at nine lodges on the right bank of the river (all the lodges passed were on that side) where I was surprised to find only two men with the women and children, of whom there were 35. They informed us that the others had not yet returned from hunting, and that they had no furs to trade. Embarking under sail, the wind being fair, we were very shortly overtaken by 15 kayaks, to the occupants of which the usual presents were made, but without eliciting any thanks. The dress of these men was observed to differ from the others in being ornamented with beads, and in most of their coats being made of the skin of the wild goat or sheep, animals only to be had in the vicinity of the Rocky Mountains. I supposed that they had received them from the western Esquimaux, and although I noticed that their manner and the expression of their countenances (which was fierce) were anything but prepossessing, it never occurred to me that they were from the vicinity of Mackenzie River, as I had no idea of encountering any of that tribe at this period of the season.

Continuing on we passed another group of lodges, from which upwards of 20 men put off to us, but no women. Finding them very troublesome and in our way, the wind having changed right ahead, I peremptorily ordered them back, and as they would not return I stopped the canoes and caused the crews to present their guns at them (this was the first occasion we had to show our arms), which had the effect of making them keep a little behind; but they persisted in following, and while we were occupied in dealing with another party who met us, those behind came up and joining the last they surrounded both canoes, laying hold of Laporte's, evidently with the intention of dragging it on shore, a proceeding which, after much trouble, aided by the chiefs, we succeeded in preventing. We were constantly joined by new arrivals, who were shouting at a great rate and making much noise, and I now saw that owing to the interpreters not having thoroughly understood what Dowlas told them regarding these Esquimaux, whom we had no doubt were from the westward, we had got into a dilemma from which retreat *with the canoes* was impossible and that there was at least as much risk in attempting to return as in proceeding agreeably to my instructions. I fully expected to encamp that night on the shores of the Arctic Sea, and should certainly have done so but for the reasons which will after appear.

Determined to go forward at all hazards, especially as from the banks of the river here being muddy and nearly level with the water, covered with ice and no drift-wood—in short, utterly unfit for any defensive purposes, I could not land, and well knowing that the Esquimaux would never resort to extreme measures while we kept on the water, so long as we did not allow them to lay hold of our canoes. With my own canoe we always made our way; not so, however, with Laporte's, despite order after order given him to keep them off he would or could not, and it was therefore necessary for us to protect him in addition to opening up a road through the kayaks before us. Guns were again presented, which had now the effect of making the Esquimaux, if anything, more troublesome than before. Seven guns were held up to intimate to us that they were as well armed as ourselves, and such of them as had none dipped their bows in the water and arranged their arrows before them. These appearances, though certainly indicating hostile intentions, were, I suspected, made at present with the view of adding to the fears of the Indians, and they had the desired effect. The latter now became anxious to be put ashore so as to return overland, of course leaving everything. This I could not agree to, and therefore continued on.

About 9 p.m. we arrived opposite to a large encampment, from which some thirty or forty canoes were seen putting off, which caused the others to close around us, and thereby almost drove us on shore. Extricating ourselves with much difficulty we managed to go on a little further and were about twenty yards from the left bank when the new arrivals approached, seeing whom, six of the Indians suddenly got out of the canoes and made for land on a *batture* which extended for some distance from the shore. The Iroquois and I immediately jumped out, dragged the canoe to land, and with some trouble I succeeded in making the Indians turn back. They were ordered to re-embark, but refused. Seeing that they would not, I ranged them in a line along the beach with their guns presented, so as to prevent the Esquimaux from landing. The beach at this place was low and flat, the mud knee deep, ice in large sheets, with snow and water immediately in the back ground, not a stick of drift-wood and the position perfectly untenable. The Indians were clamouring to be off, some of them who had been at Peel River recognized many of the Esquimaux as recent frequenters of that post, and "Brulez" also informed me that he had seen the gun and horn of the missing Indian with one of the Esquimaux.

Finding that with these crews I should never be able to get back with the canoes, even if they had agreed to remain, I at length very reluctantly consented to accompany them, and we accordingly set out with all the property, leaving behind only what was too cumbrous to be carried, viz., our stock of dried meat and pemican (5 pieces), tracking line, kettle, tent, oil-cloth, a tin pan, &c. It is but just to state that throughout, the Iroquois and "Crashey" the Esquimaux interpreter, were the only two who duly supported me. Had the conduct of the others, *from the first*, been equally satisfactory, it is my firm belief that we could have passed on and returned despite of the Esquimaux, notwithstanding their notoriously bad character and that they were well armed with guns and other weapons. Their chief object was to get possession of our guns and stock of ammunition which, added to their own, would have made them rather formidable in the event of an encounter with the Peel River brigade. While occupied in giving out the tobacco, ammunition and other trading goods, a number of Esquimaux had landed above and below where we were; those in front of us were prevented from landing by the Iroquois and interpreter. The whole proceedings, after I decided on saving the ammunition, &c., occupied but a few minutes, and it was only on consenting to abandon the canoes that I could at all prevail on the Indians to remain.

The chiefs were, if possible, in greater fear than the Indians. The Esquimaux paid not the slightest attention to what they said. I had ascertained when too late that they were not of their tribe, but from the westward, being some of the same Esquimaux who wished to pillage the Indians last spring. The chiefs wished to accompany us, but I left them with the canoes, telling them that these would yet be demanded at their hands. Their reply was a strong regret at what had occurred and that they had done all in their power to prevent it. It was plain enough to be seen that the party of western Esquimaux whom the "Good Hope" Indians saw last spring, apprized of our intended visit, had returned to their camps and afterwards, with their families and some others, came across land from the westward *via* Esquimaux Lake, and had accordingly prepared to intercept us. The chiefs informed me that this lake only existed as an inlet of the sea. We were also told that a number of the above people usually pass the winter with the Anderson River Esquimaux.

In emergencies of this kind, Indians, or at least those of the Hare tribe, who are the most peaceable in the country, are not to be depended upon. One shot fired while we were on the water would have been followed by the sacrifice of the whole party, and on land, excepting the position was really good, they would all have deserted after the first round even if they could have been brought to fire. The crews were good enough while we had to deal with the Esquimaux of Anderson River, who were merely troublesome and somewhat addicted to pilfering; and, as to those lower down, I was loath to resort to extreme measures, as in any event it was impossible to bring back the canoes, and such a proceeding would certainly have been attended with very bad results. It would have put an end to all future prospects of trade, and they are good with the Esquimaux, not only of this river, but with those along the coast, east and west of Liverpool Bay. I therefore conceived it best to act as I did, especially as I could not persuade the Indians to remain with me.

After being compelled to abandon the canoes, we pursued a course to the westward of the river and at a distance of several miles, so as to avoid the bends in its course as well as any Esquimaux, against whom the Indians now threatened the direst revenge ! The country extended in a flat plain or morass covered with slush and water, to the foot of a chain of undulating hills, along which a small deep river flowed. On ascending the summit of the highest hill we had a view to seaward. The outline of the coast was distinctly seen and beyond it what appeared to us to be the sea, of course, entirely covered with ice. The country before us consisted of a series of undulations interspersed with plains of some extent and several small sheets of water.

Continuing on until 6 a.m. of the 17th June, we encamped, finding the country as before described and destitute of timber, a few small clumps of dwarf willow occurring at long intervals. With much difficulty, a few small half dry pine sticks about an inch in diameter were collected, a fire was made and part of a deer, which one of the Indians killed, cooked. Next day, or rather that afternoon, we resumed our course through a country similar in appearance, having a low chain of hills or ridges running in a parallel direction to the right of us. Towards midnight stunted trees became frequent along the banks of several small streams which were passed, in the valleys formed between the hills observed in our descent of the river. The snow was very deep in the valleys, and altogether the walking was dreadfully bad.

From this until the 24th of June, when we reached the Indian encampment at the mouth of Lockhart River, the country was more hilly and better wooded, intersected by numerous small and two middling sized streams having their rise in the south-west. The Anderson also receives the waters of a large lake lying in the Barren Grounds on the left. Reindeer were pretty numerous and as many were shot as we required. Traces of moose were seen for three days below the said encampment. There are no musk oxen to be found on the west side of the Anderson. These animals are however pretty numerous in the country to the eastward which is said to be hilly and destitute of wood. A few small lakes were passed on our route. The composition of the hills, when exposed, was of a reddish clay mixed with sand and small stones. Our course latterly lay along the beach where the walking was rather better, and on the 22nd we met six Esquimaux who had been hunting higher up. They expressed much regret on learning what had occurred below, but trusted that it would not be attributed to their tribe which, they stated, had nothing in common with the others.

On reaching the encampment I procured a small Indian canoe, an old ricketty affair, but the only one to be had, with which I determined on examining the upper part of the river (Anderson). With this view, as I could not take them with me, I paid off most of the party, who proceeded overland to Good Hope, and by whom I forwarded the trading goods and furs. On the 25th I set out accompanied by the Iroquois, Laporte and two Indians. One of the party steered the canoe, the others tracking in their turn, but always walked along the shore as the canoe was too small to carry them. On the 29th, Laporte and one of the Indians were sent home as I found that I could as well get on without them, and the remainder of the voyage was performed by the Iroquois and Brulez.

After leaving, we found that the river trended to the eastward, the banks were well wooded, low, and composed of clay and alluvial mud, the current smooth, and the river deep but not so broad as below. The country also differed in appearance. On the 27th we encamped above a shallow part of the river which the Indians dam up with willow, &c., in the fall of the year when the water is low, and by this means take immense numbers of inconnues, white, jack and other fish. The banks on the left (E.) at this place are composed of a blue slaty marl and stone probably resting on a bed of limestone. About noon of the 28th we encountered the first rapids, three in number and small. We had however to make a portage. Several more rapids were thus met and passed the same day. On the 28th another succession of more formidable rapids flowing over a rocky bottom were met, and next day we encountered several more, and at one part also, where the banks were high and perpendicular, a portage was rendered necessary. The breadth of the river in the intervals between each succession of rapids varied from a fifth to half a mile, but contracted considerably where these rapids occurred, in some instances being less than 100 yards. The banks were now high and tolerably wooded, and the country had a flat appearance, occasionally diversified by low ridges of rising ground. The rapids generally occurred where the course of the river assumed a south-westerly tendency. Ice was still in large quantities along the beach, rendering the tracking anything but good. Our canoe also delayed us very much, it being so frail and leaky as to require repairs several times a day.

In general, the banks of the river, where no rapids occurred, were composed of clay mixed with sand and fragmentary rock; but along and in the vicinity of rapids the formation was limestone containing fossils, frequently resting on a bed of harder rock, and often overlaid by a stratum of blue slaty-marl or clay-slate and a species of pudding-stone or soft sandstone. A few boulders were also passed as well as a small sulphur spring.

On the 1st July we encamped at the foot of a long succession of rapids, being the first seen since the afternoon of the preceding day, where we shot a moose-deer. A portage of two miles was made next morning and the mouth of a small river coming from the south-east passed. Late in the evening we encamped at the foot of a defile of high perpendicular rocks through which the water flows with great velocity, forming numerous rapids, some of them rather formidable. The river here is about 30 yards wide. A portage of six miles had therefore to be made the following morning (the 3rd). I have called this defile the Lower Ramparts on account of its resemblance to the Ramparts near Good Hope on the Mackenzie. Shortly afterwards we ascended a small rapid and made another portage, above which we began to perceive indications of coal along the beach. The banks were here of a dark blue clay in which thin seams of coal were observed. A number of boulders similar in size to mill stones, but rounded on one side were also met with. They had evidently tumbled from the left bank, higher up, where the formation was clay and gravel mixed with like stones. Continuing on, our course being more southerly than before, we passed another sulphur spring flowing at the base of a rock, and encamped a short distance above the mouth of a river having its rise in the south-west, which will be described hereafter, and to which I gave the name of Chief Trader Ross. The breadth of the Anderson was now from 50 to 400 yards, and we had many narrow escapes in the smaller rapids which were mostly ascended with the line. The canoe had also become so very leaky that it was only by constant baling and frequent repairs that we could at all get forward.

Resuming our course next day (July 4th) by making a series of portages equal to two miles, we then had some fine water until the afternoon, when we encountered another defile of rocks similar to, but lower than, that lately passed. Several long portages had to be made, but not before our canoe had become nearly useless. It was so very frail and leaky that it was impossible to proceed farther up the Anderson, it being rapid to its source. Another such day as the last would have completely finished our canoe. The Indian Brulez informed me that the Ross River had its rise in a "Great Fish Lake" lying to the eastward of the La Porte, and that it flowed through a chain of smaller lakes, and was broken but by a few rapids. I therefore decided on proceeding by that route, in order to examine the adjacent country, and be able to report on any advantages that it might possess over the others, as a means of communication with the Anderson. Before leaving the latter, however, the Indian and I set out next day to examine a portion of it beyond our encampment, which we did for several miles, finding the river narrow and very rapid. We also perceived that it assumed a south-easterly course, which he informed me it maintained until near its head. He also stated that the distance thither overland was about three days' march. I conceived also that I was now on the nearest point of the river to Good Hope. A lop-stick marked with a cross was made, and we returned to the camp, where we found that the Iroquois had patched up the canoe. We then dined and retraced our steps to Ross River, which was reached and ascended for several miles. A few small rapids were passed near its mouth, but there was abundance of water higher up—breadth from twenty to fifty yards, with a smooth current, the banks high, sloping and partially timbered.

The country along the Anderson was latterly very well wooded, and some goodly pines were seen. We also saw several rafts which had been used by Indians in crossing last spring, but no Indians were met with. This quarter is seldom hunted by them, their wintering grounds being situated more to the westward. The tract of country embraced by a line drawn west from the borders of the woods on the Anderson to the Mackenzie, southward to the Peau de Lièvre River at Good Hope, is very well timbered, and doubtless rich in martens and other fur-bearing animals, as well as rabbits and moose, and reindeer in their season—and this tract is but partially hunted by the Loucheux and Hare Indians.

The Lower Ramparts are composed of a hard, compact limestone, and the rocky banks seen below and above them, not already described, as well as the Upper Ramparts, are also of limestone, but of a less durable quality. Some blue rock resembling granite was seen at one place, and also a species of shale. No fossils were noticed in the rocks passed after the 29th ult. A few deer and great numbers of geese were seen daily, and moose- and bear-tracks were not very scarce.

On the 6th July, Ross River was ascended to a lake about twelve miles in length by five in breadth, which we skirted on the north side, on account of the ice that still partly covered it. The banks were of sand, low, and but thinly wooded, and the lake shallow near land. Some strata of shale was observed on the Ross shortly before the lake was reached. On the 7th we had to make several portages over long necks of land to avoid the ice, and then paddled to the side of the lake opposite the exit of the Ross, when we made a portage of four miles through a swampy country interspersed with morasses and small sheets of water to the next lake, the river thither being too rapid for our canoe. This lake we found almost entirely covered with ice, a narrow lane of water only appearing in its centre, which we followed and got safely through, though at great risk, the ice having begun to close on us so that we had to cut our way at one spot with the axe. We then continued along the lake until we reached the Ross. It was ascended next day to another and larger lake. From a sandy knoll at its entrance, we had a view of a high and rocky mountain of an angular form, at the base of which the Anderson is said to takes it rise. It then lay N.E. ½ E. of us.

The afternoon of that day and some portion of next was occupied in proceeding along this lake, when we crossed over and made a portage of five miles to another lake, in the vicinity of which we expected to find some Indians. We therefore halted and made a large fire, which was shortly answered by a volume of smoke rising in the east, in the direction of which Brulez and I set out, and reached it in an hour and a half, when we found six lodges of Hare Indians under the Chief, "La Rocque." They were employed fishing on the banks of a small river, which empties itself into the Anderson some distance above the Upper Ramparts. All the rivers and lakes in this part of the country abound with white, blue and jack fish, the former of excellent quality. The summer is passed by the greater portion of the Hare Indians in fishing among the rivers and lakes in the tract alluded to, until the deer begin to approach the woods, about the middle or end of August. A few of the Bâtard Loucheux tribe hunt along the east side of the Anderson below the mouth of the Lockhart. Their lodges consist of poles placed nearly upright with a partial covering of turf, and their dress and appearance was extremely dirty, thus presenting a great contrast to the Esquimaux, whom they affect to despise. The country in this quarter was sandy and marshy, with several plains and numerous small lakes and its general appearance flat. The Anderson River Mountain was now much nearer and bore E.N.E.

We left the Indians in the evening, reached the Ross, and there encamped. We next day saw three more lodges on another lake, and were supplied with some half dried fish. From this place we made a portage of two miles to a smaller lake, which we crossed, and then reached a larger, along which we continued until we came to a narrow strait dividing it from another lake. These lakes were less encumbered with ice than the others, and our progress, therefore, was better. The country in the vicinity was high and hilly. Small sandy hills or knolls of a conical form were invariably observed near the entrance and outflow of the river, as well as along the banks of the several lakes.

On the 10th we ascended the Ross to the largest lake (named "Colville Lake") yet seen, which was reached about noon and found to be almost entirely covered with ice. We, however, followed a narrow space of water on the right shore, and by means of a few portages we succeeded in getting to the other end of the lake about midnight. On this occasion, while paddling along at a distance of 150 yards from land, the canoe sprung a leak which threatened to sink us, and it was only by very hard paddling we managed to save ourselves. The canoe, however, sunk in four feet of water. It was taken on shore and again repaired. In our course thither it required constant baling, but had at length become useless. The banks of Colville Lake are low, the soil moss and vegetable mould covering sand, the beach stony, shingly and sandy at intervals. A large hill or rocky mountain (several hundred feet high), destitute of wood, lay at the end (S.E.) of the lake, beyond our encampment, and a chain of lower and well wooded hills encircle the Lake. The river thence to the Great Fish Lake, said to be the largest lake in the Hare Indian country (and now named after Sir George Simpson), which then lay to the west of us, at the distance of a few miles, could not be ascended with the canoe. It was, therefore, determined on proceeding overland to Fort Good Hope. These lakes lie to the west and southwest of the Anderson. Rabbits and partridges were pretty numerous, but very few geese, and no deer were seen after leaving that river.

We set out early on the morning of the 11th July, and had dinner on the summit of the ridge at this end (S.) of the lake, to the right of the mountain alluded to, which was now perceived to be the commencement, as well as the highest, of a chain of similar hills stretching for a considerable distance to the east and south-east. The walking hither was over a series of undulations, gradually ascending as we advanced, the top of each ascent being flat, the ground dry or swampy alternately, well wooded and interspersed with small lakes. This ridge has also a similar descent on the other side. The country thence to another ridge, which we reached next day, was flat and broken by some small mounds and knolls, with lakes and marshes as usual. Until we reached the Peau de Lièvre River, on the evening of the 13th, after three long days' march, the general appearance of the country did not differ very materially. It comprised several valleys lying between ridges resembling those described, and is bounded on the left by the chain of rocky hills before mentioned, on the right, occasionally, by lower ridges of wooded ground. One lake several miles in extent, and numerous smaller ones, were passed, such of them as lay in our path having to be skirted. The soil consisted of moss, vegetable mould, turf and clay, the higher ground being sandy, mixed with clay and rock. Before reaching the Peau de Lièvre, the said rocky chain disappeared behind us, and two others arose to the south, viz : that at the Sansault Rapid, above Good Hope, and the other on the east side higher up the Mackenzie. The timber consists of pine, juniper, fir, willow, and a few groves of poplar and birch. Some of the pines were of a large size.

From the spot where we halted for dinner on the 11th, we had a fine view of a large bay on Simpson Lake. The ice thereon was still as white and firm as in mid-winter, and the Indian informed me that it never broke up until late in the season. The banks appeared high and well timbered. He also informed me that its waters were deep and of a bluish color, and its shores rocky. A great number of families pass the severe months of the winter on this lake, in which fish are obtainable all the year round.

Finding near our encampment a raft which had been used by Indians in crossing the Peau de Lièvre, last spring, we launched it and continued the descent of that river until noon, when we found an Indian canoe on the beach. This we repaired, and going on much quicker with the paddle, we arrived at Fort Good Hope late in the evening of the 14th July, after an absence of forty-one days—the Indians sent home having preceded us by nine and Laporte by seven days. Had we not lost our own canoes, this trip would have been performed in less time, as most of the rapids on Anderson River could have been ascended with the line, and all of them—one only excepted—might be run by a North canoe.

From the date of our departure until the 3rd of July we had but a few hours of rain or snow, the weather being always fine. After that date we had rain and cloudy weather until we reached the Peau de Lièvre, the descent of which was effected under a severe thunderstorm, accompanied by torrents of rain. The prevailing winds were from the north and northeast. It was also misty at night near the coast. After leaving the Anderson, musquitoes were in myriads, and proved very annoying. Vegetation had made considerable progress during our journey.

The natural history of the tract of country examined resembles that of the Mackenzie. We observed moose and reindeer, black bears, otters, wolves, wolverines, siffleurs, beaver, musquash, marten, mink, squirrels, rabbits and foxes; also frogs and mice; Canada, laughing, snow and Esquimaux geese, stock, king, teal and long-tailed ducks, divers, loons, swans, hawks, owls, swallows, gulls, plovers, robins, snow buntings, willow grouse and white partridges, or ptarmigan; white, jack and blue fish, grayling, inconnu, carp and loche.

The Barren Grounds to the East of Anderson River.

The belt of timber which at Fort Anderson[1] extends for over thirty miles to the eastward, rapidly narrows and becomes a mere fringe along the Anderson River and disappears to the northward of the 69th parallel of latitude. The country is thickly interspersed with sheets of water varying in size from mere ponds to small and fair-sized lakes. In travelling north-eastward toward Franklin Bay, on the Arctic coast, several dry, swampy, mossy and peaty plains were passed before reaching the Barren Grounds proper. The country thence to the height-of-land between the Anderson and the deep gorge-like valley through which the Wilmot Horton River (MacFarlane River of Petitot's map) flows, as well as from the "crossing" of the latter to the high plateau which forms the western sea-bank of Franklin Bay, consists of vast plains or steppes of a flat or undulating character, diversified by some small lakes and gently sloping eminences, not dissimilar in appearance to portions of the north-west prairies. In the region here spoken of, however, the ridges occasionally assume a mound-like, hilly character, while one or two intersecting

[1] Established on Anderson River in 1861 and abandoned 1866. Approx. Lat. 68° 35′.

affluents of the Wilmot Horton flow through valleys in which a few stunted spruce, birch and willows appear at intervals. On the banks of one of these, near its mouth, we observed a sheltered grove of spruce and willows of larger growth, wherein moose and musk oxen had frequently browsed. We met with no more spruce nor any traces of the moose to the eastward, and I doubt if many stragglers range beyond Lat. 69° North.

The greater part of the Barren Grounds is every season covered with short grasses, mosses and small flowering plants, while patches of sedgy or peaty soil occur at longer or shorter distances. On these, as well as along the smaller rivulets, river and lake banks, Labrador tea, crow-berries and a few other kinds of berries, dwarf birch, willows, etc., grow. Large flat spaces had the honey-combed appearance usually presented in early spring by land which has been turned over in the autumn. There were few signs of vegetation on these, while some sandy and many other spots were virtually sterile. * * * Traces of the dark bituminous formation seen on the Lockhart, Anderson and Ross rivers, of the 1857 report, no doubt exist along the Wilmot Horton River and the greater part of Franklin Bay, especially to the north of our camping point [near its southern extremity.] The foregoing Barren Grounds are chiefly composed of a peaty, sandy, clayey or gravelly soil, but stones are rare, and rock *in situ* (limestone?) was encountered but two or three times on the line of march from the woods to the coast.

Notes on the Flora of Cap-a-L'Aigle,

By Robert Campbell, M.A., D.D.

The locality represented by the flora described in this paper, is embraced in a stretch of six miles on the north shore of the St. Lawrence, between the Murray and Loutre Rivers, County of Charlevoix. The species noted are those that are found in flower or fruit during the months of July and August. Those that come forth in spring and then disappear, or that flower later than the end of August, are not embraced in this catalogue, with one or two exceptions.

Exogens.

Ranunculaceæ:

Clematis virginiana, L., very frequently met with in the clumps of wood bordering on the St. Lawrence.

Thalictrum cornuti, L., on the borders of little streams.

Ranunculus flammula var. reptans, L., found by the writer in one spot, which was somewhat under water.

Ranunculus recurvatus, Poir., abundant everywhere by the roadside and in pasture fields.

Ranunculus acris, L., the stately bright buttercup, everywhere found.

Coptis trifolia, Salisb., on dry pine hills, growing under the shade of evergreens.

Aguilegia canadensis, L., rather rare, but found on the high rocks on the banks of the St. Lawrence.

Actæa spicata, L., abundant in the rich woods on the sloping banks of the St. Lawrence.

Actæa alba, Michx, somewhat rarer, in similar situations.

Cruciferæ:

Sisymbrium officinale, Scop., seen occasionally on the roadside.

Sinapis arvensis, L., too often seen in the grain fields, where it is a nuisance.

Capsella bursa-pastoris, L., abounds in rich soil, especially in gardens and potato fields.

Cakile americana, Nutt, one of the characteristic plants of the sea shore, to which it is confined, in this district.

VIOLACEÆ:

Viola cucullata, Ait., the only species found by the writer in fruit so late as July.

CARYOPHYLLACEÆ:

Silene inflata, Smith, its beautiful white starry blossom abounds, and is one of the characteristics of the district.

Lychnis githago, Lam., seen occasionally in grain fields.

Arenaria stricta, Michx., abounds in the sandy fields on the mountain steppes.

Stellaria media, Smith, found everywhere in rich damp soil.

Cerastium viscosum, L., abundant everywhere in pastures and by the roadside.

Cerastium arvense, L., also abounds in cultivated fields.

MALVACEÆ:

Malva rotundifolia, L., one specimen found outside a garden fence.

LINACEÆ:

Linum usitatissimum, L., found near old abandoned houses and barns.

GERANIACEÆ:

Geranium robertianum, L., in the moist woods near the St. Lawrence.

Oxalis acetosella, L., abundant in shady ravines of the brooks running into the St. Lawrence.

Oxalis stricta, L., not so often seen as the last, on higher grounds.

Impatiens fulva, Nutt., in the clay slopes bordering on the St. Lawrence.

Impatiens pallida, Nutt., abundant on the borders of the brooks running into the St. Lawrence.

ANACARDIACEÆ:

Rhus glabra, L., very abundant in old clearings that have been neglected.

SAPINDACEÆ:

Acer pennsylvanicum, L., abundant in rich moist woods near the banks of rivulets.

Acer spicatum, Lam., also abounds in the same description of territory.

Acer saccharinum, Wang., this tree does not thrive in the district, although occasional scraggy specimens are seen.

Acer rubrum, L., this variety is very abundant in the low grounds bordering on the St. Lawrence.

LEGUMINOSÆ:

Trifolium arvense, L., seen occasionally on grass plots in front of houses by the roadside.

Trifolium pratense, L., everywhere in hay fields and pastures.

Trifolium repens, L., everywhere in hay fields and pastures, with its sweet perfume scenting the air.

Medicago lupulina, L., abundant everywhere in pastures, hayfields and by the roadside.

Melilotus officinalis, Willd., abundant in fields and by the roadside.

Melilotus alba, Lam., occasionally seen, but much rarer than the yellow.

Vicia sativa, L., in cultivated fields and waste grounds.

Vicia cracca, L., one of the characteristic species of the district, in which it grows abundantly and luxuriantly in all situations.

Vicia hirsuta, Koch, is also found, but is much rarer in the locality.

Lathyrus maritimus, Bigelow, seen here and there on the clayey banks of the St. Lawrence.

ROSACEÆ:

Prunus pennsylvanica, L., very abundant on edges of thickets and along fences.

Prunus serotina, Ehrhart, occasionally found of a considerable size in woods bordering on brooks.

Spiræa salicifolia, L., very abundant in damp meadows and beside roadside fences.

Agrimonia eupatoria, L., a very abundant and characteristic plant of the district.

Potentilla norvegica, L., found everywhere in pastures and fields, on high ground and low.

Potentilla anserina, L., abundant on the coast of the St. Lawrence, and generally on damp grounds.

Potentilla tridentata, Ait., another characteristic plant of this district, abundant in sandy fields.

Fragaria virginiana, Ehrhart, this favorite fruit comes in with the arrival of the first summer guests, and in damp seasons lasts for four or five weeks.

Fragaria vesca, L., this delicious variety grows on upturned roots of trees, and in the shady patches of sandy loam, and lasts right through the season.

Rubus triflorus, Richardson, seen occasionally, but rather rare.

Rubus strigosus, Michx., the summer visitors luxuriate on this fruit, which the *habitants*' children gather in immense quantities in the evenings, and sell to the English residents on their way to school in the mornings. It lasts till September.

Rosa blanda, Ait., is very abundant near dwellings and by the roadside.

Pyrus americana, D. C., is very plentiful on the rich banks of the St. Lawrence, especially near rivulets; one specimen measured, girthed 46 inches.

Amelanchier canadensis, Torr. and Gray, is occasionally seen but, of course, in fruit, its flowering season being June.

SAXIFRAGACEÆ:

Ribes cynosbati, L., in all open woods and clearings.

Ribes hirtellum, Michx., less frequently met with on low grounds near the St. Lawrence shore.

Ribes floridum, L., abounds in damp woods.

Ribes rubrum, L., less frequently met with on the edge of bogs or wet woods.

ONAGRACEÆ,

Circæa alpina, L., this delicate little plant is a characteristic of the district, carpeting the paths through the woods in July.

Epilobium angustifolium, L., everywhere seen in the woods and new clearings.

Epilobium coloratum, Muhl., is another of the characteristic plants of the district, being found everywhere in woods, grain fields and pastures.

Œnothera biennis, L., is abundant in the sandy fields and edges of the woods.

UMBELLIFERÆ :

Heracleum lanatum, Michx., is occasionally found, but abounds more in the Murray and Loutre river districts.

Pastinaca sativa, L., frequently met with on the road-sides.

Conioselinum canadense, Torr. and Gray, abounds in the swamps near the shore.

Thaspium aureum, Nutt., occasionally found in dry rich woods.

Cicuta maculata, Nutt., seen sometimes on the banks of small streams.

Ligusticum scoticum, L., this foreigner, evidently brought by vessels from Europe, grows very luxuriantly on the rocks by the Cap-a-L'Aigle wharf, and has strayed downwards along the coast.

ARALIACEÆ :

Aralia racemosa, L., rather rare, in rich soil on the border of ravines.

Aralia hispida, Michx, a characteristic plant of the district, very abundant in recently burned land allowed afterwards to lie waste.

Aralia nudicaulis, L., almost covers the ground in the rich dry woods

Aralia quinquefolia, Gray, occasionally met with in the same localities.

CORNACEÆ :

Cornus canadensis, L., vies with the *Aralia nudicaulis* for possession of the ground around the larger trees and plants of rich woods.

Cornus circinata, L'Her., now and then met with in dry rich woods.

Cornus stolonifera, Michx., abounds everywhere in damp grounds along fences.

Cornus paniculata, L'Her., somewhat rare, in the thickets on the sloping banks of the St. Lawrence.

CAPRIFOLIACEÆ:

Linnæa borealis, Gronov., this beautiful favorite is rarely seen in flower so late as July, but its trailing vine in fruit, is a characteristic of the Cap-a-l'Aigle woods everywhere.

Lonicera ciliata, Muhl., is occasionally met with on the wooded slope running down to the St. Lawrence.

Diervilla trifida, Mœnch., is one of the characteristic shrubs of the district, lining the roadside fences.

Sambucus canadensis, L., occasionally seen in clumps in fields near streams.

Sambucus pubens, Michx., is more abundant, growing on the edge of rocky woods.

Viburnum lentago, L., on the border of a marsh by the roadside.

Viburnum nudum, L., in thickets near the margin of the river.

Viburnum opulus, L., one specimen seen near the Loutre.

RUBIACEÆ:

Galium aparine, L., abounds in ditches by the roadside.

Galium triflorum, Michx., plentiful in the light woods, away from the seashore.

Galium asprellum, Michx., abounds in the thickets bordering on the coast.

Galium boreale, L., to be found in the same regions as the *Galium triflorum*.

COMPOSITÆ:

Cirsium lanceolatum, Scop., in the fields and roadsides everywhere.

Cirsium muticum, Michx., somewhat rare, on the margins of brooks.

Cirsium arvense, Scop., this pest of the farmers has taken firm hold in this district.

Lappa major, Gærth,, raises itself in very strong form throughout the locality.

Tanacetum vulgare, L., to be found only in two spots on the roadside, near dwellings, from the gardens of which it probably has strayed.

Artemisia vulgaris, L., found near old dwellings and along the roadside, having travelled with advancing civilization, but clearly not a native.

Gnaphalium decurrens, Ives, abounds on the hillsides.

Gnaphalium polycephalum, Michx., still more abundant than the last, and found in every variety of soil and situation.

Gnaphalium uliginosum, L. in all the fields, on the hilltops, and in the cultivated grounds and gardens below as well, proving rather a nuisance; one of the characteristic plants of the district.

Eupatorium purpureum, L., grows very large in spots near the Murray and Loutre rivers, but there is little of it in the intervening territory.

Eupatorium perfoliatum, L., still rarer than the last and found in the same localitiės.

Eupatorium ageratoides, L., grows high and strong in the woods bordering on the brooks.

Senecio vulgaris, L., abounds in grounds near barns and in the neighborhood of gardens especially.

Senecio aureus, L., occasionally met with in swamps and damp ditches by the wayside.

Solidago squarrosa, Muhl., abounds everywhere in open fields and borders of woods.

Solidago concolor, L., also abundant in the same localities as the last.

Solidago latifolia, L., very abundant in cool thickets.

Solidago cœsia, L., is occasionally met with near fences and on the hillsides.

Solidago arguta, var. *juncea*, Ait., prevails largely in the district in the fields and roadside.

Solidago canadensis, L., this magnificent plant is the most common variety of the golden rod in the district, found in all situations.

Solidago gigantea, Ait., also abounds.

Solidago lanceolata, this is a characteristic of the ditches and other damp portions of the wayside; it is the latest in flowering of all the golden rods of the locality.

Aster macrophyllus, L., is one of the characteristic plants of the district, contending for space throughout the woods with the *Aralia nudicaulis* and the *Cornus canadensis.* Its large heart-shaped root-leaves completely carpet the ground with green, and are fragrant when crushed; but few of them send up a stalk.

Aster undulatus, L., also abounds in the woods on the higher ground.

Aster cordifolius, L., found along fences and on the edge of woods.

Aster longifolius, Lam., frequently met with in moist thickets along streams.

Aster multiflorus, Ait., often seen on dry soil, near fences.

Aster tenuifolius, L., occasionally found in low thickets.

Erigeron canadense, L., a characteristic plant of the district, completely covering new ground lately burnt over, and found on all the hillsides.

Erigeron bellidifolium, Muhl., in thick dry woods.

Erigeron strigosum, Muhl, abounds in the dry fields.

Leucanthemum vvlgare, Lam., is as plentiful as it is everywhere in Canada.

Rudbeckia hirta, L., is occasionally met with in dry meadows.

Achillea millefolium, L., abounds everywhere in fields, woods and waysides.

Cichorium intybus, L., is rather rare, but an occasional specimen is seen on the roadside.

Hieracium canadense, Mich., this and the

Hieracium scabrum, Mich., are characteristic plants of the district, found in dry sandy fields and on the hillsides.

Nabalus albus, Hook., is very abundant in the rich woods near the banks of the St. Lawrence.

Nabalus altissimus, Hook, is occasionally found in the woods higher up on the banks of streams.

Taraxacum dens-leonis, Desf., in the fields everywhere, although its glory is past before July.

Mulgedium leucophæum, D.C., is here and there met with alongside fences and ditches.

Sonchus oleraceus, L., is occasionally found near barn-yards.

Sonchus arvensis, L., is found occasionally near ditches in rank grass.

LOBELIACEÆ:

Lobelia inflata, L., found on the high banks of the Murray river.

CAMPANULACEÆ:

Campanula rotundifolia, L., on the rocks bordering on the St. Lawrence.

VACCINIACEÆ:

Vaccinium oxycoccus, L., on the top of rocks at Cap-a-l'Aigle wharf.

Chiogenes hispidula, Torr. and Gray, found in St. Fidele marsh.

Vaccinium pennsylvanicum, Lam., everywhere found on high dry plains.

ERICACEÆ:

Gaultheria procumbens, L., found on the high wooded slope of the Murray river.

Andromeda polifolia, L., in the St. Fidele marshes.

Kalmia glauca, Ait., in the St. Fidele marshes.

Kalmia angustifolia, L., in the same situations as the two last named.

Ledum latifolium, Ait., also found in the St. Fidele marshes.

Pyrola rotundifolia, L., in moist rich woods.

Pyrola elliptica, Nutt, more numerous than the last in the the same localities.

MONOTROPEÆ:

Monotropa uniflora, L., somewhat rare, in thick woods on the Laurentian ridges.

PLANTAGINACEÆ:

Plantago major, L., abounds everywhere on roads and paths and around dwellings.

Plantago maritima, var. *juncoides*, L., grows all along the sandy shore of the St. Lawrence.

SCROPHULARIACEÆ:

Verbascum thapsus, L., occasionally seen in the high pasture grounds.

Veronica serpyllifolia, L., somewhat rare on warm sandy hillsides.

Linaria vulgaris, Mill., seen in only two spots, evidently strayed from some garden.

Euphrasia officinalis, L.: found only in two places, one on the roadside at St. Fidele, the other on the face of one of the Laurentian ridges.

Rhinanthus crista-galli, L., is very abundant, forming decidedly one of the characteristic species of the district.

Melampyrum americanum, Mich., is also so numerous in fields and woods as to be entitled to rank with the *Rhinanthus crista-galli*.

LABIATÆ:

Mentha viridis, L., found in wet ditches.

Mentha piperita, L., is still more abundant than the last, in the same situations.

Mentha canadensis, L., found plentifully on the shady moist banks of the Murray river.

Nepeta cataria, L., somewhat rare, yet one specimen near the top of one of the high Laurentian ridges.

Brunella vulgaris, L., seen everywhere in moist woods and fields.

Scutellaria galericulata, L., rare, on the moist banks of the Murray river.

Scutellaria lateriflora, L., seen occasionally in the same situations as the last named.

Galeopsis tetrahit, L., numerous in waste places and fields.

BORRAGINACEÆ:

Lycopsis arvensis, L., numerous in potato fields and gardens.

Echinospermum lappula, Lehm., so plentiful as to be a nuisance to ladies and sheep, the nutlets clinging to wool and garments.

Cynoglossum officinale, L., common in pasture fields and by the roadside.

Lithospermum arvense, L., abounds in all sandy loam soil, among the grass.

Myosotis palustris, var. *laxa*, With., found in a few localities in ditches by the roadside and on the margin of marshes.

SOLANACEÆ:

Physalis viscosa, L., occasionally met with in sandy loam soil in brush.

APOCYNACEÆ:

Apocynum androsæmifolium, L., numerous on banks and thickets, and here and there by the wayside.

CHENOPODIACEÆ:

Chenopodium album, L., extremely common in cultivated soil and by the roadside.

Chenopodium hybridum, L., in waste places, rarer than the last.

Salsola kali, L., everywhere on the seashore.

POLYGONACEÆ:

Polygonum aviculare, L., everywhere in yards and about doors.

Polygonum persicaria, L., common near dwellings in moist ground.

Polygonum acre, H. B. K., on muddy margin of streams.

Polygonum arifolium, L., common in low grounds.

Polygonum sagittatum, L., a characteristic plant of the district in marshy ground.

Polygonum convolvulus, L., abounds among grain in cultivated fields.

Polygonum dumetorum, L., in moist thickets,

Rumex orbiculatus, Spotten, everywhere along the shore of the St. Lawrence.

Rumex salicifolius, Weinmann, abounds in marshy places near the coast.

Rumex crispus, L., numerous on roadsides and near dwellings.

Rumex acetosella, Tourn., very common in poor sandy fields and woods.

Fagopyrum esculentum, Mœnch., in old fields, near deserted dwellings, strayed from cultivation.

EUPHORBIACEÆ:

Euphorbia platyphylla, L., is so plentiful everywhere as to be a characteristic plant of Cap-a-l'Aigle.

URTICACEÆ:

Ulmus americana, L., Willd., grows near the Loutre and Murray rivers.

Cannabis sativa, L., seen occasionally in waste places and by the roadside.

CUPULIFERÆ:

Corylus americana, Walt., somewhat rare at borders of woods.

Ostrya virginica, Willd., rare in rich woods on the slope of the St. Lawrence.

Carpinus americana. L., occasionally near the banks of streams.

BETULACEÆ:

Betula lutea, Michx., in moist woods occasionally.

Betula papyracea, Ait., is with the poplar, the prevailing wood of the district.

Alnus incana, Willd., grows up everywhere in fields and pastures if not kept continually cut.

SALICACEÆ:

Salix humilis. Marshall, in dry and barren grounds.

Salix discolor, Muhl., abounds in low grounds near streams.

Salix livida, var. *occidentalis*, Spotten, grows plentifully in moist situations.

Salix lucida, Muhl., also prevails largely in similar spots.

Populus tremuloides, Michx., grows very abundantly and is the chief article of fuel.

Populus grandidentata, Michx., also abounds in the district.

Populus balsamifera, L., attains a great size on the clayey banks of the St. Lawrence.

CONIFERÆ:

Pinus resinosa, Ait., not numerous,yet well represented.

Pinus strobus, L., still rarer than the last, yet found.

Abies balsamea, Marshall, }
Picea nigra, Poir, } All very abundant in damp situations near streams.
Picea alba, Link., }

Tsuga canadensis, Carr., is also met with in rocky and sandy hillsides.

Larix americana, Michx., seen on the banks of the Murray and Loutre rivers.

Thuja occidentalis, L., occasionally met with in swamps.

Juniperus communis, L., a characteristic shrub of the district, in sandy fields.

ENDOGENS.

TYPHACEÆ:

Typha latifolia, L., in marshy places, not numerous.

ORCHIDACEÆ:

Spiranthes romanzoviana, Spotten, very often seen in damp pasture and hayfields.

IRIDACEÆ:

Iris versicolor, L., abounds in wet situations.

Sisyrinchium bermudiana, L., met with in moist meadows.

LILIACEÆ:

Medeola virginica, L., occasionally in rich woods.

Zygadenus glaucus, Nutt., found in a few spots on the rocks near the St. Lawrence coast.

Clintonia borealis, Raf., under evergreens in damp woods.
Streptopus roseus, Michx., numerous in thickets.
Smilacina trifolia, Desf., occasionally in bogs.
Smilacina bifolia, Ker., numerous in moist woods.

JUNCACEÆ:

Luzula campestris, D. C., } Both prevail in woods and
Luzula pilosa, Willd., } shady banks.
Juncus bufonius, L., along damp paths, through hayfields.

CYPERACEÆ:

Cyperus diandrus, Torr., frequently met with in low places.
Eleocharis obtusa, Schultes, often seen in muddy soils.
Scirpus pungens, Vahl., abounds in marshes.
Eriophorum polystachyon, L., very common in boggy situations.
Carex intumescens, Rudge, common everywhere in moist soil.

GRAMINEÆ:

Agrostis vulgaris, With., everywhere that grass grows.
Poa pratensis, L., in all moist meadows.
Bromus secalinus, L., a common pest in wheat fields and on strong soils near the coast.
Panicum capillare, L.,everywhere in sandy cultivated soil.
Panicum crus-galli, L., grows wherever the ground is enriched with barnyard manure.
Setaria glauca, Beam, very numerous in peafields and among potatoes.
Glyceria nervata, Trin., on the loamy margins of the coast.
Arundinaria macrosperma, Michx., abounds on sandy margins of the salt water.
Spartina polystachia, Willd., Muhl., on the margin of the St. Lawrence.
Phleum pratense, L., everywhere in cultivated hayfields.
Alopecurus aristatus, Pers., grows on the seashore.
Leptochloa fascicularis, Gray, also grows near the shore.
Danthonia spicata, Beauv., abounds in the same localities.
Gymnopogon racemosus, Beauv., on the banks of the St. Lawrence.

Festuca elatior, L., is also found in similar positions.

Leersia oryzoides, Schwartz, is found high up the banks.

Milium effusum, L., is also occasionally seen.

CRYPTOGAMS.

FILICES:

Polypodium vulgare, L., rare, on shady rocks.

Adiantum pedatum, L., common in rich woods on the higher ground.

Pteris aquilina, L., is as characteristic of the district, as it is of the highlands of Scotland, covering the entire faces of many of the high hills.

Asplenium filix-fœmina, R. Brown, in rich woods.

Phegopteris dryopteris, Spotten, common in rich woods.

Struthiopteris germanica, Willd., in low wet grounds near streams.

Onoclea sensibilis, L., in wet grounds near Loutre.

EQUISETACEÆ:

Equisetum hyemale, L., is a characteristic plant, growing everywhere on the high Laurentian ridges.

Equisetum limosum, L., on dry banks of streams.

LYCOPODIAEÆ:

Lycopodium dendroideum, Michx., in dry pine woods.

Selaginella rupestris, Spring, on exposed rocks in high situations.

PROCEEDINGS OF THE SOCIETY.

The first regular monthly meeting of the Society was held on the evening of October 28th, Sir Wm. Dawson presiding.

The Curator reported the following donations:—

Collection of game birds, Mr. Henry Hogan.
Ant-eating bear and sponges, Mr. W. F. Darling.
Fossils from Lake St. John, Mr. E. T. Chambers.
Geological specimens, Mr. W. H. Rintoul.
Birds, Mr. G. Dunlop.
Beaver chips, Mr. H. T. Martin.

The thanks of the Society were tendered to the donors.

The Librarian reported the usual exchanges.

Mr. Beaudry read a letter stating that a number of human bones had been found in an excavation on Maple Avenue, Côte St. Louis, at a depth of thirteen feet below the surface. Mr. Beaudry and Mr. McLachlan were asked to investigate the matter and report upon the results of their enquiries at a future meeting.

The following were elected to ordinary membership:—Mr. E. H. Botterell, Mr. A. S. McBean, Mr. Henry Mott, Dr. F. D. Adams, Mr. D. Burke and Dr. Wyatt Johnston.

Mr. Shearer took the chair, and the President presented a paper on fossil sponges, illustrating the same with drawings and photographs, and specimens of indigenous and exotic species. The author dealt with the subject on general grounds, and traced the development of these organisms from the earlier forms.

Sir Wm. Dawson also exhibited a maple leaf found by Mr. J. Townsend in an excavation on the Don River, Toronto, at a depth of fifty-five feet. Prof. Penhallow stated that it resembled the leaf of the common sugar maple in some respects, while in others it approached the Norway maple. It might possibly be an intermediate species.

Dr. Wesley Mills exhibited a remarkable specimen of the plumage of a Langsham fowl, which presented the peculiarities of hair more than of feathers.

Prof. Penhallow gave a few additional notes upon a remarkable blaze found in the interior of a beech tree, as reported to the Society some three years ago.

On motion of Mr. Shearer, seconded by Dr. Mills, the following resolution was adopted:—

"This Society records, with deep regret, the death of Mr. Thomas Workman, one of its oldest life members, and wishes to express its sincere sympathy with the relatives of its late member; also, that a copy of this resolution be forwarded to them."

The regular monthly meeting of the Society was held on Monday, the 25th of November, Sir Wm. Dawson presiding.

In addition to the usual representation of members, there were present a large number of citizens, who assembled to participate in the presentation of a portrait of the President to the Society.

After the usual routine business had been transacted, Mr. J. S. Shearer was moved to the chair, upon taking which he announced the special business of the evening, and stated that the very fine portrait, executed by Harris, had been presented to the Society by the following friends and members: Messrs. John H. R. Molson, J. Stevenson Brown, Charles Gibb, B. J. Harrington, Sir Donald A. Smith, Prof. D. P. Penhallow, M ssrs. P. S. Ross, E. B. Greenshields, W. Drysdale, Robert Mackay, Samnel Finley, John S. Shearer, Albert Holden, George Sumner, E. T. Chambers, Hon. Edward Murphy, Messrs. Jonathan Hodgson, J. H. Joseph, Chas. Alexander, E. K. Greene, James Gardner, G. R. Prowse, J. A. U. Beaudry, and Major Latour.

The Chairman then introduced the Hon. Senator Murphy, who presented the following address to Sir Wm. Dawson:—

To Sir William Dawson, LL.D., F.R.S., F.G.S., C.M.G.:

We, the Council and members of the Natural History Society of Montreal, take advantage of the occasion of the uncovering of this portrait of yourself, with which we seek to adorn our walls, to acknowledge the obligations under which you have laid our society in particular, as well as our appreciation of the distinguished services which you have rendered to science in general.

It is now thirty-four years since your name was first enrolled as a member of this society, and from that time until now you have labored assiduously to promote its objects. No fewer than twenty times have you, by the suffrages of the members, been elected to the presidency, the highest office in their gift, although they have felt that you have done greater honor to the society than the society could confer upon you, in accepting this office at their hands, while you have been no less active in working in the interests of the society when not occupying the presidential chair.

We gratefully recognize the spirit of the true scientist in the readiness which you have ever shown to devote time and energy to furthering the aims of the society, when the pressing nature of your important professional duties might well have been pleaded as an excuse for declining to charge yourself with the responsibilities in connection with our humble undertakings. We desire to put on record also our sense of the geniality which has always marked your intercourse with the members of the society, and of the kindness and encouragement you have shown to young workers in the domain of natural history. Then you have striven to foster a taste for the study of nature in the community generally by your numerous popular lectures on scientific subjects, while in the many original papers which you have read before the society, and which have gone to enrich the columns of its journals, you have pointed out the way by which the student of special branches of science may become expert.

We recognize in you a foremost authority in the science of geology, and rejoice in the appreciation of your scientific attainments and achievements, evinced not less in your elevation by the vote of brother scientists to the presidency successively of the American Association for the Advancement of Science and of the British Association for the same object, the highest position attainable by a man of science, than in your being enrolled by our beloved Sovereign Queen Victoria, in the distinguished order of British knighthood. As members of the Natural History Society of Montreal, we have felt as if we shared in the various well deserved honors conferred upon you. We further congratulate you upon the high position attained by the university of which you are the eminent principal, among the educational institutions of the world, and upon the growing evidence, afforded from time to time, of the estimation in which it is held by prominent citizens who have contributed to its endowment. Feeling that we were doing a service to future students of natural history who will wish to look upon the features of one who had so much to do with laying its foundations in Canada, we have resolved to hang in our hall this portrait by Harris, subscribed for by members and friends of the society, hoping that it may prove an inspiration to the generations that shall come after us, to emulate the noble example which you have set them.

In reply, Sir William said:—Hon. Mr. Murphy and gentlemen, I need not say how much I appreciate the kindness of the friends who have desired to give me in that picture, a permanent place in the rooms of the society along with those who have been its friends and ornaments in the past, and to accompany this generous act with so kindly, and I fear too complimentary, words to myself. I do not, however, consider myself precisely one of the specimens of the Natural History Society. I hope that the excellent portrait executed by Mr. Harris may, as you anticipate, do its part in affording stimulus and encouragement to future votaries of science who may pursue their studies under the auspices of this society. In entering, thirty-four years ago, on the educational work in this city, which has been the main business of my life, I reckoned on this society and on the Geological survey, then under my friend Sir William Logan, as guarantees for the elevation of the study of natural science in this country and in connection with our university. In this I have not been disappointed; and if, as you kindly say, I have been ready to further the aims of the society, I have only done what gratitude prompted, as well as the feeling that the popularization of science and the promotion of original work for which this society is constituted, must furnish the most potent aids to scientific education, as well as the best encouragement to those younger workers in natural science whose interests have always been near my heart. For myself, I have felt that the place given to me has been that of an humble student in the school of nature, and an expositor to others of what I have been able to learn respecting the works of the All-Wise, of whose mighty power only a faint whisper can be heard by us in this lower sphere. This society, the earliest established in Canada for the study of natural science, can take credit to itself for the first suggestion of our now great geological survey; for the first invitation to meet on Canadian soil, extended to the great scientific associations of America and of Great Britain; for a long and invaluable series of scientific memoirs published in its proceedings, which now constitute the most complete repertory of the progress of natural science in Canada, and for the aid and encouragement which it has afforded to many of our ablest workers in scientific education and original research. During the time in which I have had the privilege of being a member of this society, it has passed through some perilous crises, but its course has on the whole been onward; and as some of its old and tried friends have passed away, others have arisen in their room. It is now in a better and more secure position than ever before. It has many young and earnest men interested in its prosperity, and has a hold on the esteem and liberality of the public which must ensure it a still higher and more useful career in the future. You have been so kind as to refer to the university with which I am connected, and in which education in science has made great progress in recent years. I am happy to know that between it and this society there have always been the most cordial relations, which have been cemented by many mutual benefits. It is an additional pleasure to me that the portrait now to be placed on the walls of this society has been contributed to by so many personal friends, long associated with me, all of them in the work of this society. I may add that it is an additional pleasure that the function of presenting it has been placed in the hands of my friend the Hon. Mr. Murphy, who has been for so long a valuable member of this society; who has always been a zealous friend and patron of science and who has been considered worthy of being one of the lords in the Senate of Canada.

Mr. Stevenson Brown presented Lady Dawson with an extremely tasteful bouquet, after which, in a few judiciously chosen terms, he accepted the picture on behalf of the society, and as curator, promised to give it a prominent place in the museum.

After adjournment, the audience passed two hours most pleasantly, in an inspection of the collections and of microscopical specimens which were kindly placed on exhibition by members of the Microscopical Society.

Book Notices.

Bulletin U. S. Geological Survey.[1]—In this interesting and valuable bulletin Mr. Russell describes the great deposits of red clays, &c., resulting from the decay of the surface rocks in the Appalachian Region, south of the southern limit of the glaciated area, and then considers their bearing on the much debated question of the origin of the red coloring matter of sandstones and shales.

Over large areas in Virginia and the Carolinas these residual deposits are over 100 feet thick. The clayey material when washed with water, leaves behind a residue composed of more or less angular fragments of quartz and feldspar with scales of mica and fragments of other minerals, each grain being coated with a thin layer having a red or brown color, which is rich in ferric oxide and alumina and may be described as a feruginous clay. This coloring matter adheres firmly and is not removed by prolonged washing, a fact which is illustrated by the red color of the sands deposited by the streams of Virginia and the Carolinas in districts underlain by crystalline rocks. Hot hydrochloric acid, however, removes the coloring matter, leaving the grains with their normal tints. The examination of a number of red sandstones showed that their coloring matter was identical, both chemically and in its mode of occurrence, with that in these residual deposits.

Mr. Russell believes that when crystalline rocks become thoroughly decomposed, especially in hot and moist climates where decomposition takes place not only more rapidly, but more thoroughly than in colder or drier climates, where rocks are often disintegrated without suffering marked decomposition, the residual deposits will be of a red color on account of the oxidation of the iron contained in the original rock, not only in the form of pyrites and magnetite, but also in various silicates such as pyroxene, mica, &c. Such deposits are by no means confined to the Appalachian Region, the terra rossa of Europe, the Laterite of India, and the red earth of Bermuda being similar in character and origin. If these deposits be washed away and redeposited, without prolonged friction such as that produced by ocean waves, the transportation being carried on by water which does not contain organic matter or other agents which would affect the reduction and solution of the iron, red sandstones and shales will be produced.

[1] Subaerial Decay of Rocks and Origin of the Red Color of Certain Formations. Israel Cook Russell, Bulletin of the United States Geological Survey No. 52, Washington, 1889. (pp. 65.)

If, however, rocks are merely disintegrated and carried away without undergoing any profound decomposition, if the iron is removed from red sediments by the agencies above mentioned or if the original rock does not contain any considerable amount of iron, the resulting rocks will not be red, but will have the subdued tints more often presented by the same rocks. After a brief statement of the views of some former writers as to the cause of the red color in question, Mr. Russell concludes his pamphlet with a good bibliography of the subject which will be of much value to any one wishing to continue his study of this most interesting problem.

F. D. A.

Metamorphosis of Rocks.[1]—This book is a thesis written for the Doctorate in Science in the University of London and is an attempt to consider more fully the Chemical and Physical side of Professor Bonney's Presidential address to the Geological Society of London in 1886.

The author considers that a greatly exaggerated importance has been attributed to "Regional Metamorphism" and endeavours to show that the theory which occounts for the genesis of the Archæn Rocks by the reactions which took place in a cooling globe, is the only true and valid one.

After a few general and introductory remarks, the subject of metamorphism is taken up and treated under the five following heads:—Paramorphism, Metatropy, Metataxis, Hyperphoric Change, and Contact-metamorphism, with the introduction of a somewhat depressing number of new, terms. Two appendices contain notes on various points connected with the subject.

The book contains little or nothing new being merely a rediscussion of facts already discussed, but the author has a good knowledge of the literature of his subject and the frequent references which he gives to important papers, will make it of value to students.

The book is unfortunately written in a very self-satisfied spirit, and the frequent more or less contemptuous personal references which it contains are, especially in a work of this kind, to be deplored.

In order to make any sound progress toward a final solution of the problem of the origin of the Archæn Rocks and Crystalline Schists, what is really needed is a *great deal* more good, careful and

[1] Chemical and Physical Studies in the Metamorphism of Rocks. A. Irving, D. Sc., B.A., F.G.S. London, Longmans, Green and Co., 1889, (pp. 137.)

laborious work in typical areas of these rocks—such work as has been carried out by Lehmann, in Saxony; Brogger, Tornebohm and Reusch, in Scandinavia; Heim, in the Alps; Macpherson, in Spain, and Lawson in part of Central Canada. When we have in this way become possessed of the facts concerning these rocks, our theoretical deductions will be much more valuable than they are at present. In the meantime, the consideration of such questions as, whether the water present on the primeval crust of the earth existed as puddles or oceans, and whether the feeble foliation of the fundamental gneisses may not be due to the solar tidal waves in the original magma, while the more pronounced foliation and apparent false bedding of the schists may be attributed to the action of the lunar tides, can scarcely be considered to be especially profitable.

F. D. A.

Notes.

A very interesting and somewhat unusual instance of reversion was recently brought to my notice in a specimen of *Trillium erectum var album* which appeared in the student collection of Mr. S. W. Mack. The plant was eight inches high and the three leaves much less than the normal size. The ordinary sepals were enlarged to two-thirds the size of the leaves, which they very closely resemble in all respects. The three petals had become sepals, which were, however, much broader and more leaf-like than in the normal flowers. The six stamens were all connected into foliar organs, each about the size of a normal sepal. They closely resembled the sepals in all respects except in the tips, which were white and quite pitaloid. The pistil was completely transformed, and each carpel replaced by two—six in all—linear and small foliar structures resembling abortive petals.

Monstrosities are common in this genus, but this particular case is one of more than passing interest.

D. P. P.

R, 1889.

Meteorologi et. C. H. McLEOD, *Superintendent.*

DAY.	THE Mean.	M	Min.	Percent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	56.93	6	4	00	0 42	....	0.42	1
2	46.03	5	0	00	0 07	....	0 07	2
3	38.82	4	0	01	0.39	....	0.39	3
4	40.37	4	10	00	0.24	....	0.24	4
5	38.93	4	10	00	...	.	....	5
SUNDAY........ 6	. ...	4	..	00	0.79	....	0 79	6 ....SUNDAY
7	39.95	4	10	00	0.33	....	0 33	7
8	37.38	4	10	00	0.08	....	0 08	8
9	44.77	5	0	80	0.04	....	0.04	9
10	40.45	4	0	44	....	..	..	10
11	41.63	4	0	79	...	....	....	11
12	39.47	4	0	54	....	....	....	12
SUNDAY....... 13	.....	4	.	95	..	....	....	13 ....SUNDAY
14	42.30	4	0	97	..	....	....	14
15	44.32	5	0	98	...	....	...	15
16	43.95	5	0	97	....	....	....	16
17	48.13	5	0	12	....	....	....	17
18	43.20	4	3	23	Inapp.		0.00	18
19	43.50	4	0	25	...	....	......	19
SUNDAY........20	.....	5	.	77	....	....	....	20 ....SUNDAY
21	33.47	4	0	70	....	.	....	21
22	34.40	4	0	17	...	....	....	22
23	27.70	3	0	98	...	....	....	23
24	33.28	4	0	92	....	. .	....	24
25	39.02	4	0	12	....	. .	....	25
26	41.13	4	10	00	....	. .	....	26
SUNDAY.. 27	.....	4	..	00	0.47	...	0.47	27 ....SUNDAY
28	38.13	4	1c	00	0.47	0.8	0.55	28
29	35.73	3	7	00	0.04	....	0.04	29
30	35.12	4	0	45	....	.	...	30
31	35.85	4	0	20	....	....	....	31
....Means.	40.15	4		36.6	3.34	0.8	3 42	Sums ....
15 yrs. means for & ncluding this mo.	45.00	5		¶41.2	3.42	1 7	3.59	15 years means for and including this month

ANA

Direction........	N.	N.
Miles...........	1703	31
Duration in hrs..	131	1
Mean velocity...	13.0	18

Greatest mileage in one hou

Greatest velocity in gusts 5

the 28th.

nd the 1st. Coldest day was the 23rd. Highest barometer reading was 30.605 on the 23rd; lowest barometer was 29.393 on the 1st; giving a range of 1.212 inches. Maximum relative humidity was 99 on the 1st and 7th. Minimum relative humidity was 38 on the 24th.

at- of as

Rain fell on 12 days.

Snow fell on 1 day.

Rain or snow fell on 12 days.

Aurora on 1 night.

Hoar frost on 12 days.

Fog on 2 days.

ABSTRACT FOR THE MONTH OF OCTOBER, 1889.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range	BAROMETER. *Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.
1	56.93	61.1	53.0	8.1	29.4642	29.543	29 393	.150	4293	92.3	54 7
2	46.03	54.4	35.5	18.9	29.7908	30.042	29 479	.563	.2482	76.8	39.0
3	38.82	42.4	32.0	10.4	29.9888	30.068	29.868	200	.2132	90.0	35.8
4	40.37	42.8	37.7	5.1	30.0917	30.242	29.846	.396	.2322	92.5	38.3
5	38.93	41.9	36.5	5.4	30 1415	30.220	30 084	.136	.1888	79.7	33.0
SUNDAY........ 6	. ..	45.1	37.5	7 6	....	......	.....	....	.....	....	....
7	39.95	42.7	38 5	4 2	29 8868	30.017	29.796	.221	.2315	93 7	38.2
8	37.38	40.0	35.5	4.5	29.8135	29.840	29.788	.052	.1908	85.3	33.2
9	44.77	53.2	35 9	17.3	29.7352	29.766	29 696	.070	.2115	71.7	35.7
10	40.45	45.0	35.1	9.9	29.8578	29.918	29.768	.150	.1728	69 0	31.0
11	41.63	47.7	36.4	11.3	29.9467	29 994	29.909	.085	.1790	67.8	31 7
12	39.47	45.0	35.6	9.4	30.0965	30.174	30.036	.138	1630	67.3	29.7
SUNDAY. 13	.....	48.1	32.2	15.9	....	.....	......	....	.....	...	....
14	42.30	49 9	33.7	16.2	30.2042	30.285	30.135	.150	.1915	71.5	33.3
15	44.32	52.8	36.7	16.1	30.1727	30.231	30 119	.112	.1787	61.2	31.5
16	43 95	51.4	36.2	15.2	30.1922	30.265	30.116	.149	.1678	59.3	30.2
17	48.13	55.6	39.6	16.0	29.9413	30.063	29.857	.206	.2328	68.7	37 8
18	43.20	48.2	38.6	9.6	29.9857	30.044	29 888	.156	.1782	71.7	31.3
19	43.50	49.3	37.7	11.6	29.9905	30.125	29.739	.386	.1942	69.3	33.7
SUNDAY.. 20	.....	53.9	31.8	22.1	......	......		. .	... .		...
21	33.47	40.9	27.6	13.3	30.2495	30.306	30.103	.203	.1215	65.0	22.5
22	34.40	41.5	28.5	13.0	30.3545	30.463	30.309	.154	.1262	63.2	22.8
23	27.70	33.2	21.8	11.4	30.5400	30.605	30.480	.125	.0988	65 3	17.8
24	33.28	42.9	22.8	20.1	30.2975	30 436	30.135	.301	.1053	57.5	19.3
25	39.02	46.3	30 7	15.6	29 9863	30.075	29.929	.146	.1428	60.7	26.2
26	41.13	46.3	35.5	10.8	30.0037	30.045	29.946	.099	.1678	64.8	30 0
SUNDAY.. 27	.....	43.8	38.1	5.7	....	......	.....	....	.....	...	..
28	38.13	42.1	33.2	8.9	29.8497	29.990	29.744	.246	.2152	93 3	36.3
29	35.73	38.3	32 9	5.4	30.1187	30.177	30.017	.160	.1770	84 3	31.5
30	35.12	41.1	30.6	10.5	30.1915	30.228	30.171	.057	.1602	78.8	28.8
31	35.85	41.1	29.7	11.4	30.1452	30 193	30.093	.100	.1785	84.8	31 5
....Means.	40.15	46.06	34 42	11.64	30.0384	......	.....	.182	.1888	74.3	32 0
15 yrs. means for & ncluding this mo.	45.00	52.02	38.24	13.77	30.0091	......	......	.212	.2399	76.0	....

DAY.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	S.W.	15.5	8.5	10	4	00	0 42	....	0.42	1
2	W.	21 2	8.2	10	0	00	0 07	....	0 07	2
3	S.	7.5	8 3	10	0	01	0.39	....	0.39	3
4	N. W.	8.2	10 0	10	10	00	0.24	.. .	0.24	4
5	N.	9.4	10.0	10	10	00	...	.	....	5
SUNDAY........ 6	N.E.	13.7	....		..	00	0.79	...	0 79	6 ....SUNDAY
7	N. W.	15.7	10.0	10	10	00	0 33	....	0 33	7
8	S.W.	20.3	10 0	10	10	00	0.08	....	0 08	8
9	S.W.	19.3	6.8	10	0	80	0.04	....	0.04	9
10	W.	11.4	6.7	10	0	44	....	..	.	10
11	W.	8.1	8.0	10	0	79	...	...	....	11
12	N W.	7.3	3.5	10	0	54	....	....	....	12
SUNDAY. 13	N.E.	19.9	..	..	.	95	.	....	....	13 ....SUNDAY
14	N E.	15.9	0.0	0	0	97	..	....	....	14
15	N.	14.0	0.0	0	0	98	...	....	..	15
16	....	8 4	0.5	2	0	97	....	....	....	16
17	S.W.	16 4	5.5	10	0	12	....	....	....	17
18	W.	12 4	7.3	10	3	23	Inapp.		0.00	18
19	S E.	9.7	6.8	10	0	25	..	....	......	19
SUNDAY.. 20	W.	16.3	....		.	77	....	....	....	20 ....SUNDAY
21	N.E.	4.3	3.8	10	0	70	....	.	....	21
22	S.W.	10.6	6 7	10	0	17	...	....	....	22
23	N.W.	9.6	0.0	0	0	98	...	....	....	23
24	S.E.	8.7	0.5	1	0	92	....	. .	....	24
25	S.E.	15.0	8.2	10	0	12	....	. .	....	25
26	N.E.	4.2	10 0	10	10	00	....	. ,	....	26
SUNDAY.. 27	N.E.	16 3	....		..	00	0.47	...	0.47	27 ....SUNDAY
28	N.E.	43.1	10.0	10	10	00	0.47	0.8	0.55	28
29	N.E.	31.1	9.5	10	7	00	0.04	....	0.04	29
30	N.W.	8 3	3 5	10	0	45	....		...	30
31	E.	4.6	8.0	10	0	20	....	....	...	31
....Means.	....	13.75	6.31	.		36.6	3.34	0.8	3 42	Sums ....
15 yrs. means for & ncluding this mo.	......	...	6 45			¶41.2	3.42	1 7	3 59	15 years means for and includine this month

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N. W.	Calm.
Miles............	1703	3150	236	374	696	1739	1712	620	
Duration in hrs..	131	170	38	36	59	112	131	62	5
Mean velocity...	13.0	18.5	6.2	10.4	11.8	15.5	13.1	10.0	

Greatest mileage in one hour was 48 on the 28th. Greatest velocity in gusts 58 miles per hour on the 28th.

Resultant mileage, 2,275
Resultant direction, N 17° W.
Total mileage, 10,230.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Eight years only.

The greatest heat was 61.1 on the 1st; the greatest cold was 21.8 on the 23rd, giving a range of temperature of 39.3 degrees. Warmest day was the 1st. Coldest day was the 23rd. Highest barometer reading was 30.605 on the 23rd; lowest barometer was 29.393 on the 1st; giving a range of 1.212 inches. Maximum relative humidity was 99 on the 1st and 7th. Minimum relative humidity was 38 on the 24th.

Rain fell on 12 days.
Snow fell on 1 day.
Rain or snow fell on 12 days.
Aurora on 1 night.
Hoar frost on 12 days.
Fog on 2 days.

R, 1889.

Meteorologica C. H. McLEOD, *Superintendent.*

DAY.	THER Mean.	Ma	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	39.47	43.	31	....	....	....	1
2	46.58	54.	00	0.07	....	0 07	2
SUNDAY........ 3	.....	55.	04	0 13	....	0.13	3 ....SUNDAY
4	42.37	48.	70	Inapp.	....	0.00	4
5	35.00	38.	58	....	. .	....	5
6	38.55	43.	46	Inapp.	Inapp.	0 00	6
7	41.77	48.	49	....	....	...	7
8	32.52	38.	86	....	....	....	8
9	39.32	47.	66	....	....	....	9
SUNDAY. 10	. ...	42.	90	....	....	..	10 ....SUNDAY
11	39.73	43.	00	Inapp.	....	0.00	11
12	43.68	46.	00	....	....	....	12
13	41 55	46.	00	0.02	....	0.02	13
14	39 02	47.	07	0.07	Inapp.	0.07	14
15	21.82	30.	06	...	0.6	0.06	15
16	22.07	25.	61	....	....	....	16
SUNDAY........17	....	40	98	....	....	......	17 ....SUNDAY
18	34.35	40.	96	...	...	....	18
19	36.22	40.	00	0.01	....	0 01	19
20	38.18	40.	00	0.96	....	0 96	20
21	39.33	42.	00	0.13	.	0.13	21
22	37.07	39.	00	0.24	....	0.24	22
23	38.62	43.	03	0.02	....	0.02	23
SUNDAY........24	.....	43.	01	0.03	. ..	0.03	24 ....SUNDAY
25	30.20	41.	12	Inapp.	. ..	0.00	25
26	26.08	28.	36	....	. .	....	26
27	23 57	27.	00	....	7.5	0.75	27
28	22.08	25.	00	. .	7.1	0.76	28
29	24.45	31.	00	....	0.4	0.04	29
30	17.98	21.	96	....	....	....	30
............Means.	34.29	40.	30.5	1.68	15.6	3.29	Sums ....
15 yrs. means for & including this mo.	32.08	38.	¶29.0	2.41	13.6	3.79	15 years means for and including this month

ANAL

Direction........	N.	N.E.
Miles............	332	2412
Duration in hrs..	28	122
Mean velocity ...	11.9	19.8

Greatest mileage in one hour v

Greatest velocity in gusts 76 i three miles on the 28th.

Resultant mileage, 4,410

ometer was 29.315 on the 22nd; giving a range of 1.296 inches. Maximum relative humidity was 100 on the 20th. and 21st. Minimum relative humidity was 49 on the 4th.

Rain fell on 14 days.

Snow fell on 6 days.

Rain or snow fell on 18 days.

Rain and snow fell on 2 days.

An Aurora was observed on 1 night.

Hoar frost on 6 days.

Lunar halo on 1 night.

Lunar corona on the 30th.

Fog on 7 days.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1889.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range	*BAROMETER. Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	39.47	43.9	35.8	8.1	30.2202	30.264	30.151	.113	.2010	83.0	34.5	W.	4 9	8.7	10	5	31	....	....	....	1
2	46.58	54.0	37.2	16.8	29.9795	30.235	29.651	.584	.2697	83.0	41.5	S.E.	16 6	10.0	10	10	00	0.07	....	0 07	2
SUNDAY........ 3	.....	55.0	44.6	10 4	....	. ..	.....	....	.....	....	....	S.W.	25.5	....	..	..	04	0 13	....	0.13	3 ....SUNDAY
4	42.37	48.7	37.2	11.5	30.0207	30.074	29.963	.111	.1810	67.7	31.8	W.	24.3	4.3	10	0	70	Inapp.	....	0.00	4
5	35.00	38.7	31.7	7.0	30 1023	30.153	30.044	.109	.1433	70.8	26.3	W.	18.4	8 8	10	1	58	...	.	....	5
6	38.55	43.2	32.8	10.4	29.9530	30.037	29.856	.181	.1573	67.5	28 5	S.W.	25.8	8.8	10	0	46	Inapp.	Inapp.	0 00	6
7	41.77	48.3	32.9	15.4	29 9347	30 113	29.840	.273	.1835	68.5	32.3	S.W.	24.3	5.2	10	0	49	....	....	...	7
8	32.52	38.0	26.7	11.3	30.1580	30.258	30 030	.228	.1302	70.8	24.2	S.	9.3	2.0	10	0	86	....	....	....	8
9	39.32	47.1	31.7	15.4	29.9630	30.017	29 918	.099	.1948	81.7	33.8	S.W.	9.6	5.3	10	0	66	....	....	....	9
SUNDAY. 10	. ...	42.6	29.8	12.8	....	....	. ....	...	.....	...	....	E.	10.7	...	..	.	90	....	....	..	10 ....SUNDAY
11	39.73	43.0	33 7	9.3	30.0640	30 107	30.042	.065	.2243	91.3	37.7	S.W.	10.6	10.0	10	10	00	Inapp.	....	0.00	11
12	43 68	46.6	40 1	6 5	30.1172	30.186	30.012	.174	.2537	89.2	40 7	S.	7.5	10.0	10	10	00	....	....	....	12
13	41 55	46.0	38.3	7.7	29.8508	29 961	29.686	.275	.2477	94.3	39 8	N.E.	10.5	10.0	10	10	00	0.02	...	0.02	13
14	39 02	47.0	29.5	17.5	29.6468	29.774	29.581	.193	.2097	87.0	35.2	W.	19 7	9.5	10	7	07	0.07	Inapp.	0.07	14
15	21.82	30.1	18 9	11.2	30.2178	30.437	29 960	.477	.0777	66.5	12.7	N. W.	16.3	8.3	10	5	06	...	0 6	0.06	15
16	22.07	25.0	17 5	7.5	30.5518	30.611	30.495	.116	.0830	70.2	14 2	W.	20.2	2 8	10	0	61	....	....	....	16
SUNDAY. 17	....	40 0	23 9	16.1	....	......	....	...	.....	.	....	W.	28 0	....		.	98	....	....	......	17 ....SUNDAY
18	34 35	40.4	27.7	12.7	30.2457	30.311	30.176	.135	.1522	76.7	27.7	W.	11.5	0.5	1	0	96	...	..	....	18
19	36.22	40.5	32.3	8.2	30.0462	30.130	29.952	.178	.1750	82.2	31.2	N.E.	12.6	10.0	10	10	00	0.01	....	0 01	19
20	38.18	40.0	35 6	4.4	29.7005	29.882	29.599	.283	.2238	96.8	37.2	N E.	15.6	10.0	10	10	00	0.96	....	0 96	20
21	39.33	42.9	36 6	6.3	29.5740	29 605	29.503	.102	.2260	93.5	37.7	S.	7.2	9.2	10	5	00	0.13	.	0.13	21
22	37.07	39.3	35.6	3.7	39.3767	39 437	29.315	.122	.2110	95.3	35.8	N.	13.3	10 0	10	10	00	0.24	....	0.24	22
23	38.62	43.0	36 5	6.5	29.7145	29.955	29.486	.469	.2072	88.3	35.2	N. W.	16.7	8.7	10	2	03	0.02	....	0.02	23
SUNDAY.. ... 24	.....	43.1	32.7	10 4	. .	......	....	....	.....	....	...	W.	16 6	....	..	..	01	0.03	. ..	0.03	24 ....SUNDAY
25	30.20	41.0	22.8	18.2	30 2738	30.441	30.109	.332	.1192	70.0	21.8	N. W.	16.4	6.3	10	0	12	Inapp.	. ..	0 00	25
26	26.08	28.9	22.8	6.1	30.5553	30.597	30.494	.103	.1018	72.2	18.3	N.W.	7.6	6.5	10	0	36	....	. .	....	26
27	23 57	27.0	20.8	6.2	30.4345	30.595	30.189	.406	.1055	84 2	19 3	N.E.	20.1	10 0	10	10	00	....	7.5	0.75	27
28	22.08	25.0	19 8	5.2	29.6868	30.029	29.473	.556	.1103	93 5	20.5	N.E.	37.6	10.0	10	10	00	.	7.1	0 76	28
29	24.45	31.0	19 9	11.1	29.7177	29.856	29.611	.245	.1158	87 5	21.2	W.	15.6	10.0	10	0	00	....	0.4	0.04	29
30	17.98	21.5	13 7	7.8	30.2017	30.369	29 956	.413	.0790	80.2	13.0	W.	28 2	3 0	10	0	96	....	....	...	30
....Means.	34.29	40.03	29.97	10.06	30.0118	......	......	.244	.1686	81.2	28 9	....	16 7	7.61	..	.	30.5	1.68	15.6	3.29	Sums ....
15 yrs. means for & including this mo.	32.08	38.08	26.04	12.04	30.0117	......	......	.261	.1551	79.9	....	......	....	7.40	.	..	¶29.0	2 41	13.6	3.79	15 years means for and including this month

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N. W.	Calm.
Miles............	332	2412	379	193	906	2192	3360	2251	
Duration in hrs..	28	122	48	18	75	133	177	113	6
Mean velocity...	11.9	19 8	7.9	10.7	12.1	16.5	19.0	19.9	

Greatest mileage in one hour was 62 on the 28th.
Greatest velocity in gusts 76 miles per hour for three miles on the 28th.
Resultant mileage, 4,410

Resultant direction, N 76°5 W.
Total mileage, 12,625.
Average velocity 16.7 m. p. h.

*Barometer readings reduced to sea-level and temperature of 32° Fahr

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Eight years only.

The greatest heat was 55.0 on the 3rd; the greatest cold was 13.7 on the 30th, giving a range of temperature of 41.3 degrees. Warmest day was the 3rd. Coldest day was the 30th. Highest barometer reading was 30.611 on the 16th; lowest barometer was 29.315 on the 22nd; giving a range of 1.296 inches. Maximum relative humidity was 100 on the 20th. and 21st. Minimum relative humidity was 49 on the 4th.

Rain fell on 14 days.
Snow fell on 6 days.
Rain or snow fell on 18 days.
Rain and snow fell on 2 days.
An Aurora was observed on 1 night.
Hoar frost on 6 days.
Lunar halo on 1 night.
Lunar corona on the 30th.
Fog on 7 days.

1889.

Mete(feet. C. H. McLEOD, *Superintendent.*

DAY.	M	LOUDED ENTHS. Max.	Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	.		..	35	....	....	....	1 ....SUNDAY
2	3	10	10	00	....	0.1	0.01	2
3		10	0	70	....	0.2	0.02	3
4	–	10	0	78	....	....	....	4
5	1	10	0	00	....	1.0	0.07	5
6	2	10	0	32	....	1.2	0.07	6
7	3	10	10	00	....	....	....	7
SUNDAY........ 8	.	·	..	00	0.41	....	0.41	8 ....SUNDAY
9	4	10	1	00	0.41	....	0.41	9
10	3	10	0	78	0.02	. .	0.02	10
11	3	10	10	00	0.55	Inapp.	0.55	11
12	2	10	0	53	....	....	....	12
13	1	10	0	24	....	0.5	0.03	13
14		10	0	00	....	0.1	0.01	14
SUNDAY........15	..	·	..	00	....	1.4	0.05	15 ....SUNDAY
16	2	10	0	64	....	....	....	16
17	2	10	10	00	....	0 2	0.02	17
18	3	10	1c	00	0.12	....	0.12	18
19	3	10	10	00	0.58	...	0.58	19
20	3	10	10	00	0.64	....	0.64	20
21	2	3	0	64	0.14	..	0.14	21
SUNDAY........22	.	·	..	00	0.06	3.2	0.50	22 ....SUNDAY
23	1	10	0	96	....	....	....	23
24	3	10	10	31	....	1.7	0.12	24
25	3	10	10	04	0.01	....	0.01	25
26	2	10	9	00	....	3.4	0.34	26
27		10	0	71	....	....	....	27
28	1	10	0	44	....	0.1	0.01	28
SUNDAY........29	.	·	..	00	0.25	0.1	0.26	29 ....SUNDAY
30	1	10	0	93	....	....	....	30
31	1	1	0	95	....	....	....	31
............Means.	2	·	..	30.1	3.19	13.2	4.39	Sums ....
15 yrs. means for & including this mo.	1		..	¶26.7	1.43	23.9	3 81	15 years means for and including this month

Direction........	N
Miles............	8
Duration in hrs..	
Mean velocity...	14

Greatest mileage in h; the giving

Greatest velocity in rmest

five miles on the 30th. ighest lowest

on our records.)

l and barometer was 29.036 on the 26th, giving a range of 1.853 inches. Maximum relative humidity was 100 on the 20th. Minimum relative humidity was 56 on the 3rd.

Rain fell on 11 days.

Snow fell on 14 days.

Rain or snow fell on 22 days.

Rain and snow fell on 3 days.

An Aurora was observed on 1 night.

Hoar frost on 3 days.

Lunar halo on one night.

Fog on 5 days.

ABSTRACT FOR THE MONTH OF DECEMBER, 1889.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range	*BAROMETER. Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	.....	35.9	17.7	18.2	....	....	......	....	....	....	....	W.	28.8	....		..	35	....	....	....	1 ....SUNDAY
2	34.72	38.2	22.0	16.2	29.9258	29.990	29.895	.095	.1598	79.0	28.7	W.	25.7	10.0	10	10	00	....	0.1	0.01	2
3	8.63	22.0	−1.0	23.0	30.2937	30.507	30.064	.443	.0472	67 2	−3.5	N.	17.8	3.7	10	0	70	....	0.2	0.02	3
4	−1.48	4.1	−7.1	11.2	30.5160	30.614	30.407	.207	.0315	78.0	−7.2	N.E.	6.3	4 8	10	0	78	....	....	....	4
5	12.52	22.4	0.8	21.6	30 0587	30.354	29.825	.529	.0742	92.3	10.5	S.E.	8.4	8.3	10	0	00	....	1.0	0.07	5
6	23.20	28.9	15.8	13.1	29.9488	30.052	29 829	.223	.1010	78.0	17.5	W.	17.4	8.0	10	0	32	....	1.2	0.07	6
7	30.70	36.9	16 7	20.2	29 8682	29.994	29.770	.224	.1350	77.0	24.5	W.	15.3	10 0	10	10	00	....	....	....	7
SUNDAY. 8	....	41.1	25.9	15.2	....	....	......	....	.....	....	....	E.	14.8	....	..	..	00	0.41	....	0.41	8 ....SUNDAY
9	41.40	45.7	34 5	11.2	29.9905	30.224	29.774	.450	.2053	78.2	34.8	W.	26.3	8.0	10	1	00	0.41	....	0.41	9
10	30.38	35.0	28.0	7.0	30.3443	30.466	30.130	.336	.1238	73.3	23.2	W.	12.7	6.5	10	0	78	0.02	. .	0.02	10
11	35.98	42 0	27.8	14 2	29.7423	29.866	29 628	.238	.1762	82.3	31.0	S.W.	26.5	10 0	10	10	00	0.55	Inapp.	0.55	11
12	24.43	31.8	20.0	11.8	30.1057	30.197	29.964	.233	.1012	76.8	18.3	W.	20 9	4.3	10	0	53	....	....	....	12
13	19.42	25.6	10.7	14.9	30.0098	30.349	29.793	.556	.0855	79.3	14.2	W.	13 9	4.0	10	0	24	....	0.5	0.03	13
14	4.60	10.7	1.3	9.4	30.3402	30.410	30.279	.131	.0392	72.7	−2.3	E.	10.6	5.0	10	0	00	....	0.1	0.01	14
SUNDAY........15	....	21.0	−1.0	22.0	....	......	....	....	.....	....	....	E.	7.1	....	..	..	00	....	1.4	0.05	15 ....SUNDAY
16	25.55	29.0	18 6	10.4	30.1852	30.282	30.064	.218	.1127	81.3	20 7	S.W.	12.4	8.0	10	0	64	....	....	....	16
17	29.58	34.5	25.5	9.0	30.2618	30.300	30.206	.094	.1405	85.3	25.8	S.	11.3	10.0	10	10	00	....	0 2	0.02	17
18	33.35	41.2	24.5	16 7	30.1420	30.258	29.947	.311	.1802	92.8	31.3	E.	15.2	10.0	10	1C	00	0.12	....	0.12	18
19	39.97	42.0	38.6	3.4	29 8507	29.882	29.829	.053	.2220	89.8	37.2	W.	20.5	10.0	10	10	00	0.58	...	0.58	19
20	35.23	39.5	32.8	6.7	29.7427	29 909	29.500	.409	.1917	93 3	33.5	W.	12.5	10.0	10	10	00	0.64	....	0.64	20
21	25.78	34.3	17.1	17.2	30.1555	30.361	29.837	.524	.1167	81.7	20.7	N. W.	28.6	1.0	3	0	64	0.14	..	0.14	21
SUNDAY........22	.....	36.0	14.9	21.1	....	......	......	..	.....	....	....	N.	20.7	....	..	..	00	0.06	3.2	0.50	22 ....SUNDAY
23	17.47	23.3	13.9	9.4	30.3490	30.444	30.177	.267	.0770	80.3	12.3	N. W.	27.6	3.0	10	0	96	....	....	....	23
24	30.57	35.2	17.7	17.5	30.2290	30.340	29.977	.363	.1500	87.8	27.2	N. W.	14.1	10.0	10	10	31	....	1.7	0.12	24
25	36.38	41.3	30.7	10.6	29.6667	29.761	29 578	.183	.1782	83.0	31.3	W.	29.1	10.0	10	10	04	0.01	....	0.01	25
26	25.88	35.5	18.6	16.9	30.3003	29.674	29.036	.638	.1158	81.3	21.0	N.W.	23.7	9.8	10	9	00	....	3 4	0 34	26
27	8.32	18.6	5.5	13.1	29.7893	29.866	29.656	.210	0455	72.0	0 7	S.W.?	28.3	5.7	10	0	71	....	....	....	27
28	13.58	17.2	10.1	7.1	30.0457	30.231	29.859	.372	.0695	86.8	10.5	S.W.	6.2	6.3	10	0	44	....	0.1	0.01	28
SUNDAY........29	.....	42.0	5.0	37.0	....	......	......	....	.....	....	....	N.E.	19.3	....	..	..	00	0.25	0 1	0.26	29 ....SUNDAY
30	19.43	45.7	9.7	36.0	30.2502	30.636	29.684	.952	.0807	68.7	11.0	N.W.	30.6	2.3	10	0	93	....	....	....	30
31	13.02	19.5	4.7	14.8	30.8330	30 889	30.767	.122	.0543	68.0	4.5	N.W.	11.2	0.2	1	0	95	....	....	....	31
............Means.	23.79	31.49	16.13	15.36	30.1133	......	......	.322	.1159	80.2	18 5	....	18.19	6.88	..	..	30.1	3.19	13.2	4.39	Sums ....
15 yrs. means for & including this mo.	19.03	25.94	11.61	14.33	30.0160	......	......	.287	.0990	82.5	....	. ...	....	7.19	.	..	¶26.7	1.43	23.9	3 81	15 years means for and including this month

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N. W.	Calm.
Miles............	814	399	1477	567	1033	2216	4271	2757	
Duration in hrs..	56	33	128	37	56	96	224	108	6
Mean velocity...	14.5	12.1	11.5	15.3	18.4	23.1	19.1	25.5	

Greatest mileage in one hour was 70 on the 30th. Greatest velocity in gusts 150 miles per hour for five miles on the 30th. (This is the greatest velocity on our records.)

Resultant mileage, 5,630.
Resultant direction, West.
Total mileage, 13,534.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Eight years only.

The greatest heat was 45.7 on the 9th and 30th; the greatest cold was 7.1 below zero on the 4th, giving a range of temperature of 52.8 degrees. Warmest day was the 9th. Coldest day was the 4th. Highest barometer reading was 30.889 on the 31st; lowest barometer was 29.036 on the 26th, giving a range of 1.853 inches. Maximum relative humidity was 100 on the 20th. Minimum relative humidity was 56 on the 3rd.

Rain fell on 11 days.
Snow fell on 14 days.
Rain or snow fell on 22 days.
Rain and snow fell on 3 days.
An Aurora was observed on 1 night.
Hoar frost on 3 days.
Lunar halo on one night.
Fog on 5 days.

E YEAR 1889.

Observations made itude N. 45° 30′ 17″. Longitude 4h 54m 18s.55 W.

C. H. McLEOD, *Superintendent.*

MONTH.	Mean.	¶ De- tion f 15 y mea / Inches of rain.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.	MONTH.
January	21 23	+ 91.88	7	40.5	19	4.67	4	22	January
February	10.59	— 40.30	2	32.2	16	3.33	0	18	February
March	28.70	+ 50.62	9	15.3	12	2.11	6	15	March
April	43.34	+ 32 14	11	0.1	2	2.15	0	13	April
May	56.95	+ 22.97	16	..	..	2.97	..	16	May
June	62.91	— 14.73	20	..	..	4.73	..	20	June
July	67.97	— 17.16	20	..	..	7.16	..	20	July
August	64.97	— 22.73	13	..	..	2.73	..	13	August
September	59.93	+ 14.63	14	..	.	4.63	.	14	September
October	40.15	— 43.34	12	0.8	1	3.42	1	12	October
November	34.29	+ 21.68	14	15.6	6	3.29	2	18	November
December	23.79	+ 43.19	11	13.2	14	4.39	3	22	December
Sums for 1889	...	..5.37	149	117.7	70	45 58	16	203	Sums for 1889
Means for 1889	42.90	+ 1...	....		....	3.80	..	16.9	Means for 1889
Means for 15 years ending Dec. 31, 1889.	41.67	...7.74	133	125 3	84	40.05	15	202	Means for 15 years ending Dec. 31, 1889.

* Barometer readings redu emperature has been *higher;* "—" that it has been *lower* than the average for 15 years, inclusive of 1889. T anemometer and wind vane are on the summit of Mount Royal, 57 feet above the ground, and 810 feet al

The greatest heat was 88.0 eatest range of the thermometer in one day was 39.8 on Jan. 30th; least range was 3.4 on Jan 7th. The erature was 10.73 below zero. The highest barometer reading was 30 889 on December 31st, the lowest wa test mileage of wind recorded in one hour was 70 on December 30th, and the greatest velocity in gusts wa was 134,829. The resultant direction of the wind for the year was S. 69° W., and the resultant mileage 47,950 alos on 8 nights. Lunar coronas on 5 nights. Solar halos on 8 days and contact arc on one day. The sle. The first sleighing of the winter was on November 28th.

The yearly means, above a

METEOROLOGICAL ABSTRACT FOR THE YEAR 1889.

Observations made at McGill College Observatory, Montreal, Canada. — Height above sea level 187 ft. Latitude N. 45° 30′ 17″. Longitude 4h 54m 18s.55 W.

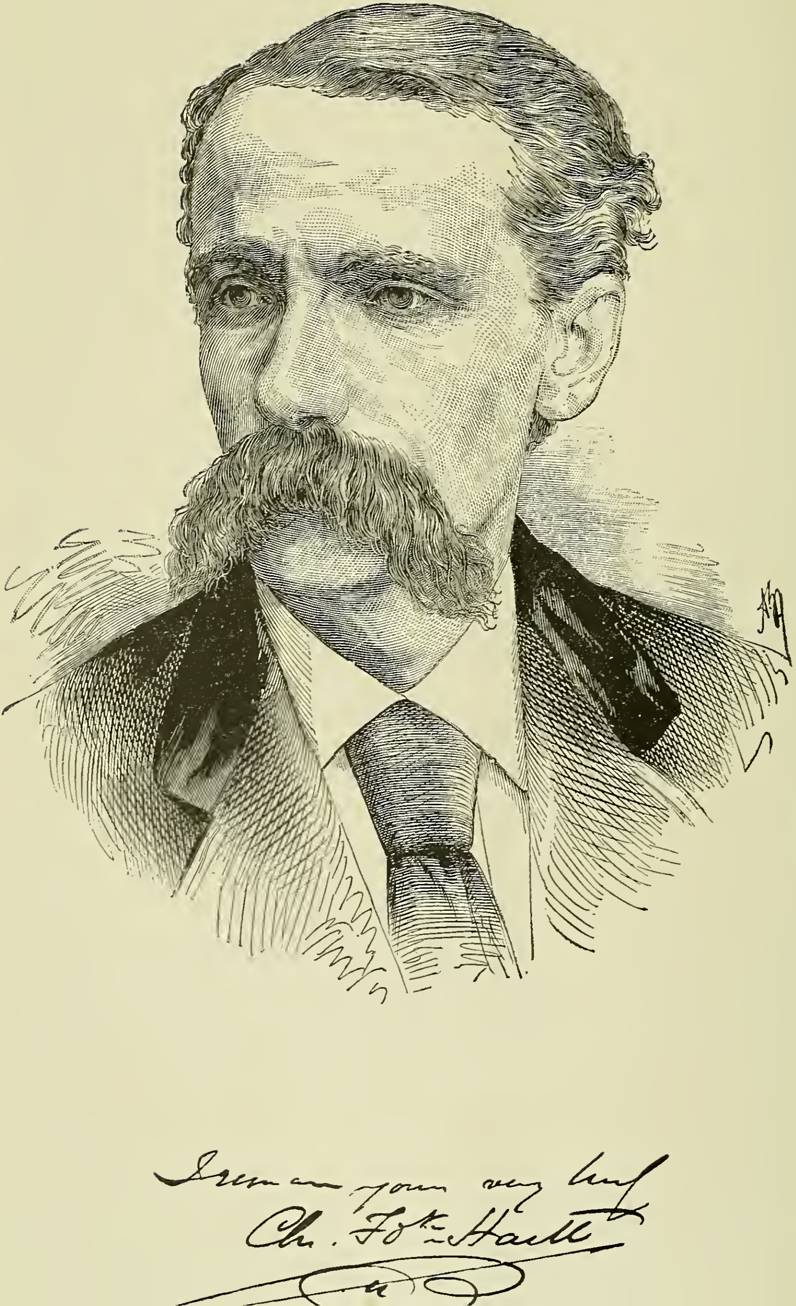
C. H. McLEOD, *Superintendent.*

Month.	Thermometer. Mean.	¶ Deviation from 15 year means.	Max.	Min.	Mean daily range.	* Barometer. Mean.	Max.	Min.	Mean daily range.	Mean pressure of vapour. †	Mean relative humidity. ‡	Mean dew point.	Wind. Resultant direction.	Mean velocity in miles per hour	Sky clouded per cent.	Per cent. possible bright sunshine	Inches of rain.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.	Month.
January	21 23	+ 9.64	44 0	— 6.5	11.9	29.9560	30.708	29 064	.298	.1038	82.5	16 6	S. 70° W.	18.5	67.3	30 5	1.88	7	40.5	19	4.67	4	22	January
February	10.59	— 4 65	39.5	— 22.6	17.5	30 0410	30 885	29.222	.287	.0638	80.9	5.6	S. 65° W.	18.9	64.5	43.6	0.39	2	32.2	16	3.33	0	18	February
March	28.70	+ 5.01	43.9	7 8	12 2	29 8885	30.503	28.982	178	.1224	75.3	21.6	S. 85° W.	17.4	63 2	40.0	0.62	9	15.3	12	2.11	6	15	March
April	43.34	+ 3.76	73.6	23 8	16.8	29 9554	30.499	29.277	.179	.19 6	65.0	31.3	S. 72° W.	14.5	54 8	53.0	2 14	11	0.1	2	2.15	0	13	April
May	56.95	+ 2 17	88.0	35.3	17.7	29.8839	30.216	29.531	.146	3338	69.5	46.3	S. 43° W.	15.8	65 2	54.1	2.97	16	..	..	2 97	..	16	May
June	62.91	— 1 55	84 9	45.1	16.1	29 9194	30.423	29.488	.180	4246	73 9	53.8	S. 57° W.	13.8	71 1	45.5	4.73	20	..	..	4.73	..	20	June
July	67.97	— 1.05	87 5	52 3	16.0	29 9286	30.247	29.582	.131	.5165	74 9	59.2	S. 51° W.	12.5	63 6	50.3	7.16	20	..	..	7.16	..	20	July
August	64.97	— 2.13	81.1	50.1	14 8	30.0049	30 329	29 668	.118	.4681	75.8	56.7	S. 54° W.	12.4	59.6	59.0	2.73	13	..	..	2.73	.	13	August
September	59.93	+ 1.37	82 1	37.7	15.6	29.9835	30.370	29.281	.142	.4197	79.2	52.9	S. 30° W.	12.4	62.1	45.0	4 63	14	..	.	4.63	.	14	September
October	40 15	— 4 85	61.1	21.8	11.6	30.0384	30.605	29 393	.182	.1888	74 3	32.0	N. 17° W.	13.7	63.1	36.6	3 34	12	0.8	1	3 42	1	12	October
November	34.29	+ 2 21	55 0	13.7	10.1	30.0118	30.611	29.305	.244	1686	81.2	28 9	N. 76° W.	16.7	76 1	30.5	1 68	14	15.6	6	3.29	2	18	November
December	23.79	+ 4.76	31.5	16 1	15 4	30.1133	30.889	29.036	.322	.1159	80.2	18.5	W.	18.2	68 8	30.1	3.19	11	13 2	14	4 39	3	22	December.
Sums for 1889	...	...	....	....	....		....	....	....	....		....		....	....	....	35.37	149	117.7	70	45 58	16	203	Sums for 1889
Means for 1889	42.90	+ 1.22	....	....	14 6	29.9687	....	....	.201	.2601	76.1	35.3	S. 69° W.	15.39	65.0	43.2	....	....		....	3.80	..	16.9	Means for 1889
Means for 15 years ending Dec. 31, 1889.	41.67	....	.. .	....	...	29.9756	....	....	....	.2497	74.4	....	....	....	61.4	§ 46 0	27.74	133	125 3	84	40.05	15	202	Means for 15 years ending Dec. 31, 1889.

* Barometer readings reduced to 32° Fah., and to sea level. † Inches of mercury. ‡ Saturation, 100. § For 8 years only. ¶ "+" indicates that the temperature has been *higher;* "—" that it has been *lower* than the average for 15 years, inclusive of 1889. The monthly means are derived from readings taken every 4th hour, beginning with 3h. 0m, Eastern Standard time. The anemometer and wind vane are on the summit of Mount Royal, 57 feet above the ground, and 810 feet above sea level.

The greatest heat was 88.0 on May 18th; greatest cold 22.6 below zero on February 4th; extreme range of temperature was therefore 110°.6. Greatest range of the thermometer in one day was 39.8 on Jan. 30th; least range was 3.4 on Jan 7th. The warmest day was May 18th, when the mean temperature was 77 82. The coldest day was Feb. 23rd, when the mean temperature was 10.73 below zero. The highest barometer reading was 30.889 on December 31st, the lowest was 28.981 on March 7th, giving a range of 1.907 for the year. The lowest relative humidity was 15 on Apri 15tth. The greatest mileage of wind recorded in one hour was 70 on December 30th, and the greatest velocity in gusts was at the rate of 150 m. p. h. for 5 miles on Dec. 30th; this is the greatest velocity on our records. The total mileage of wind was 134,829. The resultant direction of the wind for the year was S. 69° W., and the resultant mileage 47,950. Auroras were observed on 16 nights. Fogs on 42 days. Hoar-frost on 30 days. Thunder storms on 17 days. Lunar halos on 8 nights. Lunar coronas on 5 nights. Solar halos on 8 days and contact arc on one day. The sleighing of the winter closed, in the city, on March 26th. The first appreciable snowfall of the autumn was on October 28th. The first sleighing of the winter was on November 28th.

The yearly means, above are the averages of the monthly means, except for the velocity of the wind.


I remain yours very truly

THE

CANADIAN RECORD

OF SCIENCE.

VOL. IV. APRIL, 1890. NO. 2.

Some Temperatures in the Great Lakes and St. Lawrence.

By A. T. Drummond.

The equalizing influence exerted by great and deep bodies of water upon the climate of the surrounding land is well known. Apart from this general result, the temperature of the water has also a direct effect. On the banks of the Lower St. Lawrence these two effects are well illustrated. Where the cold Labrador current, trending inward from the Straits of Belle Isle, skirts the north shore of the estuary, the little semi-arctic plants are more numerous than on the south shore, where the same current returning outwards carries with it the milder waters which have descended from the Great Lakes and the St. Lawrence. Lake Superior, around whose jutting headlands dwell semi-arctic and northern plants, and west of whose coasts many of the familiar forest trees of Ontario and Quebec do not range, affords another illustration.

The vast area and depth of the St. Lawrence Great Lakes, the different latitudes in which they lie, and their relations to each other, taken in connection with the extremes of heat and cold of the Canadian seasons, combine to give an interest to the temperature of the waters of these inland seas. Lakes Superior and Michigan may be regarded as two distinct reservoirs—the former of cold and the latter of warmer water—which constitute the largest sources of supply for the lower Great Lakes. Hind found the surface of Lake Superior on 30th July, at noon, as low as 39.50° at fifty miles from land. The outlets of these two lakes into Lake Huron are close to each other, the Michigan waters flowing directly into the main basin of Lake Huron, and the colder waters from Superior, while joining them in part through the detours between the Manitoulin Islands, appearing in part also to find their way eventually to the Georgian Bay by the channels north of the same islands. Now, Lake Huron in its profound depths forms three great basins—the Georgian Bay, the Central and the Southern Basins. The Georgian Bay is separated from the Central Basin, not only by the Bruce Peninsula, but by a continuous subaqueous ridge which comes to the surface in islands at different points, whilst under water it presents on the one side bold precipitous cliffs facing the Georgian Bay, and on the other, shelves somewhat gradually towards the deeper waters of the Central Basin. This ridge prevents the free interchange of water between the deeper portions of the Georgian Bay and Lake Huron proper, and makes the former a somewhat isolated basin of cold water without any considerable free current of warmer water flowing into and through it. This isolation aids in retaining in the Bay the colder waters which have accumulated there during the winter months. Thus, whilst the surface in July and August may be as high as 65° F., the bottom temperature at 31 fathoms and upwards, varies between 39.5° and 37.75° F.

The Central and Southern basins of Lake Huron, on the other hand, are separated by the sub-aqueous corniferous escarpment which diagonally crosses the lake in a south-eastern direction from the outlet of Lake Michigan, and which also appears to have its effect on free circulation between the deeper waters of these two basins. In the Central basin, at the bottom in 65 fathoms the temperature in July was 42° F., whilst in the Southern basin at the bottom in 38 and 45 fathoms it was 52° F. The Southern basin not only lies in a lower latitude, but is much shallower and has a bottom largely composed of sand. Apart from these circumstances, the natural flow of the warm Michigan surface waters is towards and into this basin before their final entrance into the St. Clair River at Sarnia. On the other hand, the tendency of the colder Superior waters constantly flowing into the Central basin and modifying the warm surface waters from Lake Michigan, is to maintain a somewhat lower temperature in the depths of the Central than in the lesser depths of the Southern basin.

In their main expanse, Lake Superior and the Georgian Bay thus constitute in midsummer, great bodies of colder water, whilst the Central basin of Lake Huron in its greater depths also forms a reservoir of cold water, but tempered by the warmer inflow from Lake Michigan.

Lakes Erie and Ontario are, on the other hand, warmer lakes, consequent on their geographical position, their affluent streams from the south and south-west, and the necessarily higher temperature of the larger volume of waters which have flowed over the great shallows of Lake St. Clair before reaching Lake Erie.

Records of observations made by myself during this last summer near the outlet of Lake Ontario, and in the St. Lawrence and other rivers, and by Staff-Commander Boulton, R.N., during last and previous seasons in the Georgian Bay, appear to establish some interesting results which are here appended. It is not assumed that these results are new, but they exemplify some characteristics of fresh water in the great masses in which it occurs in the Canadian Great Lakes and rivers, and under the varying conditions of climate which the geographical position of these lakes and rivers presents.

The instruments used in my observations were:—for surface readings, Negretti & Zambra's Reference Thermometer with Kew corrections, and, for deep water, the same makers' Patent Marine Thermometer, carefully compared with standard instruments. Staff-Commander Boulton's thermometers were previously tested at the Toronto Observatory.

Motion as Affecting the Temperature of Water.

Some tests made above and at the foot of the rapids in the Richelieu River at Chambly, would seem to show that the motion of the water during the one mile of continuous rapid here, raises the temperature of the water at least perceptibly. Above the rapids at 3 p.m. on 29th August, the air at the surface indicated 80° F., and the water at a depth of 1.5 feet, 73.75° to 74° F., whilst at 3.45 p.m., at the foot of the rapids, with the air at the surface, 75° F., the water in 1.5 feet in the rapids was, in different tests, 74° to 74.5° F. In other words, the water showed an increase of about one-half a degree in the face of the decreasing temperature of the air, as the afternoon wore on. Again, on 7th September, at 4.20 p.m., above the rapids, with the air on the bank registering 66.5° F., the water at 1.5 feet depth indicated 69.75° F. in the sun, while at 5.30 p.m., at the foot of the rapids, the water in the rapids was still 69.75° F., though the sun was clouded and the air on the bank had fallen to 62.5° F.

Rapid currents have, however, the effect of equalizing the temperature of the water. Thus, in June, at Rockport, among the Thousand Islands in the St. Lawrence, where there is a strong current, the water, at nearly 40 fathoms, indicated only 0.5° lower temperature than at the surface.

Areas of Water of Different Temperatures.

Under conditions which appear to be the same, and at points relatively near each other, the water on the surface of the lakes and rivers is not uniform in temperature, but seems to flow in areas of different temperatures—the variation being generally from 1° to 3°. At different depths down to the bottom, there are equally marked variations. In the tributary streams similar results appear. An interesting illustration occurred in a shallow creek, fully exposed for an eighth of a mile to the sun's rays, and slowly flowing over a succession of limestone ledges, where, in 1.5 inches of water, the mercury on a warm June afternoon could be seen rising and falling between 81° and 83° F. Here there were some exceptional causes, but in the line of outflow from Lake Ontario to the St. Lawrence, the fluctuations are rather to be ascribed to the evaporation at the surface, and to the cooler waters beneath ascending to supply the place of the evaporated water. As the evaporation would be irregular, varying with the passing clouds, the gusts of wind, and the features of the land, the ascending currents would also be irregular. These ascending waters would give rise to a slight inflow at the bottom from deeper and cooler parts of the lake to take their place, and both these currents would be affected by the general onward flow of the lake waters towards the entrance of the St. Lawrence.

Bottom Currents in Georgian Bay.

On 20th August, 1886, Commander Boulton, in a series of soundings diagonally across the centre of the Georgian Bay, in a somewhat southerly direction, found the temperature of the water at the bottom at one point (31 fathoms deep) 39.5° F., at another (47 fathoms) 38.25° F., and at a third (42 fathoms) 37.75° F.—the distance between the extreme points being about 40 miles. On 10th July, 1889, nearer the Bruce peninsula, the readings in 70 fathoms gave 38.75° F., and on 8th September following, at another point in 63 fathoms, the reading was 39° F. In all these different cases, the surface water varied from 59.75° to 68°—the last being on 8th Sept., at 10.10 a.m. As the temperature of water at its maximum density is 39·2° F., and below that, the density again diminishes, there would be a tendency in these bottom strata of water to rise until they intermingled with water of a higher temperature and equivalent density. It is thus necessary to seek some explanation of this singular fact that the bottom temperatures in this extensive bay are in summer as low in places as 37.75° F. The probability is that there are strong bottom currents which prevent what would be the natural course upwards of the colder and lighter waters of the bottom. Commander Boulton is also inclined to take this view. The two leading physical features which characterize the bottom of the bay, are, first, the somewhat shelving nature of the bottom from east to west, the western side, along nearly its whole length, being remarkably deep, and continuing so up to the very cliffs which bound it, and, secondly, the apparently complete severance of its deeper waters from those of Lake Huron by the submerged escarpment between the Bruce peninsula and the Manitoulin Islands. These two features may be found to have some influence in this connection.

Harbour Temperatures.

The more land-locked a harbour is, the higher is the temperature of its water as compared with that of the water outside of the harbour. It may be equally predicated that, up to a certain point, the more foul the harbour water is, the higher, to a further extent, is the temperature likely to be. At Kingston, this occasionally, in midsummer, is well illustrated. On 10th July last, after two or three days of comparatively calm weather, during which the upturned sediment of the bottom. the floating harbour accumulations, surface drainage, and the sewage appeared to be gathered together in the harbour to an unusual extent, while the mercury at 3000 feet off the wharves indicated 73.5° F. two inches under the surface; it, at 100 feet, rose to 78° F., at the same depth three hours subsequently, though in the meantime the sky had become overcast with clouds. These accumulations contaminate the water for very considerable distances outward in the harbour, and warn us how important to the health of cities and towns, similarly situated, it is to have the water, supplied for domestic uses, taken from points beyond any possible line to which such accumulations may extend. The higher temperature of the harbour waters would form some objection to their use for household purposes, though not so serious an objection as their contamination.

TEMPERATURE IN RELATION TO DEPTH.

It is impossible to lay down any general rule regarding the changes of temperature with the increase of depth. Apart from variations resulting at the different seasons, surface readings are affected by sunlight and cloud, gusts of wind, channel currents, the inflow of affluent streams, and the physical features of the surrounding land. Readings beneath the surface are affected by the depth of the water, by ordinary currents resulting from changes of level, by evaporation at the surface creating an upward flow of the water underneath, by the contour of the bottom, and by high winds which drive the surface waters before them, creating return currents underneath to take their place. Each case has to be judged by its own special circumstances. Thus, in the Georgian Bay, between Cabot's Head and Cape Croker, Commander Boulton, on 27th July, 1888, at 8.30 a.m., obtained the following record:

Surface	60·2° F.
10 fms	45·7°
20 "	41·4°
35 "	41°
66 " (bottom)	39·5°

On 14th June, 1889, at 11.25 a.m., one mile south-west of Kingston, in the channel from the lake to the river, one of the records was:

Air in sun	79° F.
Surface water	58.5°.
6 feet	56.25°.
18 "	54°.
30 "	54.25°.
60 " (bottom)	52°.

On the 25th July following, at 4.15 p.m., at a point in the same channel, two miles distant, the readings showed not only a higher range, but a much nearer approach between the surface and bottom temperatures, thus:

Air in sun	80° F.
Surface water	69°.
5 feet	68.75°.
12 "	67.75°.
18 "	67.66°.
30 "	67.75°.
72 " (bottom)	67°.

Again, in a very shallow stream on Wolfe Island, lightly flowing over exposed limestone rocks, the air on June 14th, at 3.15 p.m., at three feet above the water, indicated 73° F., whilst the water at 1.5 inches registered 83° F., at 4 inches varied between 79.5° and 82 5° F., and at 7 inches, on the bottom, fell to 72.5° F.

Junction of Affluent Streams.

An illustration of the effects of the warmer waters of the affluent streams on the main body of the St. Lawrence waters, was the case of the Gananoque River at its outlet. The temperature of the bottom near the foot of the fall was, on 10th June, 62.75° F.; a quarter of a mile down stream, at the outlet to the St. Lawrence, it was 61.5° F.; in the St. Lawrence, 150 yards off the outlet, 57° F.; 100 yards west of this, against the current of the St. Lawrence, 56.75° F., and 100 yards still further west 54.25° F. The surface water at these different points varied only between 62.25° and 63° F. The Gananoque River current below the falls is strong, and by a westward deflection of the sandstone banks at the outlet, it is thrown against the much lighter St. Lawrence current, but as above shown, the effect is soon gradually lost at the bottom of the St. Lawrence, however much farther it might be traced at the surface.

Gradual Absorption of Heat.

The general rise in the temperature of Lake Ontario waters as the summer advances is, at first, slow, compared with the general rise in the temperature of the air, but, as midsummer is reached, the rise is more rapid both at the surface and at the bottom. On June 14th, at noon, when the air indicated 79.75° F., the surface water in the main channel, two miles from Kingston, was still as low as 57.5° F. or only 5° higher than on May 23rd. On July 5th, the readings at the same place and hour had increased to 69.5° F., with the air at 79° F., and on July 10th to 74.75° F., with the air at 92.75° F., the thermometer being always in the sun. The most marked change was between June 25th and July 5th, when the advance registered was 9°. The bottom temperatures indicated somewhat similar results. On May 23, at 13 fathoms, the deep sea thermometer registered 50.25° F.; on June 14, at 12 fathoms, 52° F., on July 10, at 11 fathoms, 62.25° F., and in another spot in 17 fathoms, 53° F., and on July 25, at 12 fathoms, 67° F.

The absorption and retention of the sun's heat is most noticeable in the small streams and quiet pools. There we find well illustrated the general proposition that in high temperatures, the surface of comparatively still water, where unaffected by under currents, absorbs and retains the heat of the sun to a much greater degree than the immediately overlying air. A remarkable illustration has already been given in the case of the lightly flowing but shallow Wolfe Island stream, where the surface water was 7° higher than the immediately overlying air, and 10° higher than the air at 3 feet above, whilst on the bottom, at 7 inches in depth, the temperature fell again to 10.5° below that of the surface water. The records of other creeks did not indicate such extremes, but showed that each stream in its bottom, current and surroundings, may have circumstances which vary the temperature. In very shallow, still pools, exposed freely to the sun and breeze, but almost isolated from the main stream, the difference between the temperature of the surface of the water and of the immediately overlying stratum of air, is, however, sometimes still more marked, the water on sunny afternoons in June and July showing over 11° higher range. In such pools, the water, though indicating variation, is tolerably uniform even to the bottom.

Note on a Fossil Fish and Marine Worm found in the Pleistocene nodules of Green's Creek on the Ottawa,

By Sir William Dawson, LL.D., F.R.S.

I. Cottus fasciatus. Reinhardt.

The Pleistocene clays of Green's Creek on the Ottawa, are celebrated for the nodules holding fossil fishes which they contain. The most common of these is the Capelin (*Mallotus villosus*, Cuvier) but the Lump-sucker (*Cyclopterus lumpus*, Lin.) also occurs, and I have also found a species of Gasterosteus, possibly the two-spined stickleback of the St. Lawrence, (*G. aculeatus*, Lin.,) and a skeleton which seems to be that of the smelt (*Osmerus mordax*, Gill.)[1]

There have been in my collections for some time two specimens of these nodules, which appear to contain the skeletons of some species of *Cottus* or Sculpin. They are, however, imperfectly preserved, so that I have been unable to identify the species. Recently, Mr. J. Stewart of Ottawa has kindly placed in my hands a better preserved specimen, showing more especially the pre-opercular spines and pectoral fins in comparatively good preservation, and with the help of this I think I can identify the species, notwithstanding the confusion which at present seems to reign as to our North American cottoids.

The characters of the hooked spines and of the pectoral fin seem to identify this specimen with *Cottus* (*Centrodermichthys*) *uncinatus* of Gunther's British Museum catalogue. This is *C. uncinatus* of Reinhardt, and *Icelus uncinatus* of Kroyer and Gill. I feel convinced, also, that it must be the *Cottus gobio* of Fabricius, though this is usually identified with *C.* (*Gymnacanthus*) *tricuspis* of Reinhardt, a very distinct species. *Cottus uncinatus*, occurs in Greenland, and in

[1] Notes on Pleistocene of Canada, Canadian Naturalist N. S. Vol. V, 1871.

ERRATUM.

In the paper on a Fossil Fish from the Pleistocene, by Sir William Dawson, (Vol. IV, No. 2, April 1890, p. 86) for "*Cottus fasciatus*," in the title of the paper, read "*Cottus uncinatus*," as in the text.

deeper water as far south as New England, according to Jordan, who creates for it a new genus (*Artediellus*).[1]

The total length of the specimen, without the caudal fin which is absent, is 4 inches, of which the head measures one inch. It belongs to the collection of Mr. Stewart. The other and less perfect specimens, which I refer to the same species, are in the Peter Redpath Museum.

Nereis, Sp.

Among the specimens submitted to me by Mr. Stewart are two that represent remains of marine worms, but not sufficiently perfect for determination. Their study has, however, induced me to re-examine some specimens of this kind collected some years ago and now in the Peter Redpath Museum, and one of these affords some characters which it may be useful to describe.

It resembles at first sight a whitish stripe of calcareous matter about four inches in length and scarcely two lines in breadth. This strip of calcite is a longitudinal section through the body of the worm, and shows nothing of its external characters, and the somites of the body are indicated only by the tufts of brown bristles or setæ at intervals along the sides. In the specimen in question, these are in the middle portion of the body from a tenth to a twelfth of an inch apart. On the anterior segments they are closer together, the body having apparently been contracted in that part. Each foot, as indicated by the setæ—the soft parts having entirely perished—seems to have had one strong spine and several others very fine and hair-like in a separate bundle. When disengaged from the matrix (which can easily be done by treating a small portion with diluted acid) and examined microscopically, they seem to be simple, nearly straight and pointed. Near what seems to be the anterior extremity, are obscure indications of one of the horny mandibles. These characters, as far as they go, would indicate a chætopod worm or "sea centipede," and, of the

[1] Catalogue of Fishes, Fish Commission Reports.

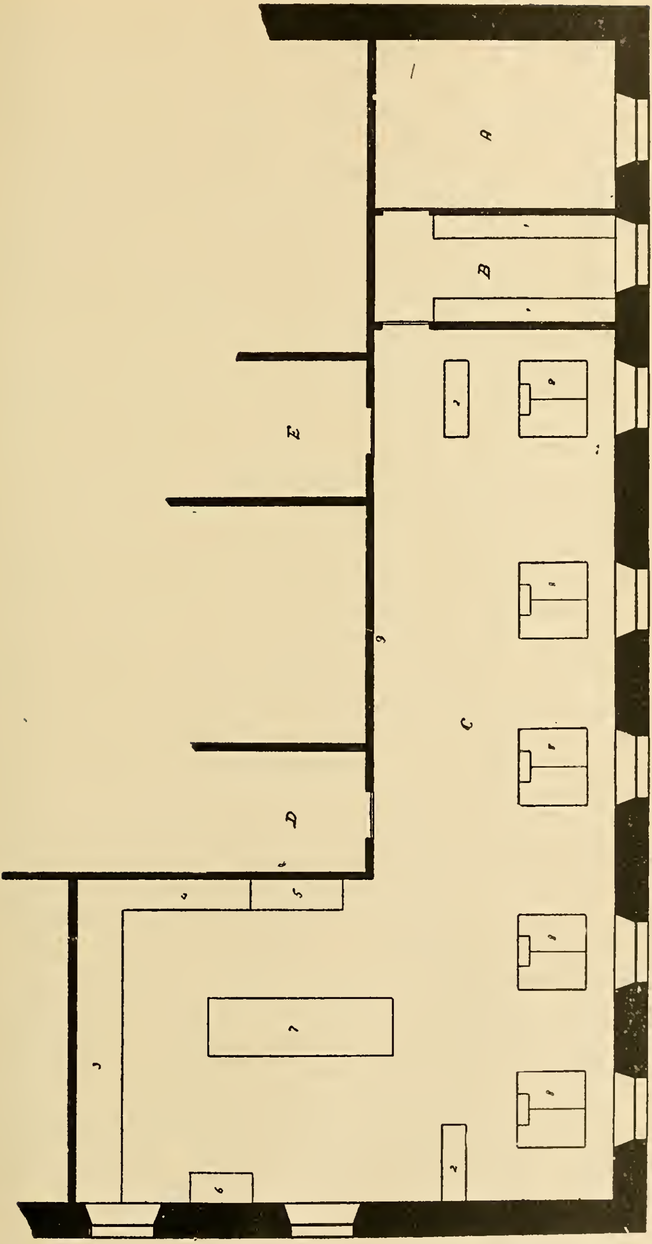
species known to me on our coasts, they resemble most nearly those of *Nereis pelagica*, Lin., a common and widely distributed animal, found in the Arctic seas and on the Northern coasts both of Europe and America, and which therefore would be a fitting associate of the species found with it at Green's Creek. It appears to be the *Nereis cæca* of Fabricius.

I would not, however, be too positive as to the specific identification of such material; but there can be no doubt that it indicates a member of the group Polychæta, of the family Nereidæ and probably of the genus Nereis.

A New Botanical Laboratory.

By D. P. Penhallow.

The Chair of Botany in the McGill University was first filled by Dr. Andrew F. Holmes, afterwards Dean of the Faculty of Medicine, who was appointed in 1829. Dr. Holmes was a zealous botanist who had studied in Edinburgh, had collected in Great Britain and France while pursuing his studies in medicine, and had formed a large Canadian collection which he afterwards presented to the University. When Dr. Holmes, owing to other engagements, became unable to attend to these duties, the lectures were delivered for a time by Dr. Papineau. After the reorganization of the University, in 1852, a combined Professorship in Art and Medicine was created in favor of Dr. James Barnston, an able and accomplished botanist, trained under Dr. Balfour, in Edinburgh, who lectured not only in the University, but in connection with a botanical society, which owed its origin to him, to create a taste for the science. Dr. Barnston was appointed in 1857, but had only been in office for two years when he was removed by death, and in the then depressed condition of the finances of the University, the Board of Governors found it necessary to assign the duties of the chair to Dr. Dawson, as Professor



BOTANICAL LABORATORY, MCGILL UNIVERSITY.

of Natural History, by whom they were performed without remuneration till 1882. In 1883 the chair of Botany was established by the appointment of Professor D. P. Penhallow, B. Sc., under whom practical and additional courses and laboratory work have been introduced, to which it is desired more particularly to refer in the present paper.

In 1886 an additional course in the third and fourth years, embracing practical histology, was instituted for the benefit of those students who evince a special taste for such work, and desire to carry it on beyond the ordinary course of the second year. Accommodations for this purpose were secured in the Peter Redpath Museum, but within the past two years the combined growth of the botanical collections and of a greater desire for instruction in this branch, resulted in the room then occupied being wholly inadequate to meet the requirements of the work. The removal of the Faculty of Applied Science to new quarters, left vacant a suite of rooms in many respects well adapted to the purpose of a laboratory, and which were granted by the Board of Governors for this use. They are on the upper floor of the main building, and thoroughly lighted, the aspect being northern. The problem then was to convert these rooms to the required purpose with a minimum of expense, utilizing, as far as possible, such furnishings as were on hand. This has been accomplished in such a way as to meet present requirements in a very satisfactory manner, although were a laboratory to be constructed *de novo*, various changes from the present form and arrangements would be made. By reference to the plan, the details will be made clear. Room C originally consisted of two apartments which were thrown into one. Room A is used as a private office and laboratory. It measures 11 × 15.5 feet. Room B, 7 × 15.5 feet, contains two series of shelves, 1, 1, with drawers and cupboards for the storage of apparatus, reagents in bulk, general supplies and balances. Room C is the general laboratory, measuring 15.5 × 56.5 feet, with an ell room, 19 × 21 feet. Access to these rooms is gained through the halls D, E, which open out from the main hallway of the building.

The windows are five feet wide and at just the height of an ordinary table from the floor. They afford an abundance of good light. Opposite each window are two tables, $4\frac{1}{2} \times 2\frac{1}{2}$ feet, placed back to back. Accommodation is thus afforded for ten students at one time. which answers all present needs, though there is room for sixteen.

Affixed to each pair of tables, at the outer end, is a rack, two shelves of which hold test tubes and specimen bottles, while the two lower shelves hold narrow bottles containing such reagents and stains as are in common use. For those reagent which are required less frequently, the general reagent stands 2, 2, are provided. Each table has a plain wood top dressed with hot boiled linseed oil, while in the centre of the working side there is a black working square, 18×24 inches. The furnishings provided each student include a supply of needles, forceps, rods, dipping tubes, a razor, various covered dishes and watch-glasses for preparations; slides and covers, wash bottles holding distilled water and alcohol; drop bottles containing glycerine, carbolic acid and balsam: camera lucida, vegetation dishes, Bunsen burner, and an albo-carbon drop light for illuminating purposes—an essential part of the outfit, on account of the very early approach of darkness in winter. A row of gas pipes, bearing T arms, extends the whole length of the room. One end of each T—the outer—bears an ordinary burner for illuminating purposes, while the other bears a nozzle from which a rubber tube feeds the drop light of each table. A wall bracket at each table supplies gas for the Bunsen burner furnished to each student.

At 9, the entire wall space between the doors is occupied by a blackboard, which can be seen reaching from each end of the room. At 5, a large sink is provided with two taps, supplying water at a pressure of 120 pound; 4, is a short bench for section cutting and other work of a similar nature. It is provided with two microtome—one King and one Becker—and a paraffine bath for imbedding; 3 is a general work bench, well supplied with gas, and also with a water blast and exhaust. Above is a wall case for specimens in bulk. At 6 is a gas closet for macerations; 7 is a table holding a sterilizer, vegetation oven and other apparatus. An effort has been made to so arrange all the details that a student, when once seated at his table, may continue work with a minimum of interruption arising from the want of reagents or apparatus.

As now equipped, this laboratory affords ample facilities and accommodation for select classes in the third and fourth years, and for demonstrations to large classes in the second year. The course of study embraces a thorough grounding in vegetable histology. The work may be said to be divided into four stages. In the first, the student is instructed as to the construction and use of the microscope, the defects common to such instruments, and the means adopted to overcome them; determination of amplifications, and the measurement of objects. The second stage involves the examination of the various histological elements of the plant, which, for this purpose, are grouped as, 1st, albuminoids; 2nd, cellulose and its derivatives; 3rd, amyloids and sugars, 4th, glycosides; 5th, mineral products; 6th, miscellaneous organic products. These are dealt with in the order given, commencing with protoplasm. Each is fully considered with before proceeding to the next, and the student is thus made thoroughly familiar with the physical characteristics of every histological element, as well as with its behaviour under the action of micro-chemical tests.

This forms the basis for the third stage, which embraces a study of tissues and their constituent elements, after which the student proceeds to the fourth and last stage, for which he is now well prepared, the complete histology and life history of plants. In this part of the course, the higher Angiosperms are dealt with first, lower groups following in regular succession until the unicellular Thallophytes are reached. This order would more properly be reversed, were it not that some students cannot devote more than one year to the work, and for them a good knowledge of the higher plants is likely to be of the greatest value. It will be seen, however, that the aim is to lead the student on from the simple to the complex by natural stages, and in such a way that each successive step depends upon and is, to some extent a review of all the preceding.

Drawing constitutes an important feature of the course, and each student is expected to make a complete series of drawings of at least one plant in each of the groups studied. This not only fixes the main facts securely, but leads to greater accuracy of work, and a more critical judgment, while it also promotes facility in drawing, a most essential adjunct to all biological work.

Notes on Göthite, Serpentine, Garnet and other Canadian Minerals.[1]

By B. J. Harrington, McGill College, Montreal.

1.—Göthite.

In a report on the Iron Ores of Canada, published in 1874, the writer called attention to the occurrence of göthite in Nova Scotia. It was found by him associated with the hematite and limonite of Clifton (Old Barns), and also with black oxide of manganese, calcite, barite, &c., in veins cutting the Lower Carboniferous limestones of Black Rock, near the mouth of the Shubenacadie River. In some cases it appears as a velvety coating upon hematite, calcite, or other minerals, but the finest specimens obtained consisted of beautiful radiating needles with adamantine lustre (*nadel-eisenstein* or needle iron-ore), the needles occassionally being capped with rhombohedral crystals of calcite. Minute single crystals of the göthite were also observed.

[1] Read before the Natural History Society, Jan. 27th, 1890.

The mineral was recognized by its well-marked physical characters, and a determination of the water gave 10.23 per cent. Recently a specimen from the mouth of the Shubenacadie has been analysed by Mr. A. E. Shuttleworth, student in applied science, with the following result :—

Ferric Oxide	88·92
Manganic Oxide	0·14
Water	10·20
Silica	0·32
	99·58

The formula $Fe_2O_3 + H_2O$ gives, ferric oxide 89·89 per cent. The specific gravity of the specimen analysed was found to be 4·217 and the hardness 5.

2.—Serpentine.

I am indebted to Dr. Ells of the Geological Survey for specimens of an interesting variety of serpentine from Coleraine in the Eastern Townships. The mineral was obtained at Fenwick and Sclater's asbestus mine, about a mile and a-half from Coleraine station on the Quebec Central Railway, and according to Dr. Ells, occurs in irregular veins traversing the ordinary massive serpentine of the region. The veins are said to be generally thin, and to sometimes contain a little mica and asbestus. When first found, the mineral was quite soft, and could be readily squeezed between the fingers as in the case of saponite, but on exposure to the air, it soon became harder, and when examined by the writer, had a hardness of about 3½. It is sub-translucent and has a resinous lustre. The colour, in the specimens which I have seen, ranges from white to pale apple-green, but thin fragments often have an opalescent appearance, and show reddish reflections like some varieties of opal. This is best seen by gas-light. The fracture is distinctly conchoidal. The specific gravity as obtained without exhaustation of air was only 2·402 ; but on suspending the mineral in water in a vacuum, until no further escape of air bubbles took place, the true specific gravity proved to be 2·514.

On drying in vacuo over sulphuric acid the mineral lost 1·584 per cent. of its weight, but further drying in the steam-bath gave an additional loss of only 0·08 per cent. Under I is given the analysis of the undried material, and under II. the analysis calculated for the dried material :—

	I.	II.
Silica	42·42	43·13
Magnesia	41·36	42·05
Ferrous Oxide	0·36	0·37
Manganous Oxide	tr.	tr.
Nickel Oxide[1]	"	"
Lime	"	"
Water	15·29	13·88
	99·43	99·43

It will be seen that the substance has essentially the composition of serpentine, the figures for the dried material coming very near to those required by the formula $Mg_3 Si_2O_7 + 2H_2O$ (Silica 43·48, Magnesia 43·48, water 13·04.) The proportion of iron is much lower than that commonly met with in serpentine, and in fact of the 78 analyses given in Dana, there are only two showing as small a quantity. As a rule, the serpentine rocks of the Eastern Townships contain a considerable proportion of iron, and this we should expect if we regard them as alteration products of basic eruptive rocks. In the veins under consideration, however, we have serpentine of later origin, deposited by aqueous agencies, and presenting, as might be expected, striking differences from the parent rock, both in appearance and composition. Such differences of origin are too frequently lost sight of in the study of serpentines.

The mineral described above resembles in some respects such varieties of serpentine as retinalite and porcellophite.

[1] The presence of nickel was ascertained with the blowpipe, and no attempt was made to estimate the quantity.

3.—Garnet.

A number of varieties of this interesting species are known to occur in Canada, but as yet few of them have been made the subject of careful investigation. Dr. Hunt analysed a specimen from Lake Simon on the River Rouge which proved to be an iron-alumina garnet (almandine) containing 8.85 per cent. of magnesia. He also showed that a curious white rock associated with some of the serpentines of the Eastern Townships had the composition of lime-alumina garnet. The beautiful green garnet of Orford in the Eastern Townships was also analysed by him and found to contain 6.20 per cent. of chromic oxide.[1] Another green garnet from one of the apatite-bearing veins of Wakefield was analysed by the writer, and contained 4.95 per cent. of chromic oxide.[2] The garnet from lot 7, range 1 of Wakefield, which varies from "colourless to yellow and brown," was found by C. Bullman to be a trüe lime-alumina garnet.[3]

Spessartite occurs at the Villeneuve mica mine in this province[4] and andradite (lime-iron garnet) at the Malaspina copper mine on Texada Island, British Columbia.[5] A black isotropic mineral occurring in some of the nepheline-syenites of Montreal is also probably an iron garnet. A variety of the mineral having the colour of cinnamon-stone has been met with at a number of localities, including Orford, St. Jerome (in crystalline limestone) and Grenville. Fine specimens have also been found in the apatite region of Ottawa County (Wakefield, Range 1, lot 6 ?) and the following description and analysis refer to a specimen from this locality, obtained from the collection of the Peter

[1] Geology of Canada, 1863, pp. 496, 497.

[2] Canadian Naturalist, N. Series, ix., p. 305.

[3] G. F. Kunz, Am. Jour. of Sci. Ser. iii., vol. xxvii., p. 206.

[4] Since this paper was read the Villeneuve garnet has been analysed, and the analysis will be given in a future paper.

[5] G. M. Dawson, Report Geol. Survey, 1886, p. 34 B.

Redpath Museum. The garnet is associated with calcite, quartz, vesuvianite, &c., crystals of the last-named mineral often penetrating those of garnet. The latter occurs both massive and crystallised in rhombic dodecahedrons, one of which, in the Redpath Museum, is over $2\frac{1}{2}$ inches in diameter. The specimen examined was of a cinnamon-brown colour and had a specific gravity of 3·58. The analysis was made by Mr. James C. Brown, a student in the chemical laboratory, and gave the following results :—

Silica	36·22
Alumina	18·23
Ferric Oxide	7·17
Manganous Oxide	0·63
Lime	37·39
Magnesia	tr.
Loss on ignition	0·70
	100·34

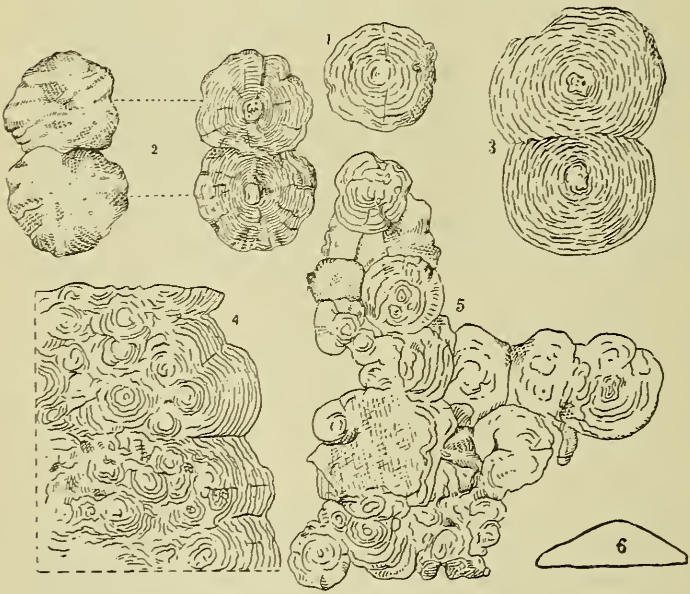
Visitors to Murray Bay, below Quebec, are familiar with the deep rose-red garnet which occurs abundantly in the Laurentian gneiss of that region. A specimen with a specific gravity of 4·047 has been analysed by Mr. R. H. Jamieson, chemistry student, with the following result :

Silica	37·97
Alumina	22·44
Ferric Oxide	2·39
Ferrous Oxide	26·12
Manganous Oxide	1·18
Lime	5·27
Magnesia	5·43
	100·80

The mineral is, therefore, almandine, and this is no doubt the variety of garnet which commonly occurs in the Laurentian gneisses.

4.—Chalcedony Concretions.

The exact locality from which these curious concretions were obtained is not known to the writer, but they are said to have been found embedded in clay in the region between Irvine and the Cypress Hills in the North-West. They consist of a greyish-white, opalescent chalcedony with hardness of 7 and specific gravity 2·592. The person who found them supposed they were fossils, and some of them certainly remind one of nummulites. In some cases they are flat on both sides, in others flat on one side and convex on the other. The convex sides are mostly smooth, and in some cases exhibit slight radial depressions or furrows. The flat sides, however, show marked concentric furrows. When viewed by transmitted light, the concretions are seen to have a radiated as well as a concentric structure, and the radiated structure is made much more apparent by grinding down



until the concretion has become transparent. This is especially true if the section be examined in polarised light when it is also seen to be doubly refracting. The concretions are from a-quarter of an inch or less in diameter up to nearly an inch, and mostly a sixteenth to an eighth of an inch in thickness. They occur as single individuals (fig. 1), or in pairs (figs. 2 and 3), or aggregated in groups (figs. 4 and 5). Figure 4 is from a specimen $2\frac{1}{2}$ inches square and less than $\frac{1}{8}$th of an inch in thickness. Figure 6 gives the outline of a transverse section of one of the convex concretions. Some of the specimens are crusted over by a dull white mineral whose composition has not been determined.

5.—Dawsonite.

($Na_2O + Al_2O_3 + 2\ CO_2 + 2\ H_2O$ or $Na_2Al_2\ C_2O_8 + 2\ H_2O$).

It is worthy of record that this species has been found by Mr. E. T. Chambers at the Corporation quarry on the west side of Montreal mountain. It there occurs in thin radiating blades along the walls and in the joints of a grey trap dyke which cuts the nepheline-syenite, and also in joints in the nepheline-syenite itself. In appearance it closely resembles the mineral from the original localities (McGill College grounds and Montreal Reservoir), but as yet it has not been analysed quantitatively.

6.—Ittnerite.

A grey mineral occurring in the nepheline-syenite of the Corporation quarry has the blow-pipe characters of ittnerite. It contains both chlorine and sulphuric acid, but has not yet been fully examined.

Scolecite from a Canadian Locality.

By J. T. Donald, M.A.

This interesting mineral has recently been found at Black Lake, Megantic Co., Que., in one of the granitic dykes which are so abundant in the serpentine of that locality. The writer's attention was called to it by Mr. Matthew Penhale, Superintendent of the Scottish-Canadian Asbestus Co. It occurs in transparent, glassy needles filling minute veins, and in masses of gray, white, and colorless radiating fibres.

Before the blowpipe its conduct is highly characteristic, the heated portion quickly curling up in worm-like forms. A portion was analysed by the writer, and the results are stated below, together with the analysis as given in Dana's Mineralogy of a specimen from Iceland and of one from Chili, for comparison :—

	Black Lake.	Iceland.	Chili.
Silica....	46.24	46.76	46.30
Alumina	26.03	26.22	26.90
Lime.....	14.09	13.68	13.40
Water.............	13.88	13.94	14.00
	100.24	100.60	100.60

This Scolecite from Black Lake is of considerable interest, being, it is believed, the first Zeolite found in the dykes cutting the serpentine of the Eastern Townships, and also because, so far as can be learned, it had not hitherto been known to occur in Canada.

Notes on Asbestus and some Associated Minerals.

By J. T. Donald, M.A.

Asbestus mining operations which are now extensively carried on at various points on the great serpentine belt, which extends "north-eastward from the Vermont boundary for some distance beyond the Chaudiere river," afford excellent material for the study of the problems as to the origin and nature of the serpentines and associated rocks.

On this subject much has been written, and the majority of those who have studied the rocks of this region consider, in most cases at least, the serpentine an alteration product of some form of dioritic rock rich in olivine. The asbestus, which is found throughout the serpentine in irregular veins varying greatly in width, appears to be a still later product of alteration. In many places the serpentine contains magnetic iron disseminated in fine particles; the associated asbestus shows the same iron, not disseminated, but usually concentrated toward the middle of the veins. It seems evident that both the serpentine and iron oxide have been dissolved by percolating water and redeposited in the crevices of the rock, the less soluble silicate first and lastly and in the middle of the vein, the more soluble iron.

Asbestus or chrysotile is commonly regarded as a fibrous variety of serpentine, and undoubtedly the two are very similar in composition. Dr. T. Sterry Hunt[1] has pointed out that asbestus is distinguished from serpentine by its lower specific gravity. There are, however, other points in which it appears that asbestus differs from ordinary serpentine. As a rule the former contains a higher percentage of water. The average water in five samples of Canadian serpentine chosen at random was found to be 13.49 per cent., while for four samples of chrysotile the water averaged 14.25 per cent. Alumina appears to be more frequently present in asbestus than in serpentine. In this respect, and in the degree of hydration, Italian asbestus is similar to its Canadian rival, but a greater number of analyses must be made before much stress can be laid upon the presence of alumina in chrysotile.

A question of interest, and one of great practical importance to those engaged in the asbestus industry, is, as to the cause of the difference in texture of various veins of the mineral. In some cases we find the fibres very soft and possessed of great flexibility; in other cases they are extremely harsh and brittle, the latter being of course much less valuable than the former. Analysis shows that harsh and brittle asbestus contains less water than the softer kind. The writer found 14.05 per cent. of water in very flexible fibre, whilst in a harsh-fibred sample only 12.62 per cent. was present. It is well known that if soft fibres be heated to a

[1] Mineral Physiology and Physiography, p. 324, s. 59.

temperature that will drive off a portion of the water of combination, there results a substance so brittle that it may be readily crumbled between the fingers. Wherever asbestus is found in rock that is faulted and shattered, the fibre is almost certain to be harsh at or near the surface, although at greater depth softer fibre may be found.

If the aqueous orgin of asbestus be admitted, it seems reasonable to suppose that all the fibre when first deposited was soft and flexible, containing a maximum amount of water, and that movements of the rock producing heat have driven off a portion of the water of the contained asbestus and thereby destroyed the softness of the original fibre. Veins at considerable depths may have been subjected to the heat produced by these movements and yet not deprived of any portion of their original water, because of the resistance of overlying rocks.

It is probable, too, that movements of the rocks and resulting heat have been intimately connected with the formation of picrolite,[1] a "columnar variety of serpentine, with fibres or columns not easily separable." In all the asbestus mines picrolite is found along the lines of faulting, and at one point near Broughton Station on the Quebec Central Railway, where there is abundant evidence of faults, picrolite abounds. Here mining was formerly carried on and large quantities of rock have been removed. Hundreds of tons of picrolite of most fantastic forms constitute one of the dumps, the whole forming a remarkable sight.

Associated with the chrysotile are found some singular forms of serpentine. At the Megantic mine, Coleraine, there occur narrow seams of material so soft that it may be compressed between thumb and finger, and varying in color through white, blue, green and yellow ; when exposed to the air it gradually becomes hard and assumes a waxy lustre. Dr. B J. Harrington has already referred to the green variety, and his analysis shews it to be simply a variety of serpentine.

[1] Dr. Hunt gives 12.45 as the percentage of water in a picrolite from Bolton, Quebec. Geo. Survey Report, 1863, p. 499.

At the Thetford mines, also, there are found veins of a soft white mineral. On exposure to the air it hardens but does not acquire a waxy lustre, but has much the appearance of unglazed white earthenware, and absorbs water with avidity. On analysis its composition was found to be:—

Silica	43.191
Alumina	1.463
Ferrous oxide	.293
Magnesia	41.520
Water	14.000
	100.467

The Laurentian serpentine also contains seams of soft silicates. A Montreal gentleman who determined to ascertain the character of the Laurentian asbestus at some distance from the surface, in blasting the rock at a point some miles north of Lachute, met with a soft mineral, in physical characters much resembling those already described. The writer received a small sample which was laid aside in a warm and dry room, and examined from time to time. It gradually hardened, then crumbled to powder. After two months of exposure to warm and very dry air, it was found to lose no less than 6.05 per cent. moisture at 100° C. In composition this mineral is closely related to sepiolite or meerschaum, as the following analysis shows:—

Silica	61.585
Carbonic acid	1.290
Alumina	......
Lime	4.037
Magnesia	25.980
Water	6.600
	99.492

Fragments of light greenish-yellow serpentine were scattered through this specimen, whilst particles of a darker variety are disseminated through the Thetford mineral and through some of the material from Coleraine.

Other minerals found associated with the asbestus are soapstone, magnetic iron, chromic iron, mica and enstatite. The first mentioned occurs abundantly in veins and bedded masses; whilst magnetite, as already stated, is found disseminated through the serpentine, and forming veins in the asbestus; chromite is much less frequently met with, although the asbestus miners persist in calling all the iron found in their workings, chromic. Small particles of mica are found in the serpentine at various points. It is fairly abundant at Coleraine, and in Garthby township[1] it occurs in curious association with picrolite, plates of mica being arranged in columns which alternate with the picrolite columns.

Enstatite, conspicuous because of its bronze lustre, is found in the serpentine at the Calvin-Carter mine, Black Lake.

The Lower Helderberg Formation of St. Helen's Island.

By William Deeks, B.A.

The existence of Upper Silurian fossils on St. Helen's Island was first discovered in the autumn of 1856 by Sir William Dawson, on the occasion of a Geological excursion to the Island with his class, when *Atrypa reticularis,* a species of *Favosites,* and other fossils sufficient to establish the age of the limestone were obtained. These fossils were handed over to Sir William Logan and more extensive collections subsequently made by Mr. Billings. Reference was made to these in 1857, at the meeting of the American Association, when its members visited the Island. This was the first publication of the facts.

The structure of St. Helen's Island was described in the Geology of Canada (1863), and the following facts stated:— "The outlier appears to repose on the Utica formation, the shales of which, with some of their characteristic fossils, are

[1] Lots 5 and 6, Range I, south.

visible at the upper extremity of the Island. The deposit consists principally of a conglomerate, the enclosed masses of which are sometimes rounded, but chiefly angular. They consist of fragments of Laurentian gneiss; of white quartzose sandstone resembling that of the Potsdam formation; of dark grey limestone in some cases holding Trenton fossils; of black shale resembling that of the Utica formation; and of red sandstone and red shale similar to those of the Medina. With these fragments are associated others of igneous rocks. All of these, varying in size from a quarter of an inch to five and six inches, are enclosed in a paste of a light grey dolomite, which weathers to a reddish-yellow." . . . "About two-thirds of the distance down the east side of the Island, there occur two masses of dark-grey fossiliferous limestone, weathering to a light grey. . . . They have a breadth of scarcely more than ten feet, and appear to run under the dolomitic conglomerate. . . . The fossils observed in the limestone are *Favosites Gothlandica*, *Strophomena rhomboidalis*, *S. punctulifera*, *Orthis oblata*, an undetermined species of *Rhynchonella* with *R. Wilsoni*, *Athyris bella*, *Atrypa reticularis*, and two undetermined species of *Spirifera*."

Exposures indicating the same kind of agglomerate were discovered at Round Island, Isle Bizard, Rivière des Prairies, and near Ste. Anne, but no limestone.

In addition to the localities mentioned a small patch of similar agglomerate has been found on the McGill Grounds, immediately behind the Medical building, and probably many others may eventually be found on the Island of Montreal.

Sir William Dawson has in papers, and addresses to the Natural History Society of Montreal, stated reasons for regarding the agglomerate as a portion of the fragmental ejecta of the old Silurian volcano of Montreal, which continued active up to and beyond the time of the deposition of the Lower Helderberg limestone. Some of these trappean dykes are found cutting and altering the limestone. This conclusion is supported by the angular character of the greater part of the fragments in the agglomerate, by the irregularity of deposition and want of regular bedding, by the fact that nearly all the material of the agglomerate belongs to rocks known to include the locality, and by the character of the paste, which may be regarded as volcanic ash and debris cemented by dolomite. It is also to be observed that Helderberg fossils occur not only in the limestone, but also occasionally in the paste of the agglomerate itself.

In 1880 Mr. Donald, now Prof. Donald, who had collected at St. Helen's Island, and had access to the collection in McGill College, determined and published a list of these fossils, comprising sixteen genera and thirty-six species.[1]

Since that date annual Geological excursions have added a few more species, and better specimens of others personally known, to the McGill collection; and the object of the present paper is to summarize all the work that has been done in connection with this isolated patch of Silurian rock.

The following is a list of the fossils so far determined, also for comparison, those which are common to the New York, Gaspé and Nova Scotia fauna. These are denoted by asterisks :—

LOWER HELDERBERG LIMESTONE OF ST. HELEN'S ISLAND.	New York.	Gaspé and Bay des Chal'urs	Nova Scotia.
Crinoid stems	*	*	*
Stenopora	*	—	*
Chaetetes abruptus	*	—	—
Callopora incrassuta	—	—	—
Favosites Helderbergiæ	*	*	—
Favosites Sp. ?	*	—	—
Zaphrentis corticata	*	—	—
Zaphrentis Roemeri	*	*	—
Zaphrentis Sp. ?	*	*	*
Heliolites	*	*	—

[1] Canadian Naturalist. Vol. IX., p. 302.

LOWER HELDERBERG LIMESTONE OF ST. HELEN'S ISLAND.	New York.	Gaspé and Bay des Chal'urs	Nova Scotia.
Fenestella (allied to) perangulata	*	—	—
Ptilodictya acuta	—	—	—
Atrypa reticularis	*	*	*
Chonetes Sp. ?	—	*	—
Zeptaena Sp. ?	—	—	—
Lingula perlata	*	—	—
Orthis deformis	*	—	—
Orthis discus	*	—	*
Orthis eminens	*	—	—
Orthis hipparionyx	—	—	—
Orthis oblata	*	—	—
Orthis tubulostriata	*	*	—
Pentamerus galeatus	*	—	*
Pentamerus pseudogaleatus	*	—	—
Pentamerus berneuilli	*	—	*
Rhynchonella æquivulois	*	—	—
Rhynchonella formosa	*	—	*
Rhynchonella mutabilis	*	—	—
Rhynchonella (allied to) mutabilis	—	—	*
Rhynchonella nucleolata	*	*	—
Rhynchonella vellicata	*	—	*
Rhynchonella ventricosa	*	—	—
Spirifer (allied to) Sp. arenosus	—	*	—
Spirifer concinnus	*	*	—
Spirifer cyclopterus	*	*	*
Sricklandinia Gaspensis	—	*	*?
Streptorhynchus radiata	*	—	*
Strophodonta profunda	—	—	*
Strophodonta punctulifera	*	—	*
Strophodonta varistriata	*	*	*
Strophomena rhomboidalis	*	*	*
Avicula Sp. ?	—	—	*
Platyostoma depressa	*	*	*
Tentaculitis Helena	—	—	—

Our present knowledge justifies us in drawing the following conclusions, which embody those stated by Prof. Donald :

1st. The fossils determined belong to 24 genera, comprising 44 species. Of these 33 are common to New York, 16 to Gaspé, and 19 to the Nova Scotia series.

2nd. *Atrypa reticularis*, *Pentamerus pseudo-galeatus*, *Rhynchonella formosa*, *Rhynchonella nucleolata*, *Spirifer concinnus*, *Spirifer cyclopterus*, *Strophodonta varistriata* and *Strophodonta punctulifera*, from their abundance, may be called the most characteristic fossils of the deposit.

3rd. They are closely related to the New York series, and are probably the continuation of the same beds. This is the more striking when we consider the small number that has been collected from St. Helen's Island, and yet many of these are typical New York species.

4th. From the large number of St. Helen's Island species common to the Gaspé and Bay des Chaleurs series, and also to the Nova Scotia series, it must be inferred that these are closely related also, and particularly since five of the characteristic species of St. Helen's Island are characteristic also of these formations.

5th. In Canada no sharp line of demarcation can be drawn between the Lower Helderberg and Oriskany formations, as a number of specimens of Spirifer allied to arenosus, and *Orthis hipparionyx* have been found in the limestone.

6th. The species called *Tentaculites Helena* is different from any published by Dr. Hall as occurring in the Lower Helderberg, and as it has occurred only in loose fragments may possibly be of foreign origin and of Hudson River age. "Tube strong, somewhat rapidly enlarging from apex; varies in length from $\frac{7}{16}$ to $\frac{7}{8}$ of an inch ; annulated by sharp elevated rings, extending to the apex, eight to nine in the eighth of an inch. Spaces between the elevated rings from two to three times the width of the rings. These spaces are marked by numerous very fine vertical striæ."

It closely resembles *Tentaculites Sterlingensis* which is described in Worthen and Meeks' reports on the Hudson

River formation of Illinois, except that it is straight, the raised rings are more angular, and it is a little less slender in general form.

Thus we have the picture presented of the old Silurian sea, in which flourished a very rich fauna, depositing limestone over a broad belt south of the St. Lawrence, as far west as the Adirondack Mountains, and east over Gaspé and a part of Nova Scotia. Contemporaneous with this the volcano, of which Mount Royal is the remains, poured lava and fragmental debris into the waters, hardening the limestone, and affording sufficient protection to preserve this small outlying patch from the denuding agencies which afterwards swept away all similar limestone between it and the New York series on the South-west and the Gaspé series on the East.

This outlier of Helderberg limestone constitutes an interesting feature in the local geology of Montreal, being the only example of Silurian strata with characteristic fossils in a district so rich in fossiliferous strata of the older Cambro-Silurian, or Ordovician age.

Notes on a Bird new to the Province of Quebec.

By F. B. Caulfield.

I have much pleasure in recording the fact that this winter has brought to us a very interesting addition to our list of birds occurring within the Province of Quebec, viz., the Evening Grosbeak, *Cocothraustes vespertina*, Coop., one of the most beautiful of a group, many of whose members, unite in a marked degree, brilliancy of tint, with bold contrasts of color.

The Evening Grosbeak was first described by Wm. Cooper in the Annals of the Lyceum of Natural History of New York. Audubon states that a few were observed by School-craft in April, near the Sault Ste. Marie in Michigan, from which it was traced to the Rocky Mountains.

Dr. Richardson, in the Fauna Boreali Americana, states that it is common in the maple groves of the Saskatchewan, where it is known as the "sugar bird." Townsend found it abundant in the pine groves of the Columbia River, and from specimens obtained by him, Audubon re-described the species and drew his beautiful plate, figures of the adult male and female and young male. Townsend found that they were of social habits, keeping together in large flocks; he also states that they are noisy during the day, from sunrise to sunset.

McIlwraith, in his Birds of Ontario, 1886, gives the following record of its occurrence in that Province:—The first report of their appearance in Ontario was made by Dr. T. J. Cottle, of Woodstock, who, in May, 1866, observed a flock among the evergreens near his residence, and obtained one or two of them. In 1871 they were noticed near London, and several were obtained; and on March, 1883, Mr. McIlwraith, when passing through a swamp in West Flamboro', observed two in a bush by the roadside and secured both. He further tells us that he has also heard of a female having been obtained at Toronto by the Rev. Mr. Doel on the 15th of December, 1854. He gives its habitat as Western North America, east to Lake Superior, and casually to Ohio and Ontario; from the fur countries south into Mexico. The species is not mentioned in any of our Quebec lists, and the honor of obtaining the first specimen falls to Mr. Dodd, gardener to J. H. R. Molson, Esq., who on or about the 1st of February of the current year, secured a male in this neighbourhood; and Dr. Harrington noticed several of the birds in the McGill College Grounds on the 28th of January last. On February 5th, four specimens were obtained by Dr. Brousseau at Laprairie, one of which was brought to me for identification; and Mr. E. B. Audette, of the same place, secured one alive. I am indebted to the kindness of Mr. E. D. Wintle for the following additional records of its occurrence during the present season:—

New Hampshire and Massachusetts, Wm. Brewster.
New York, A. K. Fisher.
Oswego, N. Y., J. Alden Loring.
Lockport, N. Y., J. L. Davidson.

All obtained between December 14th and February. I have not yet seen any notice of its appearance in Ontario during the present winter, but doubtless it has been there also. At all events the foregoing records are sufficient to prove that we have not been visited by a few stragglers only, but that there has been a widespread migration, extending much farther to the east than any point at which it had been observed in former years. The specimen examined was in excellent condition, plump and fat, the stomach being filled with vegetable matter.

Charles Frederick Hartt.[1]

By G. F. Matthew.[2]

It is now nearly twelve years since, to the surprise and sorrow of his friends, news came from Brazil of the sudden and untimely death of Prof. Charles Frederick Hartt; cut off in the midst of his noble work of making known to the world the Natural History and resources of the great Empire of Brazil.

He died in middle age with all the enthusiasm of youth upon him, with his life work giving promise of a glorious future. When we think of what he might have accom-

[1] Read before the Natural History Society of New Brunswick, 5th Nov. 1889.

[2] In the preparation of this paper I have quoted freely and verbatim from a sketch of the life of Professor Hartt written by Mr. G. V. Hay, and from the very excellent sketch prepared by Mr. Richard Rathbun, one of Prof. Hartt's assistants in Brazil. The present sketch is fuller, for his early life and a few incidents that have transpired since his death have been added.

plished, had his life been spared, we cannot repress a feeling of regret at the loss which science has sustained in the death of this talented and devoted man.

Prof. Hartt was the eldest son of the late Jarvis William and Prudence (Brown) Hartt and was born at Fredericton, New Brunswick, August 23, 1840.

His father, Jarvis Hartt, on the completion of his education was appointed Principal of the Baptist Educational Seminary in Fredericton. He was noted for his earnest character and quiet devotion to educational work, and these qualities no doubt helped to mould the character of his son, and implant in him those habits of intense and continous application which he possessed. And to the fine temperament and high ideals of his mother we may believe that Prof. Hartt was largely indebted for the inspiration which carried him along in the study of Nature. Mrs. Hartt was educated at Cambridge, Mass., and came to Fredericton to take charge of one of the departments of the seminary where her future husband was teaching. Her intellectual training enabled her to appreciate her son's tastes, and in her he found a sympathetic and ready listener, when as school-boy and student he propounded to her his schemes for future study and work. Through her friends he found himself at home in later years in Cambridge, and frequently wrote to her of his plans and prospects.

Hartt's early education was carried on under the direct supervision of his father, who, for a long time was identified with the educational interests of Nova Scotia and New Brunswick. He studied at Horton Academy in Wolfville N.S. where his father was at the time professor, and afterward at Acadia College in the same town. In 1860 he graduated from the college with honor, receiving the degree of Bachelor of Arts, and later that of Master of Arts.

When still a boy, Hartt developed a strong taste for philology, and with the aid of transient people of the village near his home, would make vocabularies of Gaelic and Italian; and it was a day to be remembered by him when

Mr. Rand, the Micmac missionary, on his round visited Wolfville and taught him something of the Indian dialects.

Hartt's passion for Nature Science was not a late growth, for at the age of ten he showed a decided predeliction for Natural History and as he grew up took great delight in assisting Prof. Chipman of Acadia College in preparing and arranging his specimens. With the professor's aid and encouragement he made great progress in acquiring a knowledge of Mineralogy which, owing to the abundance of trap-minerals (zeolites &c.) in the vicinity, was a favourite study of the Professor of Acadia College and his pupils. Fortunately Hartt was not with Prof. Chipman when the latter made the trip by boat to the trap-cliffs of Blomidon, which cost him his life.

Hartt's versatility was shown in his talent for drawing, and for the acquisition of languages, and we are told that he became instructor in drawing in Acadia College when quite a youth. While at college he learned the elements of Portuguese from a shoemaker of the village, and this acquisition no doubt proved useful to him when he visited Brazil; he attained afterward such proficiency in this language that he lectured with great success to cultivated audiences in Rio Janeiro. His skill as a draftsman and his command of language always drew to his lectures interested hearers.

Already, while occupied with his college studies, he entered with zeal into the work of geological investigation. He explored the parts of Nova Scotia in the vicinity of the Annapolis Valley and the Basin of Minas, traversing the country on foot, and making large collections of specimens whenever the opportunity was afforded him. It was his intelligent eye and busy hands that selected in the Gaspereaux Valley the material which enabled Sir Wm. Dawson to establish the genus *Aneamites* on a remarkable fern of the Lower Carboniferous period, which, before that had been confounded with *Cyclopteris*. Many of the specimens of minerals and fossils which Hartt collected in those days, are to be found in the Museum of the Natural History Society at St. John, in the Peter Redpath Museum of McGill University in Montreal and at the Agassiz Museum in Cambridge. While engaged in his college studies, he also made a large collection of insects; and made meteorological observations for the Smithsonian Institution which have received much commendation.

While yet at Acadia College pursuing his studies, Hartt entered into correspondence with the author of this sketch, and before he graduated, we made a visit together to the mineral localities of Minas Basin and the adjacent shore of the Bay of Fundy, where the rich harvest of zeolites and showy varieties of quartz minerals, set free by the frost of winter, still attract numerous summer visitors. This visit was the beginning of a more intimate acquaintance, which was continued when Mr. Hartt moved to St. John.[1]

Later in this year (1860) Mr. Jarvis Hartt removed with his family to St. John for the purpose of establishing a Young Ladies High School, which he carried on successfully for many years. For some time his son aided him in conducting the school, but the son's love for his favourite studies was such, that every spare moment which could be snatched from the immediate duties of the school, was given to explorations in the neighborhood of the city, and the gathering of a rich harvest of fossils from the ballast of vessels, arriving from the west coast of Ireland, the Mediterranean and elsewhere.

When Mr. Hartt came to St. John, but little was known to the Scientific World of its geology. Some twenty years previously the late Dr. Abraham Gesner, then employed on the Geological Survey of New Brunswick, had traversed the neighborhood of the city of St. John, and had referred the rocks of that vicinity to the "Grauwacke Formation," with the reservation that certain portions near the city were "imperfect coal measures." He made the latter part of this statement in consequence of the discovery of a fossil tree in the sandstones East of the city. Dr. Jas. Robb of King's College, Fredericton, the successor of Dr. Gesner in the study of the geology of New Brunswick, pronounced the same rocks some years later to be Upper Silurian. It remained for Mr. Hartt and his *collaborateurs* to amass the materials which, in the hands of the sagacious Principal of McGill University, were to show that these plant-bearing sandstones contained a Devonian flora.

The writer had already found in these beds a sufficient number and variety of species to enable Sir Wm. Dawson to pronounce upon their Devonian age, but the rich harvest of fossils—exquisitely preserved ferns, asterophyllites, and psilophyta were not discovered until Mr. Hartt entered the field. To the collection and observation of these plants he gave the whole of his vacations during the years 1861, '62 and '63; and the result of this work has been of the most enduring value to science. Every bed of the unique section at the "Fern ledges" in Lancaster, West of St. John, was carefully studied, its fossils collected and its remains recorded. Such a work had not been done before in the Maritime provinces of Canada. The thoroughness of the work will be seen from the fact that while Hartt discovered scores of species in these beds, no new species of plants have been added to those which crowned his researches, and remains of only two insects beside those he found.

The discovery of insects of such great antiquity was perhaps the most striking result of these investigations. A few insects mostly related to the cockroaches had previously been found in the Coal Measures in several countries, but Hartt's discovery of insect wings in these older rocks threw a new light upon the history of insect life in the first geological ages. These insects were of five species, and were placed in the hands of Dr. S. H. Scudder of Boston for study. He referred them all to the Neuroptera; in part to new, in part, doubtfully, to old families, and suggested that some of the forms were synthetic types. But their important bearing on the history of insect-life was not then fully reached by that sagacious and experienced student of insects, for he has since referred them all to a great Palæozoic order, now quite extinct, the Palæodictyoptera of Goldenberg, from which he conceives that all the modern orders of insects have arisen.

Plant remains and insects, however, were not the only organisms discovered by Mr. Hartt in these interesting beds, for crustaceans also were found. These were of peculiar types and others found since in the same beds are not less remarkable.

Hartt's restless energy would not allow him to be content with field work alone, so in conjunction with several other young men of kindred tastes, in the city of St. John, he formed the "Steinhammer Club" an association devoted to the study of Geology. Subsequently at the suggestion of Sir Wm. Dawson of Montreal, this club was changed into a public society under the name of the Natural History Society of New Brunswick, whose meetings have been the means of sustaining an interest in the natural sciences in St. John, and in whose publications are recorded much that is of value relating to the Natural History of the Province of New Brunswick.—In this society Mr. Hartt took the warmest interest, attending its meetings, reading papers germain to its object, and devoting much material and time to the enlargement and arrangement of its museum.

Absorbed as he was in geological studies Mr. Hartt could not long remain content with his work in the High School. Accordingly he resolved to seek a larger field for study and work. Prof. Louis Agassiz had then recently come to America, and had already become widely known on this continent, as a successful teacher and instructor in Natural History. To his Zoological museum Mr. Hartt resolved to go in order to complete his studies. He sold his Devonian collections to the Natural History Society of New Brunswick, and proceeded to Cambridge to avail himself of the great stores of material for study in Agassiz Museum, and to obtain instruction from that talented and most attractive teacher of Natural History. Here, with such kindred spirits as Verrill, Morse, Putnam, Hyatt, Scudder and St. John, he devoted himself for several years to the investigation of Nature under the intelligent eye of Agassiz.

The writer of this sketch had meanwhile commenced the study of the older slates at Saint John, whose age hitherto had not been determined, but which were supposed to be a downward continuation of the measures which contained the Devonian plants. At first only some badly preserved trilobites were found, which, on account of their long thoraces were supposed to be of Lower Silurian age.[1]

Subsequently (1863) much better material of well preserved species of trilobites were found by the author in Portland (St. John) and these, with the collections of the Geological Survey of Southern New Brunswick, were placed in Mr. Hartt's hands for study. Taking advantage of the opportunities which he possessed at Cambridge, he gave these fossils a careful scrutiny, and was able to announce that they were equivalent in age to those of Etagé C. of M. Barrande and, therefore Primordial. After his first brief notice in the report of the Geological Survey of New Brunswick, announcing this discovery, Hartt continued his study of these organisms with the aid of additional material. Upon this material, together with what had been previously obtained, was based his fuller descriptions of the fossils, with many figures, which appeared in Dr. (now Sir Wm.) Dawson's Acadian Geology in 1868.

In 1864 Mr. Hartt and the author were invited by Professor L. W. Bailey, to take part with him in the Geological Survey of Southern New Brunswick instituted by the Provincial Government. The results of this survey were published in the following year, and were a very important addition to the knowledge of the geological structure of this part of New Brunswick. The results embodied in this report, formed the basis from which the Geological Survey of Canada in this region, after the confederation of the Canadian provinces, was carried on.

Beside his work on this survey in New Brunswick, Mr. Hartt did independent geological work in Nova Scotia. In 1864 he obtained proof of the pre-carboniferous age of the gold of Nova Scotia. His observations were made at Cor-

[1] At that time the Cambrian had not by common consent, been separated from the Lower Silurian.

bitt Mills, where the well-known auriferous slates are immediately overlaid, unconformably, by conglomerates, grits, and sandstones of Lower Carboniferous age. The lower portion of these rocks contains an abundance of gold, which was undoubtedly extracted from the underlying slates, while the former deposits were in process of formation, and was mixed with the loose gravelly material, which subsequently became consolidated into the conglomerate and sandstone.

We owe to Hartt also, the careful investigation of the relations of the different members of the carboniferous limestone deposits in the neighborhood of Windsor, Stewiacke, &c. in Nova Scotia. He collected and studied the fauna of each separate set of beds with much pains, and in this way was enabled to determine their sequence. The fossils which are marine, are very numerous, and some new species were described by him in the "Acadian Geology." Much interest attaches to the study of this formation at the above localities, where, in the upper beds, occur many forms common to both the Carboniferous and the Permian, and a great likeness is apparent to the upper members of the Carboniferous system in the western United States, called Permo-Carboniferous. Dr. Meek, who examined the fossils, suggested that we might have here what Barrande would call an upper Coal-Measure or even Permo-Carboniferous fauna, 'colonized' far back in the Sub-carboniferous period. Dr. (Sir Wm.) Dawson has enlarged on Hartt's results, and shows that the divisions made by him are of more general application than Hartt had known them to be.

As early as this, Hartt developed a constitutional tendency to asthma, which interfered with his field work in the cold and humid climate of this region, and which, after he entered on his professional work in the United States, prevented him from revisiting his native land. This, probably, was one of the causes which induced him to seek occupation in the warmer climate of Brazil.

Upon the organization of the Thayer Expedition to Brazil, by Prof. L. Agassiz, Mr. Hartt was appointed one of its two geologists, Mr. Orestes H. St. John being the other. This expedition left New York in April 1865 and returned in July 1866, having been absent a little more than a year. This was the strong and final inducement that called Hartt away from the geology of his own country. Although he was not fortunate in finding a very rich geological territory during his wanderings while connected with the Thayer Expedition, he saw enough to thoroughly interest him in returning again to Brazil, and in finally giving his whole attention to Brazilian studies.

The primary object of the Thayer Expedition was to investigate the distribution of the fresh water fishes of Brazil, but much time was also devoted to its geology. Prof. Agassiz limited himself mostly, in his geological work, to the examination of the superficial deposits at Rio de Janeiro and on the river Amazon, which were studied in connection with the question of glaciers. Hartt was retained near Rio for some time, in making examinations of the many Railroad cuttings around that city. After this work was completed, his field of exploration lay mostly between Rio and Bahia, where he carefully studied the geological and other features of the coast, and of the principal river basins leading to it. Large collections of the fresh water fishes of the rivers, and of the marine animals of the coasts and reefs were made. In consequence of the absence of fossils, no results in systematic geology were obtained, but, nevertheless, Hartt's studies of the geology of this monotonous tract were of great interest.

In the neighborhood of Porto Seguro he explored the coral and sandstone reefs, the latter of which is a prominent feature of the Brazilian coast. He was the first to carefully work out the structure and mode of formation of these sandstone reefs.

After Hartt had returned to the United States from the Thayer Expedition, he felt that he had left unfinished some of the more important investigations he had made in Brazil. He was unable to report as fully as he wished, on many subjects of interest which he had partly studied. So in 1867 he returned to Bahia, to perfect his former work and to continue his observations. He worked out the geology on the line of the Bahia railroad in detail, and collected some fossils from the Cretaceous terreins of that region. He also studied the structure of the Abrolhos islands and reefs which lie off the coast of Bahia. The islands are of stratified deposits, capped with trap, while the reefs, which had never been to any extent examined by a naturalist, are of coral, generally assuming curious tower-like forms, and often growing together to form a large connected expanse.

In addition to throwing new light on the formation of certain kinds of coral reefs, he also discovered a large number of species of corals of which the majority were new, but belonged to West Indian types. The absence of many prominent West Indian genera such as *Madrepora*, *Meandrina*, *Diploria* &c. was noted by him. The Cretaceous region of Sergipe was visited and yielded many fossils, which have been in part described by Prof. Alpheus Hyatt.

In the short interval which elapsed between his first and second trip to Brazil, he was engaged in scientific teaching and lecturing in and near New York city, at the Cooper Institute, Pelham Priory, Adelphi Academy and other places where he attained much success, and made many warm friends who aided him in his second Brazilian expedition. In 1868, soon after returning the second time, he was appointed Professor of Natural History in Vassar College; but he resigned this position in the autumn of the same year to accept the chair of Geology in Cornell University, where he was retained at the head of the department of Geology until the time of his death. In 1869 he was elected General Secretary of the American Association to serve at the meeting of 1870, but before that time he had departed on his third trip to Brazil.

It was in the year 1869 also, that he was married to Miss Lucy Lynde of Buffalo, N. Y., by whom he had two children, a son and a daughter. Both his widow and children are living. His son, now in his twenty-first year, is studying at Williams College, Mass., and his daughter at the

Buffalo Seminary, Buffalo, N. Y., of which her mother, for several years past, has been the principal.

While at Cornell University, when not occupied with college duties, he was engaged in working up the results of his Brazilian explorations, and in preparing his report as geologist of the Thayer Expedition. This report, however, grew to so great a size, and was so complete in itself, that it was found advisable to publish it separately in 1870 as "The Geology and Physical Geography of Brazil." It forms a large octavo volume of over six hundred pages, and contains in addition to an account of his own researches, a *résumé* of our previous knowledge of the natural history of the country. It is thus not limited to a discussion of the subject indicated by the title, but treats of the topographical and general features of the country, of its flora and fauna, both marine and terrestrial, and of its mining, agricultural, commercial and manufacturing interests. The numerous maps and sketches which illustrate it, were drawn by Professor Hartt himself, and the greater part of them represent regions never before depicted. The volume closes with a valuable appendix on the Botecudo Indians.

In the year 1870, the same in which his book was issued, Professor Hartt organized the largest of his own expeditions from the United States. It was composed, beside himself, of Professor Prentice and eleven students of Cornell University. His object in taking so many young men was to give them thorough practical training, and to stimulate them to undertake original work. He says in his report of this expedition, that he did not expect to make scientists of them all, but hoped that some of them might thus be induced to accept this calling. The means for defraying the expenses of the trip were contributed by several parties, the most prominent of whom was Mr. E. B. Morgan of Aurora, N. Y. whose name has been given to this and the subsequent expedition.

Prof. Hartt determined on this occasion, to change his field of research, and explore the Amazonas. Accordingly he went with his party direct to Pará, and in the neighborhood of this city, spent some time in training his inexperienced assistants. The tributary rivers Tocantins, Zingú and Tapajos, were then examined throughout their lower courses, and many valuable geological facts ascertained. On the Tapajos were discovered highly fossiliferous carboniferous deposits.

At the falls on each of the above named rivers were found series of metamorphic rocks, which, from their position and lithological characters, have been referred to the Silurian system. Passing to the North side of the valley of the Amazonas they minutely investigated the geology of the vicinity of Monte Alegre and the Sierra Ereré. On the plain of Ereré were discovered sandstones and shales, with characteristic Devonian fossils, corresponding more or less with those of the Hamilton and Corniferous groups of New York State. These were the first Devonian fossils found East of the Andes in South America.

One of the party examined the ancient Indian mounds of the island of Marajó at the mouth of the Amazonas, at that time only imperfectly known, and discovered large quantities of richly ornamented pottery, mostly in fragments These have since been made the subject of considerable study by Prof. Hartt and others. The sea coast was examined at several points, from Pará to Pernambuco, and in the neighborhood of the latter city, the fossiliferous Cretaceous formations of the province of the same name, were studied for the first time. At all the localities visited, they made large collections in geology and zoology, which were sent to the United States, and are now contained in the museum of Cornell University.

Prof. Hartt's researches on the Amazonas did not tend to bring proof of the former existence of glaciers there. The sierra of Ereré was found not to belong to the series of table-topped hills, as Professor Agassiz had been led to suppose, but to consist of inclined strata of very irregular outline. The Devonian fossils of the plain were from a portion of the supposed "drift" material of Agassiz.

Professor Hartt returned to Ithaca, N. Y., January 1872, where he remained two years and a half, giving all the time he could spare from his college duties to working up the results of his two Amazonian trips, with the aid of his two assistants, Orville A. Derby and Richard Rathbun. His reports were published as soon as finished, in the journals of several scientific societies. During this time he also gave popular lectures on Brazil in New York, Boston and Syracuse.

But Professor Hartt was unable to continue long in this state of comparative quietude. In bringing together the result of his several trips to South America, with the object of explaining the geology of all Brazil, he saw how meagre were his data for this purpose, notwithstanding all that he and others had recently done toward elucidating the structure of this vast region. He wished to extend his researches and conceived the idea of organizing a survey of the whole Brazilian Empire, which has an area scarcely less than that of the United States. There was only one way of accomplishing such an undertaking; it must be supported by the government. Hartt ventured to bring the matter before some of his Brazilian friends, and his ideas met with such favour that in 1874 he received an unofficial invitation from the Brazilian minister of Agriculture, to submit a proposition for the systematic geological exploration of the Empire. In August of the same year, he accordingly went to Rio de Janeiro for the purpose of formally presenting his plans. Upon arriving at that city he was received with almost as much enthusiasm as was Prof. Agassiz nearly ten years earlier. His thorough acquaintance with the language of the country enabled him to communicate freely with the people, and he soon found himself encircled with friends, who gladly gave their influence in advancing his plans.

A Geological Commission of the Empire of Brazil was organized on the 1st May 1875 with Prof. Hartt as chief, and the following assistants E. F. de Jordão, Engineer, O. A. Derby and Richard Rathbun, Assistant Geologists and F. G. de Freitas, "Particante." Mr. John Branner, now in charge of the geological survey of Arkansas, was soon added to the staff, and a few other additions and changes were made.

The active work of the Commission began in June 1875, and the coast region North of Rio to Cape San Roque was explored. Here extensive cretaceous deposits were found, with remains of sharks, crocodiles and other reptiles; and large collections of recent marine animals were made along the coast.

In the next year, the work in the maritime provinces North of Rio was continued and abundant remains of reptiles, fishes, and other animals were found. The diamond-bearing gravels near Bahia were also examined for the purpose of discovering the source of these gems. In the province of Sergipe was gathered a rich harvest of cretaceous fossils for the museum at Rio.

In this and the following year (1877) explorations were carried on in the provinces South of Rio, where Carboniferous and Devonian or Silurian deposits were discovered, rich in fossils, and the gold regions of this part of the empire and of Minas Geraes were examined by Mr. J. E. Mills.

While this work was in progress in the South, Mr. Derby was arriving at important results on the Amazonas, where he proved the existence of an immense basin of Palæozoic rocks with carboniferous deposits occupying an extensive area in the centre, surrounded by Devonian and Silurian beds rich in fossils. Owing to the dense vegetation of the lowlands of the valley of the Amazonas, they were unable to discover whether these Carboniferous rocks held deposits of coal or not. Immense collections of geological, zoological and ethnological specimens were sent to the capital by the various exploring parties, and it was found necessary to set apart a large house to contain them.

In June 1877, prompted by motives of economy, and unacquainted with the amount and value of the work being done by the Commission, the Government gave orders for the temporary suspension of the Commission on the 1st of July. The Emperor, soon after returning to Rio, fresh from the Museums of the Old World and North America, carefully inspected the building and work of the Commission. He showed a just appreciation of the value of the new Museum of Geology, both to his own country and to the world at large; he was generous in his words of praise to the talented chief, who had so dearly earned them, and declared that the work should go on.

In the beginning of the following year, an entire change was made in the Ministry of Brazil, and before the several departments had been entirely re-organized, and the appropriations determined upon, Professor Hartt died. There was no one to succeed him, and his large collections were placed in the care of the National Museum at Rio de Janeiro. It is expected that steps will be taken by the Brazilian Government at an early date, toward publishing the many reports which were finished under the direction of Prof. Hartt.

It would appear that before the researches of Professor Hartt, the systematic geology of vast areas of Brazil, was an utter blank. The Carboniferous system was known to exist in the South of Brazil, and some Palæozoic fossils had been found on the Tapajos R. in the North of the Empire; the Cretaceous formation had been recognized on the eastern coast, but it remained for Hartt to exhibit the general geologic structure of extensive areas of the Empire, and to recognize wide spread formations of Upper Silurian, Devonian, Carboniferous and Triassic (?) age. He also divided the vast areas of metamorphic rocks in Central Brazil into Eozoic and Lower Silurian by their lithological aspect and other characters.

Nor did he confine his studies to Geology alone, for in addition to voluminous reports on this subject, he had the following works nearly or quite ready for publication

I. Brazilian Antiquities,—about 500 pages, 4 to.

II. Mythology of the Brazilian Indians,—about 300 pages 4 to.

III. Grammar, Dictionary &c. of the Tupé Language, 400 pages.

IV. An Album—of about 100 photographs, illustrating the country, people &c. of the Lower Amazonas. With about 100 pages of text.

Prof. Hartt's scientific career may be said to have covered a decade and a half, and one can only wonder at the marvellous industry which crowded what might well be considered the work of an ordinary life-time into this short period. Only those engaged in his enterprises knew the variety and excellence of his scientific work, or could appreciate the skill with which he directed the operations first of his exploring parties in Brazil, and then of the Geological Survey of that vast region. Judging from his brilliant beginning, we may confidently assert that, had he not been cut off in his prime, he would have accomplished a work that would have placed him beside the greatest of the geological investigators of the present century.

None but the hardiest constitution could stand the great strain which Hartt laid on his physical powers, and under the exhausting heat of a tropical climate he finally succumbed. Having been on an exploring expedition inland, he came out upon the coast at Rio de Janeiro tired and worn out by physical toil and mental anxiety; the latter due to the difficulties in which the Survey had been placed by changes in the administration of the country. Here he was attacked by that formidable scourge of the lowlands of tropical America—yellow fever. His exhausted system could not withstand the disease. His illness was of scarcely more than two days duration, and he suddenly (and unexpectedly to those who were watching him) passed away in the early morning of Monday 18th of March 1878.

Prof. Hartt was a man of winning manners, affectionate disposition and generous nature, and was greatly esteemed by his scientific associates. He was gifted with an original and inventive mind, and indefatigable industry. The Christian training of his early home, and the stimulating influences of the educational institutions where he spent the first years of his life, no doubt served largely to form his character. His death terminated the Geological Survey of Brazil, as no one was thought worthy of taking the mantle which fell from him. His assistants remained to work up the material which he had gathered; but the leading mind which had inaugurated the Survey was gone, and further investigation of the physical structure of Brazil with governmental aid is left to the enterprise of another generation.

Since Professor Hartt's death, two volumes of the Archives of the National Museum of Brazil have been published, which testify to the extent of his labors. The first (No. VI.) contains an account of the Archæology and Ethnology of the tribes of the Amazonas, based on observations made by Prof. Hartt and his assistants on the shell-heaps, the cemeteries and the artificial mounds of that region, and contains descriptions and figures of the articles found in these repositories of the relics of its pre-historic people. It contains also an essay on the origin of art, and the evolution of ornamentation as exhibited by their pottery &c.; as well as an account of certain tribes of the region and their mythology.

In the remainder of the volume the result of Prof. Hartt's work stands out on many a page, especially in the very interesting memoir by Dr. Ladislaus Netto on the Archæology of Brazil. The material collected under Prof. Hartt's direction at the island of Marajó and at Maracá, are largely used by Dr. Netto in illustrating his memoir.

The succeeding volume of the Annals of the Museum (No. VII.) is devoted to a description of the Cretaceous Mollusca of Brazil by Dr. C. A. White of the geological survey of the United States. This voluminous memoir, published in Portuguese and English, is also based on the material collected under Prof. Hartt, when in charge of the geological survey of Brazil.

Several years after his death, the remains of this devoted man were removed from Brazil to Buffalo, N. Y., the home of his widow, where they now lie in a cemetry on the shore of Lake Erie.

Since his death, a tablet to his memory has been placed in the library of Acadia College (his "alma mater"). This tablet was set up by his classmates in commemoration of his great services to Science. On the unveiling of the monument, June 1884, one of their number, Dr. Silas Alward, paid a high tribute to the character and worth of their deceased companion in an oration before the faculty and friends of the college.

The following is a list of the scientific writings of Professor C. F. Hartt as far as known to me:—

1. The Gold of Nova Scotia of Pre-Carboniferous Age. Canadian Naturalist, 1, No. 6, 459–461, 1864.

2. Observations on the Geology of Southern New Brunswick, made principally during the Summer of 1864, by Prof. L. W. Bailey and Messrs. George F. Mathew and C. F. Hartt; prepared and arranged, with a Geological Map, by L. W. Bailey, A.M. Contains the three following reports by C. F. Hartt:—

(a) Preliminary Notice of a Fauna of the Primordial Period in the vicinity of St. John, N. B., pp. 30–31. (Published also in Can. Nat., VII, 318-320 1865; and in Dawson's "Acadian Geology," 2nd Ed., 1868, 641–643.)

(b) On the Devonian Plant Locality of the "Fern Ledges," Lancaster, New Brunswick, with a detailed Section, and Notes on the Fossils, 131–141. (Includes report of S. H. Scudder on the Devonian insects. An abstract was published in "Acadian Geology," 1868, 513–523.)

(c) List of New Brunswick Fossils, 143–147.

3. The recent Bird-Tracks of the Basin of Minas. American Naturalist, I, 169.176, 234.243, 1867.

4. On a Sub-division of the Acadian Carboniferous Limestones, with a desciption of a section across these Rocks at Windsor, N. S. Can. Nat., III, 212–224, 1867. (A summary of the results recorded in this paper are given in "Acadian Geology," 1868, 279–280.)

5. [Descriptions and Notices of the Trilobites and other fossils of the Acadian Group, at St. John, N. B.] "Acadian Geology," 1868, 643–657, with many figures. (Prepared by Dr. Dawson from the MS. notes of Prof. Hartt.)

6. Résumé of a Lecture on the "Growth of the South American Continent," delivered before the Library Association, Ithaca, N. Y., Dec. 4. 1868. Cornell Era, Dec. 12, 1868. (Pamphlet reprint contains 8 pages.)

7. A Vacation Trip to Brazil. Amer. Nat., I, 642–651, 1868.

8. A Naturalist in Brazil. Amer. Nat., II, 1–13, with illustrations, 1868.

9. The cruise of the "Abrolhos." Amer. Nat., II, 85–73, with illustrations, 1868.

10. On the Botocudos of Brazil, (abstract). Proceed. Amer. Ass. Adv. Sci., 18th meeting, Salem, 1869, 273–274.

11. Thayer Expedition.—Scientific Results of a Journey in Brazil, by Louis Agassiz and his Travelling Companions.—Geology and Physical Geography of Brazil, by Charles Fred. Hartt, with illustrations and maps, 8°, pp. 620. Boston, Fields, Osgood & Co., 1870.

12. Discovery of Lower Carboniferous Fossils on the Rio Tapajos, (A letter written near Monte Alegre, Rio Amazonas, Oct. 5, 1870.) Amer. Nat. IV, 694–695, 1871.

13. Devonian Rocks in the Amazonian Valley. Amer. Nat., V. 121–122, 1871.

14. Amazonian Drift. Amer. Jour. Sci. and Arts, I, April 1871, 294–296.

15. Braz. Rock Inscriptions. Amer. Nat., V, 139–147, with 9 plates, 1871.

16. The Ancient Indian Pottery of Marajó, Brazil. Amer. Nat. V, 259–271, with numerous figures, 1871.

17. Recent Explorations in the Valley of the Amazonas, with Map. Jour. Amer. Geogr. Soc., N. Y., III, 1872, 231–252, (read May 16, 1871).

18. [The Origin of the Basin of the Amazonas (abstract).] Proc. Boston Soc. Nat. Hist., XV, 153–154, 1872.

19. On the Tertiary Basin of the Marañon. Amer. Jour. Sci. and Arts, IV, July, 1872, 53–58.

20. On the Occurrence of Face-Urns in Brazil. Amer. Nat. VI, 607–610, with one large figure, 1872.

21. Notes on the Lingoa Geral or Modern Tupí of the Amazonas. Tráns. Amer. Philog. Ass., 1872, pp. 20.

22. O Mytho do Curupira. Aurora Brazileira, Ithaca, N. Y., Oct. and Nov. 1873. (Also separate reprint, pp. 12.)

23. Morgan Expeditions 1870–71.—Contributions to the Geology and Physical Geography of the Lower Amazonas. The Ereré-Monte-Alegre District and the Table-Topped Hills. Bull. Buffalo Soc. Nat. Sci., I, No. 4, 201–235, with maps and sketches. 1874.

24. Preliminary Reports of the Morgan Expeditions, 1870–71.—Report of a Reconnoissance of the Lower Tapajos. Bull. Cornell University Society (Science), No. 1, pp. 37, with map, 1874.

25. Evolution in Ornament. Popular Science Monthly, January, 1875, 266–275, with many figures.

26. Morgan Expeditions, 1870–71.—On the Devonian Trilobites and Molusks of Ereré, Province of Pará, Brazil; by Ch. Fred. Hartt, and Richard Rathbun. Ann. Lyc. Nat. Hist., N. Y., XI, 110–127, May, 1875.

27. The Indian Cemetery of the Gruta das Mumias, Southern Minas Geraes, Brazil. Amer. Nat., IX, 205–217 (illustrated), 1875.

28. Amazonian Tortoise Myths. Rio de Janeiro, Wm. Scully. Publisher. 1875, pp. 40.

29. Notes on the Manufacture of Pottery among Savage Races. Published at the office of the "South American Mail," Rio de Janeiro, 1875, pp. 70.

30. Exploraçoes Scientificas,—I. Commissão Geologica do Brazil. Catalogo da Exposição de Obras Publicas do Ministerio da Agricultura, Rio de Janeiro, 1876, 96–106.

31. Nota sobre Algumas Tangas de Barro Cosido dos Antigos Indigenas da Ilha de Marajó. Archivos do Museu Nacional do Rio de Janeiro, I. Trimestre I°, 21–25, Estampas III, IV & V, 1876.

32. Descripçao dos Objectos de Pedra de Origem Indigena Conservados no Museu Nacional. Arch. do Mus. Nac. do Rio de Janeiro, I, Trim. 2° & 3°, 45–53, Estampas VII & VIII, & 2 figuras, 1876.

33. The Geological Survey of Brazil. First Preliminary Report made to the Counselor Thomaz José Coelho de Almeida, Minister and Secretary of State for Agriculture, etc.; by Ch. Fred. Hartt, Chief of the Geological Commission of the Empire of Brazil, Rio de Janeiro, 1876. Translated and abridged by Prof. T. B. Comstock. Amer. Jour. Sc. and Arts, XI, June, 1877, 466–473.

(Posthumous).

34. Contribuições para a ethnologia do valle do Amazonas, par C. F. Hartt. In Archivos do Museu Nacional do Rio de Janeiro, Vol. VI, 1885.

Book Notices.

Fern Flora.[1]—This little book, issued as an appendix to the School Fern-Flora of Canada, is a useful contribution to Canadian Botany. The first seven pages are devoted to the structural characters of ferns, and taxonomic considerations. The remainder is occupied by a description of the various genera and species, together with an account of their geographical range, and special localities for the rarer species. The descriptions are clear and direct. The principal genera are illustrated by a plate of well-executed figures. The book is of a convenient size to be used in the field, but its usefulness for the ordinary student would be enhanced, had an analytical key been provided.—D. P. P.

[1] The Fern Flora of Canada; descriptions of all the native ferns of the Dominion, with the localities where they grow. By George Lawson, Ph. D., &c. Halifax, A. & N. MacKinlay, 1889, (pp. 29.)

Proceedings of the Society.

The regular monthly meeting was held on Monday evening, January 27th, Sir Wm. Dawson presiding.

The minutes of the previous meeting having been read and confirmed, Dr. Harrington reported that the Lecture Committee had arranged for the usual Sommerville course of seven lectures upon Food Supply and Food Adulterations.

The Curator reported the following donations:—

Chinese New Testament, Mr. C. Griffen.

Quartz Crystals from Mount Stephen, Mr. A. B. Chaffee, jr.

Olive-sided Fly Catcher and Black Crowned Night Heron, Mr. F. B. Caulfield.

Various papers relating to the Society, Mr. J. Ostell.

A New York newspaper under date of 1800, giving an account of the death of General Washington; also a portion of log, supposed to be Norway spruce, from an excavation on Commissioners street, on or near the site of Maisonneuve's fort, and supposed to have formed part of the same, Mr. F. W. Henshaw.

Some discussion followed respecting the last donation and its relation to the fort, and Messrs. J. A. U. Beaudry, J. S. Brown, Prof. Penhallow and J. McLachlan were appointed a committee to collect all available evidence bearing upon the character of the specimen, and present the same at a future meeting of the Society.

The balloting for new members resulted in the election of Messrs. E. P. Hannaford, G. H. McHenry, Thos. E. Hodgson, Edwd. H. Hamilton and M. H. Hersey.

The Curator drew the attention of the Society to the need of putting the Museum in a more attractive shape, and suggested that a sub-division into departments, each under an assistant curator, would greatly promote the usefulness of the collections.

The following papers were then presented and ordered to be printed in the Record of Science:—

"Fossil fish from the Pleistocene of Green's Creek, Ottawa," Sir Wm. Dawson.

"Mineralogical notes on some Canadian Minerals from new Localities," Dr. B. J. Harrington.

"Notes on the flora of Cap à L'Aigle, Quebec," Rev. Dr. Campbell.

After the usual vote of thanks to the authors of papers, the meeting adjourned.

The regular monthly meeting was held on Monday, February 24th, Sir Wm. Dawson in the chair.

The Curator suggested the adoption of a by-law providing for the acceptance of specimens and the disposal of duplicate material. He also announced the following donations:—

Head of Maskinonge, Mr. C. E. Dawson.
Blue Heron, Hon. Edward Murphy.
Evening Grosbeak, Mr. F. B. Caulfield.

The thanks of the Society were tendered to the donors.

The following papers were read and accepted for publication in the Record of Science:—

"Helderberg Fossils from St. Helen's Island," by W. E. Deeks, B.A.

"Notes on Asbestus and Some Associated Minerals," by Prof. J. P. Donald.

"Notes on a Bird New to the Province of Quebec," Mr. F. B. Caulfield.

After the usual discussions, the thanks of the Society were tendered to the authors for their valuable contributions.

Sir Wm. Dawson introduced Mr. J. Stevenson, who presented some statements bearing upon the past and present distribution of eider ducks in the Gulf of St. Lawrence. He showed that under the present system of egg gathering, the birds had greatly diminished in numbers of late years, and there was great danger of ultimate extermination. He urged the desirability of having the Government take some steps looking to the protection of the birds, and to the encouragement of the settlers along the shores of the Gulf, to engage in the industry of gathering their feathers. He made an earnest plea for the better protection of the birds against wanton destruction, and asked if the Society felt disposed to use its influence in the matter. After some discussion the following committee was appointed to take the matter into consideration and co-operate with Mr. Stevenson:—Messrs. J. A. U. Beaudry, J. S. Brown, Dr. Wesley Mills, F. B. Caulfield, J. S. Shearer and Alex. Henderson.

The ballot for new members resulted in the election of Messrs. A. P. Winn and W. A. Scott.

890.

Me t. C. H. McLEOD, *Superintendent.*

DAY.	ED S. Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	o	00	0.28	....	0.28	1
2	o	00	0.17	....	0.17	2
3	o	93	....	...	....	3
4	o	00	....	0.2	0.02	4
SUNDAY........ 5	.	00	....	6.6	0.77	5 ....SUNDAY
6	9	00	0.41	Inapp.	0.41	6
7	o	87	....	Inapp.	0.00	7
8	I	00	....	2.3	0.11	8
9	o	95	....	....	....	9
10	o	12	....	Inapp.	0.00	10
11	o	00	....	6.4	0.82	11
SUNDAY........12	.	00	....	0 2	0.02	12 ....SUNDAY
13	o	11	0.55	....	0.55	13
14	o	100	....	....	....	14
15	o	00	0.04	2.5	0.25	15
16	c	00	....	6.7	0.39	16
17	o	81	....	0.3	0.01	17
18	o	64	....	0.3	0.02	18
SUNDAY........19	.	00	....	....	....	19 ....SUNDAY
20	9	00	0.18	1.0	0.28	20
21	o	97	....	2.0	0.07	21
22	o	87	....	Inapp.	0.00	22
23	o	00	....	1.5	0.09	23
24	o	91	....	Inapp.	0.00	24
25	o	00	....	1.0	0.10	25
SUNDAY........26	.	84	....	....	....	26 ....SUNDAY
27	o	54	....	0.1	0.01	27
28	o	43	....	0.1	0.01	28
29	o	42	....	....	....	29
30	o	00	....	....	....	30
31	o	07	0.01	0.1	0.02	31
....Means		33.8	1.64	31.3	4.40	Sums ....
16 yrs. means for & including this mo.		¶33.5	0.84	30.3	3.68	16 years means for and including this month

Direction........	
Miles...........	2
Duration in hrs..	
Mean velocity...	1

Greatest mileage i e
Greatest velocity i g
on the 13th. st
Resultant mileage st
Resultant directio st

d barometer was 29.201 on the 13th, giving a range of 1.516 inches. Maximum relative humidity was 100 on 7 days. Minimum relative humidity was 44 on the 28th.

Rain fell on 7 days.

Snow fell on 21 days.

Rain or snow fell on 24 days.

Rain and snow fell on 4 days.

Hoar frost on 2 days.

Lunar halo on one night.

Fog on 3 days.

ABSTRACT FOR THE MONTH OF JANUARY, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range	*BAROMETER. Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	31.70	38.7	16.3	22.4	30.4448	30.679	30.209	.470	.1563	84.8	27.8	S.	21.8	8.3	10	0	00	0.28	....	0.28	1
2	42.82	52.3	36.4	15.9	30 0345	30.207	29.893	.314	.2477	88.5	39.7	S.W.	32.3	6.8	10	0	00	0.17	....	0.17	2
3	22.42	37.0	14.5	22.5	30.5820	30.695	30.394	.301	.0792	63 2	12.3	N. W.	20.0	0.3	6	0	93	....	...	....	3
4	14 48	18.8	8.9	9.9	30.5453	30.679	30.343	.336	.0617	71.3	6.8	W.	10.5	8.3	10	0	00	....	0.2	0.02	4
SUNDAY........ 5	......	22.0	17.6	4.4	....	....	......	....	.....	....	....	N.E.	13.1	....	..	..	00	....	6.6	0.77	5 ....SUNDAY
6	26.22	35.0	19.6	15.4	29.6543	29.828	29.446	.382	.1303	91.3	24.0	E.	9.9	9.8	10	9	00	0.41	Inapp.	0.41	6
7	12.98	29.0	8.0	21.0	30.0228	30.091	29.931	.160	.0608	78.0	7.3	W.	12.4	3.5	10	0	87	....	Inapp.	0.00	7
8	20.90	29.2	13.9	15.3	29.5015	29.833	29.226	.607	.1023	89.0	18.2	S.W.	17.0	8.5	10	1	00	....	2.3	0.11	8
9	−7.57	14.6	−13.3	27.9	29.9925	30.138	29.804	.334	.0237	78.2	−12.8	W.	22.3	2.3	10	0	95	....	....	....	9
10	−15.73	−11.0	−21.6	10.6	30.2417	30.411	30.161	.250	.0205	96.7	−16.0	N.E.	26.3	5.3	10	0	12	....	Inapp.	0.00	10
11	−5.03	7.0	−14.5	21.5	30.2015	30.469	29.922	.547	.0345	96.5	−5.7	N.	24.3	8.3	10	0	00	....	6 4	0.82	11
SUNDAY. 12	. ...	10.5	6.5	4.0	....	......	....	....	.....	....	....	N.E.	14.5	....	..	..	00	....	0 2	0.02	12 ....SUNDAY
13	30.77	50.8	9.0	41.8	29.5617	30.127	29.201	.926	.1413	74.7	23.3	S.W.	40.5	5.5	10	0	11	0.55	....	0.55	13
14	13.98	19.6	7.0	12.6	30.5822	30.678	30.372	.306	.0538	65.3	4.5	S.W.?	19.4	2.8	10	0	100	....	....	....	14
15	20.70	22.5	18.2	4 3	30.1458	30.438	29.903	.530	.1037	93.2	19.0	**N.**	6.1	10.0	10	10	00	0.04	2.5	0.25	15
16	16.15	24.9	−1.5	26 4	29.9030	30.286	29.699	.587	.0907	88.8	13.3	**N.W.**	20 5	7.8	10	c	00	....	6.7	0.39	16
17	−1.12	8.1	−11.5	19.6	30.5000	30.553	30.435	.118	.0328	76.7	−6.8	**W.**	17.6	5.0	10	0	81	....	0.3	0.01	17
18	4.13	8.9	−1.1	10 0	30.4675	30.490	30.439	.051	.0442	85.0	0.5	**N.**	**6.5**	6.3	10	0	64	....	0.3	0.02	18
SUNDAY.. 19	.....	14.1	−4.9	19.0	...	......	......	....	.....	....	....	**N.**	**11.8**	....	..	.	00	....	....	....	19 ....SUNDAY
20	25.30	38.0	13.8	24.2	29.6297	30.010	29.356	.654	.1150	84 8	21.2	**N.**	**33.0**	9 8	10	9	00	0.18	1.0	0.28	20
21	15.23	24.3	9.4	14 9	29.8850	29.962	29 750	.212	.0670	76.8	9.3	**W.**	25 9	5.3	10	0	97	....	2.0	0.07	21
22	5.80	16.0	1.0	15.0	30 3747	30.628	29.954	.674	.0365	64 8	−4.2	**N.W.**	24.9	1.3	9	0	87	....	Inapp.	0.00	22
23	2 30	6.8	−2.0	8.8	30 3090	30.620	30.012	.608	.0380	79.5	−3.0	**N.W.**	11.3	8.3	10	0	00	....	1.5	0.09	23
24	7.30	11.1	1.0	10.1	30.2268	30.324	30.069	.255	.0457	75.5	1.0	W.	16.4	1.7	10	0	91	....	Inapp.	0.00	24
25	22.87	33.0	5.0	28.0	29.7867	30.165	29.605	.560	.1060	81.7	18.0	S.	23.9	8.3	10	0	00	....	1.0	0.10	25
SUNDAY.. 26	.....	33.0	23.8	9.2	....	......	......	....	.....	...	....	S.W.	15.9	....	..	.	84	....	....	....	26 ....SUNDAY
27	14.22	24.0	8.7	15.3	30.1415	30.411	29.904	.507	.0582	69.0	6.0	N.E.	17.6	6.8	10	0	54	....	0.1	0.01	27
28	3.65	11.9	−4.4	16.3	30.5852	30.717	30.389	.328	.0348	66.2	−5.5	S.W.	17.4	6.7	10	0	43	....	0.1	0.01	28
29	31.30	38.0	11.5	26.5	30.0913	30.215	29.956	259	.1272	73.0	23.5	S.W.	27.0	9.8	10	6	42	....	....	....	29
30	13.43	29.9	9.9	20.0	30 3357	30.388	30 257	.131	.0602	74.8	6.8	N E.	21.8	10.0	10	10	00	....	....	....	30
31	32.02	38.5	13.9	24 6	30.0303	30.286	29.885	401	.1523	81.0	26.8	S.E.	24.8	7.5	10	0	07	0.01	0.1	0.02	31
....Means	14.86	23.76	6 42	17.34	30.1399	......	......	400	.0824	79.6	9.5	....	....	6.46	..	..	33.8	1.64	31.3	4 40	Sums ....
16 yrs. means for & including this mo.	11.79	20.42	3.53	16.88	30.0659	......	.....	.343	.0724	80.7	....	....	....	6.35	..	..	¶33.5	0.84	30.3	3.68	16 years means for and including this month

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles............	2473	1698	288	313	1757	2679	3144	2205	—
Duration in hrs..	170	89	26	13	78	119	149	93	1
Mean velocity...	14.5	19.1	11.1	24.1	22 5	22.5	21.1	23.7	

Greatest mileage in one hour was 67 on the 13th.
Greatest velocity in gusts 104 miles per hour on on the 13th.
Resultant mileage, 5,070
Resultant direction, N. 75° W.

Total mileage, 14,557.

NOTE.—The wind directions and velocities in heavy faced type are from the City Hall record. The mileage has been multiplied by 1.5 to reduce it to the Mountain Anemometer.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 52.3 on the 2nd; the greatest cold was 21.6 below zero on the 10th, giving a range of temperature of 73.9 degrees. Warmest day was the 2nd. Coldest day was the 10th. Highest barometer reading was 30.717 on the 28th; lowest barometer was 29.201 on the 13th, giving a range of 1.516 inches. Maximum relative humidity was 100 on 7 days. Minimum relative humidity was 44 on the 28th.

Rain fell on 7 days.
Snow fell on 21 days.
Rain or snow fell on 24 days.
Rain and snow fell on 4 days.
Hoar frost on 2 days.
Lunar halo on one night.
Fog on 3 days.

390.

Meteora C. H. McLEOD, *Superintendent.*

DAY.	Mean	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	15.9	96	....	....	....	1
SUNDAY........ 2	. . .	46	....	....	....	2 ....SUNDAY
3	33.9	00	0 12	.. .	0.12	3
4	16.4	33	0.28	0.3	0.31	4
5	27.9	53	0.21	....	0.21	5
6	5 0	100	....	...	....	6
7	10.6	57	....	1.7	0.09	7
8	35.2	00	....	9.5	0.50	8
SUNDAY. 9	..	99	....	....	....	9 ....SUNDAY
10	—2.0	91	....	....	....	10
11	3.1	80	....	....	...	11
12	24.5	51	....	2.0	0 10	12
13	32.8	50	...	....	....	13
14	34.7	00	1.08	....	1.08	14
15	19.5	76	0.20	....	0.20	15
SUNDAY.. 16	....	71	....	1.6	0.05	16 ....SUNDAY
17	6.8	41	....	1.0	0 10	17
18	8 9	00	....	4.3	0.42	18
19	10.0	90	....	0.3	0.02	19
20	13.1	00	....	5.3	0.23	20
21	—3.1	61	....	....	....	21
22	0.8	100	....	Inapp.	0.00	22
SUNDAY.. 23	....	47	....	1.0	0.03	23 ....SUNDAY
24	33.1	14	Inapp.	0.4	0.03	24
25	34.5	00	0.11	....	0.11	25
26	34.9	00	0.06	....	0.06	26
27	33.4	00	0 01	....	0.01	27
28	37.2	00	0.78	....	0 78	28
............Means.	19.(	44.9	2.85	27.4	4.45	Sums ....
16 yrs. means for & including this mo.	15.4	¶41.7	0.90	22.6	3 07	16 years means for and including this month

A

Direction........	N.
Miles...........	453
Duration in hrs..	22
Mean velocity...	20.6

Greatest mileage in o
Greatest velocity in g
12 miles on the 5th.
Resultant mileage, 4,

on 5 days. Minimum relative humidity was 42 on the 1st.

Rain fell on 10 days.

Snow fell on 12 days.

Rain or snow fell on 20 days.

Rain and snow fell on 2 days.

Hoar frost on 2 days.

Fogs on 7 days.

Parhelic arcs on the 11th.

The rainfall of this month (2.85 inches) is the greatest for February in 16 years, the next highest being 2.18 in 1884.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range	*BAROMETER. Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	15.93	36 2	7 6	28.6	20.4885	30.676	30.087	.589	0598	60.2	4.2	S.W.	21.9	0 7	2	0	96	....	....	....	1
SUNDAY........ 2	...	32 0	—6.0	38.0	...	..	......	....	..	....	....	S.E.	17.0	....	.	..	46	....	....	....	2 ....SUNDAY
3	33.98	39.0	23 0	16.0	29.9530	30.220	29 831	.389	.1785	88.3	31.0	S.W.	28.3	8.3	10	0	00	0 12	...	0.12	3
4	16.43	34 5	8.8	25.7	29 9848	30.345	29 315	1.030	.0775	75 3	10.0	N.E.	14.8	6.7	10	0	33	0.28	0.3	0.31	4
5	27.95	45.0	10 0	35.0	29.5477	30.081	29.092	.989	.1377	75.5	21 3	W.	35.8	4.8	10	0	53	0.21	....	0.21	5
6	5 03	11.0	0 0	11.0	30.3887	30.567	30.205	.362	.0358	66.3	—4 3	W.	10.7	0.0	0	0	100	....	...	....	6
7	10.62	19.8	1.5	18.3	30.5090	30 683	30 142	.541	.0572	78.2	4.8	E.	9.1	6.7	10	0	57	....	1.7	0.09	7
8	35.23	30.0	18.7	11.3	29 7170	29 854	29.599	.255	.1237	90.5	23.0	S.	16.3	9.8	10	3	00	....	9.5	0.50	8
SUNDAY. 9	. .	24.5	0 0	24.5	....	......	......	. .	... .	....	....	W.	13.0	....	..	..	99	....	....	....	9 ....SUNDAY
10	—2.03	2 3	—7 0	9.3	30 6583	30.702	30.603	.099	.0305	78.2	—7.5	N.E.	10.5	1.8	10	0	91	....	....	....	10
11	3.18	10.4	—6 4	16.8	30.4357	30.614	30.136	478	.0412	82.0	—1.7	E.	5.3	4.7	10	0	80	....	....	...	11
12	24.57	30.1	6 9	23.2	29.8862	30.011	29 747	.264	.1113	81.2	19.5	S.W.	27.6	7.0	10	c	51	....	2 0	0 10	12
13	32.80	36.9	25 8	11.1	29.9638	30.045	29.896	.149	.1247	67.7	23.2	S.W.	27 8	6.8	10	0	50	...	....	....	13
14	34.75	39.9	26 8	13.1	29 6350	29.883	29.207	.676	.1695	82.3	29.5	S.	14.7	8.3	10	c	00	1.08	....	1.08	14
15	19.55	39 2	5.5	33.7	29.8002	30 180	29.277	903	.0873	68.7	11.2	W.	35.6	2.8	10	c	76	0.20	....	0.20	15
SUNDAY.. ...16	.....	13.2	—2.0	15.2	. ...	......	......	....	. .	...	....	S.W.	19.9	....	..	..	71	....	1.6	0.05	16 ....SUNDAY
17	6.81	14 2	2.7	11.5	30.2070	30.332	30.051	.281	.0452	76.2	0.7	N.E.	19.4	7.0	10	c	41	....	1.0	0 10	17
18	8 92	11 0	7.0	4.0	29.8520	29.932	29.750	.182	.0587	91.0	6.7	N.E.	29 8	10.0	10	10	00	....	4.3	0.42	18
19	10.02	12.8	7.0	5.8	30.1517	30 284	29 922	.362	.0520	76.3	3.8	N. W.	7.3	3.7	10	0	90	....	0.3	0.02	19
20	13.13	26.7	—0.5	27.2	29 5957	29.835	29.299	.536	.0733	85.8	9.7	W.	27.8	8.0	10	0	00	....	5.3	0.23	20
21	—3.12	3 0	—9.1	12.1	29.9742	30.017	29 913	.104	0272	73.0	—10 2	W.	33.1	3.5	10	0	61	....	....	....	21
22	0.80	6.8	—8.0	14.8	30.0602	30.123	39.976	.146	.0300	66.8	—8.5	S.W.	21.7	1.7	10	0	100	....	Inapp.	0.00	22
SUNDAY. 23	....	27.6	3.0	24.6	....	......	....	....	.....	..	....	S.	11.5	...	..	..	47	....	1.0	0.03	23 ....SUNDAY
24	33.15	40.2	13.9	26.3	29 8807	29.944	29.799	.145	.1655	86.3	29.5	S.	12.4	10.0	10	10	14	Inapp.	0.4	0.03	24
25	34.52	38.0	33.2	4.8	29.9060	29.985	29.793	.192	.1960	98.0	33.8	E.	10.4	10 0	10	10	00	0.11	....	0.11	25
26	34.93	37.0	32.7	4.3	29.8643	30.139	29 715	.424	.1968	96.8	34.0	S.W.	7.5	10.0	10	10	00	0.06	....	0.06	26
27	33.48	35.0	31.3	3.7	30.1620	30.226	30.096	.130	.1798	93.8	32.2	E.	8.3	10 0	10	10	00	0 01	....	0.01	27
28	37.20	39 0	34.2	4.8	29 8195	30.044	29.672	.372	.2005	90.3	34.5	S.E.	23.1	10.0	10	10	00	0.78	....	0 78	28
....Means.	19 08	26.26	9 31	16.95	30.0184	......	.....	.400	.1025	80 4	13 8	....	....	6.35	..	..	44.9	2.85	27.4	4.45	Sums ....
16 yrs. means for & including this mo.	15.48	23.95	6.79	17.16	30.0414	......	......	.323	.0821	78.6	....	... .	....	5.84	..	..	¶41.7	0.90	22.6	3 07	16 years means for and including this month

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N. W.	Calm.
Miles............	453	1492	823	1192	1322	3217	3734	288	—
Duration in hrs..	22	92	69	74	78	146	144	20	27
Mean velocity...	20.6	16.2	11.9	16.1	17 0	22.0	25.9	14.4	

Greatest mileage in one hour was 60 on the 5th. Greatest velocity in gusts 72 miles per hour for 12 miles on the 5th.
Resultant mileage, 4,435

Resultant direction, S. 52° W.
Total mileage, 12,521.
Average mileage per hour 18.63.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 45 0 on the 5th; the greatest cold was 9.1 below zero on the 21st, giving a range of temperature of 54.1 degrees. Warmest day was the 28th. Coldest day was the 21st. Highest barometer reading was 30.702 on the 10th; lowest barometer was 29.092 on the 5th, giving a range of 1.610 inches. Maximum relative humidity was 100 on 5 days. Minimum relative humidity was 42 on the 1st.

Rain fell on 10 days.

Snow fell on 12 days.

Rain or snow fell on 20 days.

Rain and snow fell on 2 days.

Hoar frost on 2 days.

Fogs on 7 days.

Parhelic arcs on the 11th.

The rainfall of this month (2.85 inches) is the greatest for February in 16 years, the next highest being 2.18 in 1884.

890.

Me C. H. McLEOD, *Superintendent.*

DAY.	[DED] THS. Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	0	23	....	...	....	1
SUNDAY........ :	.	97	....	....	...	2 ....SUNDAY
:	0	95	....	....	....	3
4	0	64	....	.	....	4
5	0	84		Inapp.	0 00	5
6	0	18	...		....	6
7	0	99	....	....	....	7
8	0	98	....	....	...	8
SUNDAY. .... · 9	.	100	....	....	....	9 ... . SUNDAY
1(	0	85			...	10
1:	10	00	0 07	.	0 07	11
1:	10	00	0 20	....	0.20	12
1:	10	00	0.03		0 03	13
1	2	23			....	14
1!	0	17	....	Inapp.	0.00	15
SUNDAY.... ...1(	..	40	..	Inapp.	0.00	16 ....SUNDAY
1	0	51	....	....	....	17
1	0	83	....	0.1	0 00	18
1(	0	57	...		....	19
2(	0	52	..	Inapp.	0.00	20
2	0	03	0.17	0.2	0.21	21
2	0	00	....	....	....	22
SUNDAY....... 2	..	51	....	....	....	23 .... SUNDAY
2	0	85	..	...		24
2	10	00	...	0.7	0.07	25
2(	4	31	0.01	0 4	0.06	26
2	0	62	......	Inapp.	0.00	27
2	0	00	....	4.5	0 45	28
2(	10	00	....	4.0	0.33	29
SUNDAY....... 3(	..	29	....	1.8	0 11	30 ....SUNDAY
3	0	75	....	....	....	31
....Mean	.	45.9	0.48	11 7	1 53	Sums . ...
16 yrs. means for including this m	..	¶45.5	0.86	25.6	3 41	16 years means for a... including this month

Direction.......	
Miles..........	
Duration in hrs.	
Mean velocity..	

and on the 12th. Minimum relative humidity was 35 on the 9th.

; the ...ving ...mest ...hest ...west ...ge of ...s 100

Greatest milea...
Greatest veloc...
the 29th.
Resultant mil...

Rain fell on 5 days.
Snow fell on 12 days.
Rain or snow fell on 15 days.
Auroras were observed on 4 nights.
Hoar frost on 5 days.
Lunar halo on 4 nights.
Lunar corona on one night.
Fogs on 1 days.

ABSTRACT FOR THE MONTH OF MARCH, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range	*BAROMETER. Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY
1	25.05	40 8	7.0	33.8	29.8788	30.089	29.751	.338	1100	73.0	17.8	S.W.	31.5	5.5	10	0	23	...	...	..	1
SUNDAY........ 2	...	14 1	2.0	12.1	.		.....	....	.	....	....	N. W.	8.5	...	.	.	97	.	....	...	2 ....SUNDAY
3	12.22	20.0	4 0	16.0	30 0885	30 137	30 013	.124	.0412	54.3	—1.2	S.W.	19 5	2.0	8	0	95	....	....	.	3
4	23.93	31 8	10.9	20 9	30 0280	30.159	29 854	.305	.0795	61 3	12.5	S.E.	14.2	6 8	10	0	64	...	.	...	4
5	16.05	31.2	8 7	22.5	30 1093	30 243	29.918	.325	.0643	68.3	7 2	S.W.	20.0	4.7	10	0	84	.	Inapp.	0 00	5
6	2.78	9.9	—1 0	10.9	30.3550	30.410	30.299	.111	.0272	55.0	—10.2	W.	9.0	6.0	10	0	18	.		...	6
7	6.60	16.0	—4 0	20.0	30.3387	30 412	30 280	132	.0368	59.5	— 4.5	S.W.	22.0	0.0	0	0	99	....	....	....	7
8	17 98	26.9	7.8	19 1	30 3498	30 432	30 307	.125	.0658	65.3	8.7	W.	19.4	0.2	1	0	98	....	...	...	8
SUNDAY. ... 9	. .	28.0	12 9	15 1	..... .	.....	.....		.	....	....	S.W.	11.5		.	.	100	....	....	....	9 .... SUNDAY
10	28.12	37.0	14 1	22.9	30 3288	30 424	30 246	178	0990	63.8	17.7	S.W.	5.9	3 2	10	0	85			...	10
11	35.67	40.6	29 0	11.6	30.1168	30.271	29.952	319	.1672	79.3	29 8	S.E.	12.4	10.0	10	10	00	0 07		0 07	11
12	40.12	43.0	36 7	6.3	29 9875	30 045	29 952	.093	.2437	97.8	39.3	S.W.	10.0	10.0	10	10	00	0 20	....	0.20	12
13	36.90	41.0	35 5	5.5	30.1450	30 200	30 078	.122	.2083	.94 7	35.3	S.W.	12 4	10.0	10	10	00	0.03		0 03	13
14	35.48	40.2	32 7	7.5	30 0762	30 191	29.931	.260	.1840	89 2	32 7	S.	9.0	9 7	10	2	23			...	14
15	30.92	34 9	27 8	7.1	29.8168	29 913	29.680	233	.1098	62 3	19.5	S. W	11.8	8.0	10	0	17	...	Inapp.	0 00	15
SUNDAY.. .. 16	...	28.0	15.9	12.1	. ...	...	......		.	....		S.W	24.0	...		.	40		Inapp.	0.00	16 ....SUNDAY
17	23.33	32.4	10.9	21.5	29.4110	29 519	29.329	190	.0860	66.0	13.8	S.W.	32.7	4.8	10	0	51	....	...	....	17
18	25 90	30 7	19.7	11.0	29 6112	29 831	29 434	397	.0895	62 7	15 0	W.	19.8	2.2	10	0	83	....	0 1	0 00	18
19	19.48	25.0	12.9	12.1	29 8317	29 899	29 777	122	.0643	60.8	8 2	N E.	7.9	5 0	10	0	57			....	19
20	31.65	39.1	18.8	20 3	29 8253	29.884	29.759	.125	.1310	73.5	23.8	S.W	16.9	6.5	10	0	52	.	Inapp.	0.00	20
21	37.62	42.9	32 5	10 4	29.5202	29.683	29 359	324	.1905	84.3	33.2	S.	22.7	8.3	10	0	03	0 17	0.2	0.21	21
22	35.98	40.4	33.6	6.8	28.7815	29 841	29.729	112	.1518	72.2	27 7	S.W.	11.8	8 3	10	0	00	....	....	.	22
SUNDAY.. .. 23	....	34 7	19.5	15.2	....	.. .	.....	.	.....	....	...	N.W.	18.9	...	..	..	51	...	...	....	23 .. SUNDAY
24	23.32	28 9	16.9	12.0	30 4257	30.505	30.288	.217	.0762	60.7	12.3	W.	18.3	1.8	9	0	85		..		24
25	30.32	36.2	21.8	14.4	30.1835	30.496	29.843	.653	.1252	73.2	22.7	S.E.	16.3	10 0	10	10	00	.	0.7	0.07	25
26	36.15	41.1	33.5	7.6	29.5733	29.711	29 509	.202	.1830	85.8	32.2	S W	23 7	10.0	10	4	31	0 01	0 4	0.06	26
27	33.13	37.9	27.6	10 3	29.7692	29 971	29.553	418	.1307	69.3	23.8	S.W.	28.6	6 8	10	0	62	......	Inapp.	0.00	27
28	24.65	28.8	21 9	6 9	29 7177	29.975	29 482	.493	.1093	82 3	20 0	N.E.	25.2	8.3	10	0	00	....	4.5	0 45	28
29	29.17	33.0	25.8	7.2	29.6178	29.775	29.475	.300	.1445	89.7	26 7	N.	23 5	10 0	10	10	00	....	4.0	0.33	29
SUNDAY....... 30	.....	33.0	25 8	7.2	.. ..	......	.....		....	....	....	N.	7.3		..	..	29	....	1.8	0 11	30 ....SUNDAY
31	26.87	33.9	16 4	17.5	30.2370	30.301	30 194	.107	0930	65.0	16 3	S.W.	9.5	5.3	10	0	75	....	...	....	31
....Means	26.51	32.30	18.63	13.67	29.9663	......	...	.243	.1158	71 9	18 5	.....	16.94	6.28	.		45.9	0.48	11 7	1 53	Sums . ...
16 yrs. means for & including this mo.	23.87	31.14	16.17	14.97	29 9578	......	......	.265	.1068	75.6		. ...	....	6 17	.	..	¶45.5	0.86	25 6	3 41	16 years means for and including this month

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
Miles............	854	913	78	1015	659	6497	1756	829	—
Duration in hrs..	66	45	8	65	56	311	107	66	20
Mean velocity...	12.9	20.3	9.7	15 6	11.8	20.9	16.4	12.6	

Greatest mileage in one hour was 46 on the 1st. Greatest velocity in gusts 48 miles per hour on the 29th.
Resultant mileage, 6,735

Resultant direction, S. 55° W.
Total mileage, 12,601.
Average mileage per hour 16.94.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100

¶ Nine years only.

The greatest heat was 43.0 on the 12th; the greatest cold was 4.0 below zero on the 9th, giving a range of temperature of 47.0 degrees. Warmest day was the 12th. Coldest day was the 6th. Highest barometer reading was 30.561 on the 9th; lowest barometer was 29.329 on the 17th, giving a range of 1.208 inches. Maximum relative humidity was 100 on the 12th. Minimum relative humidity was 35 on the 9th.

Rain fell on 5 days.

Snow fell on 12 days.

Rain or snow fell on 15 days.

Auroras were observed on 4 nights.

Hoar frost on 5 days.

Lunar halo on 4 nights.

Lunar corona on one night.

Fogs on 1 days.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. IV. JULY, 1890. NO. 3.

The Quebec Group of Logan.

By Sir William Dawson, F.R.S.

The discussion of questions of names in Geology is usually unprofitable and often invidious, and is useful only where justice to the claims of original discovery or the right understanding of natural facts is affected by such questions. I have, as a rule, avoided controversies of this kind, and in my geological work, extended over fifty years, I have refrained as far as possible from any reclamations as to my own rights, being disposed rather to allow others to take what I might have regarded as my own, than to make any objection, except where some important truth was endangered. I have, however, been less reticent as to the claims of my friends, and especially of those who have passed away.

In the Presidential address delivered before this Society in 1879, I entered at considerable length into the questions then raised as to the validity and importance of those great and important discoveries of the late Sir William Logan, which led to the establishment of the Quebec Group; and in a later address to the Royal Society of Canada,[1] I took

[1] Presidential address in Section IV. Points on which American Geology is indebted to Canada. 1886.

occasion to return to this subject, and to remark also on the attempts which had been made to depreciate Logan's great work in the Laurentian and Huronian systems. In a still more recent paper on the "Older Rocks of Eastern Canada in comparison with those of Modern Europe,"[1] I have incidentally referred to the same questions, and in the new edition of my "Handbook of Canadian Geology" (1889), have upheld the Laurentian and Huronian and the Quebec Group in all their integrity.

It would seem, however, from some recent discussions, especially on the other side of the international boundary, that there is still need to vindicate, not so much the reputation of our great Canadian geologist as some important facts of Canadian geology connected with his work, and which are not appreciated by some as they deserve.[2] I shall here refer mainly to the reasons which seem to me good and sufficient for retaining the term "Quebec Group" for that peculiar and important development of the lower member of the Siluro-Cambrian, Cambro-Silurian or Ordovician, which is so widely distributed in the eastern part of the Province of Quebec, constituting indeed the dominant feature, as the name itself would import, in the palæozoic geology of this portion of Canada.

The "Quebec Group" of the great Canadian geologist should be understood in the sense in which he proposed it thirty years ago,[3] viz., as designating "*a great development of strata about the horizon of the Chazy and Calciferous,*"

[1] Journal Geological Society of London, Nov. 1888.

[2] American Journal of Science and American Geologist, April, 1890.

[3] The first publication of Logan's name known to me was in 1861; and it is true that before this time Amos Eaton had designated similar rocks as "First Graywacke," and Emmons had called them "Upper Taconic," but there were good reasons why Logan, while frankly admitting the credit due to Emmons for maintaining the true age of these rocks, should not think it expedient to adopt either of the above names, one of which had been discredited by the progress of science, and the other by errors and controversies, the evil effects of which continue even until now.

as these exist further to the west; but to this should be added his expositions in the Geology of Canada, 1863, and in his note appended to Murray's Report on Newfoundland in 1865, in which he explains the peculiar character of the series as a sub-marginal or marginal group, distinct in structure because of its special conditions of deposit from the equivalent formations of the interior plateau. This distinction has been subsequently elaborated and enforced by the writer,[1] and lies at the foundation of any scientific conception of the general geology of Eastern America and Western Europe. Hence one important element in the value of the name as well as of the thing designated.

As Logan's summary of this subject in the Newfoundland Report is comparatively little known, it may be useful to quote a few sentences of it here, bearing in mind that it was written twenty-five years ago, when many of our present geologists were in their school-boy days.

"The sediments, which in the first part of the Silurian period were deposited in the ocean surrounding the Laurentian and Huronian nucleus of the present American continent, appear to have differed considerably in different areas. Oscillations in this ancient land permitted to be spread over its surface, when at times submerged, that series of apparently conformable deposits which constitute the New York system, ranging from the Potsdam to the Hudson River formation. But between the Potsdam and Chazy periods, a sudden continental elevation, and subsequent gradual subsidence, allowed the accumulation of a great series of intermediate deposits, which are displayed in the Green Mountains, on one side of the ancient nucleus, and in the metalliferous rocks of Lake Superior on the other, but which are necessarily absent in the intermediate region of New York and central Canada.

"At an early date in the Silurian period, a great disloca-

[1] The Quebec Group, Canad. Naturalist, 1879. Address to British Association, 1886. Palæozoic Rocks of Eastern America, Journ. Geol. Soc., 1888.

tion commenced along the south-eastern line of the ancient gneissic continent, which gave rise to the division that now forms the western and eastern basins. The western basin includes those strata which extended over the surface of the submerged continent, together with the Pre-chazy rocks of Lake Superior, while the Lower Silurian rocks of the eastern basin present only the Pre-chazy formations, unconformably overlaid in parts by Upper Silurian and Devonian rocks. In the western basin the measures are comparatively flat and undisturbed, while in the eastern they are thrown into innumerable undulations, a vast majority of which present anticlinal forms overturned on the north-western side. The general sinuous north-east and south-west axis of these undulations is parallel with the great dislocation of the St. Lawrence, and the undulations themselves are a part of those belonging to the Apalachian chain of mountains. It is in the western basin that we must look for the more regular succession of the Silurian rocks, from the time of the Chazy, and in the eastern, including Newfoundland, for that of those anterior to it."

The last sentence may, in the light of recent discoveries, be regarded as little less than a prophetic anticipation of the work of Hartt, Matthew, Walcott and others.

It may be asked, however, why, if these rocks are of Chazy-calciferous age, give them a distinct name. The answer is that there is in such cases a real value in local names. They designate the special development of particular groups in distinct localities; and it would be well if geologists, instead of wrangling about these names, would recognize each in its several sphere. Old Red, Devonian, Esfelian and Erian, may all be names for one set of rocks, but they designate entirely distinct developments, and are therefore useful, though it is no doubt more desirable to have uniform names for *systems* of formations than for *series* under these. More especially names of this kind, which distinguish the older rocks of the Atlantic basin from their contemporaries on the submerged continental plateaus, are eminently useful in the present state of science. Let it be borne in mind here, that the sediments which were deposited and the animals which lived in the comparatively cold and deep waters of the Atlantic basin, were always different from those which existed on the submerged portions of the continental plateaus, and that while in some cases, as in the Siluro-Cambrian and Silurian, we know both kinds of deposit and life, in others, as in the lower and middle Cambrian, we know only the oceanic forms, and in others again, as the Devonian and Carboniferous, we are as yet entirely ignorant of these latter conditions. I have not space here to illustrate this significant fact, but may refer to my British Association Address of 1886.

It has been further objected to the name Quebec Group, that it has been used to designate other rocks, both older and newer than those included in it by Logan. As to newer rocks, I can testify that neither Logan nor Billings ever knowingly included any rocks or fossils newer than Chazy in this group ; and in the case of certain beds at Quebec, to which reference has been made, they knew of the existence of these, but supposed them to be there faulted against the Quebec series, or as Hunt has suggested, resting unconformably on it, a view which I have myself been inclined to adopt.

With respect to Cambrian and other rocks, said to be included in the Quebec Group, I can state from my own observations, that fossils older than the Quebec Group are imbedded in large boulders in the lime conglomerates, in such a manner, that unless where the exposures are very good it is difficult to separate them. I have seen such travelled slabs, as much as nine feet in length, full of fossils, and lying flat in the conglomerate. In point of fact, the Quebec Group is in part, as I have on many occasions affirmed, a great palæozoic boulder formation, and in this respect as well as others, very distinct from its equivalents further to the west.

Again, in districts so disturbed as many of those in Eastern Canada, it is inevitable that rocks of different ages must be folded up together, and may be difficult to separate.

We all know how the Silurian in similar disturbed districts was originally made to include the Cambrian, and the latter the rocks since separated as Pebidian, and how Logan's Huronian has been made to include great masses of rock he would not have admitted as members of it. Such mistakes are inevitable, and shou d not invalidate good names.

With reference to the proposal to substitute the term "Levis" for Quebec, all the objections to the latter name would apply to the former. Besides this, the rocks exposed at Levis are known by all who have studied the geology of the Lower St. Lawrence, to be only a part of the Quebec Group. The latter name is also the more appropriate to a series so eminently characteristic of a large portion of the Province of Quebec, and so well exposed and easily studied in the vicinity of that city. It is besides to be observed, that the Quebec Group represents that development of the lower member of the Cambro-Silurian or Ordovician system, which is characteristic of all the Eastern part of Canada, and which connects this best, both as to rocks and fossils, with the development in Western Europe, as for instance, the Arenig and Skiddaw groups of England.

I may say here also, that this is entirely independent of the questions which have been raised as to the relative position of the Sillery sandstone and Levis shales. Admitting with Hunt and Ells, that the Sillery sandstone near Quebec is older than the Levis, this Sillery is only one group of sandstones out of several, which elsewhere underlie and overlie the Levis, and the Levis itself is only one of at least three (possibly four) bands of shale holding different groups of fossils, which belong to the great Calciferous-chazy formation of the Quebec group. This is established by Lapworth's studies of the Graptolites, and I well know the facts, from my own observations in the Lower St. Lawrenee, where I have passed the summer vacations of many years, and have occupied some of my leisure in studying these puzzling deposits; mainly, however, as a lesson in the intricacies of disturbed and originally irregular strata for the benefit of my students.

In this connection it may be proper to adduce even the commonplace consideration of personal convenience in favour of the use of the term Quebec series. In collecting fossils or observing physical phenomena on the Lower St. Lawrence, it may often be impossible to assign a particular band of shale or boulder conglomerate to any special horizon in the chazy or calciferous, yet it can be referred safely to Logan's series. For example, the shale at Metis, containing the remarkable sponges lately described,[1] may be an equivalent of the Levis shale, or a little lower, and may be contemporaneous with Upper Calciferous or Lower Chazy; but all that can be positively affirmed at present is, that it is in the Quebec series.

For such reasons as the above, I have retained the name "Quebec Series," in my recently published handbook, as the name for *the Atlantic type of the lower member of the Ordovician*, and as equivalent to Upper Calciferous and Chazy of the interior region of America. I would commend this view of the matter to other geologists, in connection with the principle stated above, of the utility of local names for local developments of particular series, while the great systems of formations should have general names.

It may be said that the same arguments would necessitate the retention of the Taconic system of Emmons. To this I have not the slightest objection, provided that the same rule be applied to it; namely, that it be taken on Emmons' own definition, and without including rocks or fossils referred by mistake, either by him or by others, to the horizon so defined.

In his American Geology, 1855, Emmons says (part II. p. 6) that in 1836 he had regarded the Potsdam sandstone as "the base of the Silurian system," but that he had since found "the same base resting on sediments still older." These he called the Taconic system, and defines this as a fossiliferous group under the Potsdam, and itself "found to

[1] Trans. Royal Soc. of Canada, 1889.

rest upon primary (that is crystalline) rocks." Thus his Taconic of 1855 is clearly the Middle and Lower Cambrian of modern geologists, and the fossils which he attributes to the Taconic, are in great part of this age. That in the subsequent pages of his book, in tracing the Taconic through the complex structure of the districts in which it occurs, and enumerating its fossils, he mixes other formations with it is most true. But fair critics of Emmons would do well to eliminate these errors, and leave him the credit of his discoveries in those pre-Potsdam rocks, which, though different in age from the Quebec group, are like it, in the main a marginal Atlantic series, not represented in the central plateau.

I do not wish, however, to enter into the "Taconic controversy," or to discuss the utility of now reviving Emmons' name, but merely to mention the points in which it resembles and differs from that of Logan, which belongs to a different series, and to which it has in many respects inferior claims.

I may sum up the matter by quoting a few sentences from one of the papers above referred to:—"The researches of Sir William, with those of Dr. Sterry Hunt and Professor Hall and Mr. Billings, have sufficed to demonstrate—1. The general diversity of mineral character in the Palæozoic sediments on the Atlantic slope as compared with the internal plateau of Canada. In these results Bailey, Matthew and Hartt in New Brunswick, and the writer in Nova Scotia, have also borne some part. 2. The establishment of the Quebec group of rocks as a series equivalent in age to the Calciferous-chazy of America, west of the Apalachian mountains, and to the Arenig and Skiddaw of England, and the elucidation of its special fauna. 3. The tracing out and definition of the peculiar faulted junction of the coastal series with that of the interior plateau, extending from Quebec to Lake Champlain. 4. The definition in connection with the rocks of the Quebec group, by fossils and stratigraphy, of formations extending in age from the Potsdam sandstone to the Upper Silurian, as in contact with this group, in various relations, along its range from the United States frontier to Gaspé; but the complexities in connection with these various points of contact, and the doubts attending the ages of the several formations, have never yet been fully solved in their details. 5. The identification of the members of the Quebec group and associated formations with their geological equivalents in districts where these had assumed different mineral conditions, either from the association of contemporaneous igneous beds and masses, or from subsequent alteration, or both. It is with reference to the results under this head the most difficult of all, that the greater part of the objections to Sir William's views, taken by Hunt, Selwyn and others, have arisen, and that recent discussions and observations have somewhat modified his conclusions."

Into the question of the age or ages of the crystalline rocks identified by Logan with those of the Quebec group, I do not now propose to enter. Facts in my possession with reference to the fossils contained in some of these rocks, cause me to hesitate as to the more pronounced views on the subject. This question is, however, independent of those relating to the position and character of the unaltered fossiliferous sediments, though very interesting in itself.[1]

I had intended to refer here to what can scarcely be characterized as other than a very injudicious attempt of a recent writer in the "American Geologist," to revive Desor's name "Laurencian" for the Pleistocene beds of the St. Lawrence valley, to the exclusion of Logan's name Laurentian for the rocks of the old Laurentide hills. This attempt has, however, been so ably and temperately rebuked by Professor Hitchcock, in the last number of the same journal, that any further argument is quite unnecessary, especially in Canada, where it is probable that no one would countenance such a heresy. Hitchcock says:

"It does not concern us now whether it was judicious for

[1] See a paper by Dr. Sterry Hunt, American Geologist, April, 1890, p. 212.

Logan to suggest a name of (nearly) the same sound (with Desor's) for the fundamental group, but it is clear that he took pains to derive the name from the Laurentide mountains."

"He says (Report of Progress, 1852–53, p. 8) 'it has been considered expedient to apply to them for the future, the more distinctive appellation of the Laurentian series, a name founded upon that given by Mr. Garneau to the chain of hills which they compose.' From his standpoint Laurentian was the proper term for the great system, and any use of a homophonous word for an insignificant terrane should not stand in its way. The geological public has thoroughly endorsed him."

It is fortunate that when the more aggressive spirits of the great Republic try to wrest from us the few geological laurels which we can fairly claim, we find friends and allies among the more just and liberally minded of their compatriots.

NOTE.

Since writing the above, I have seen the interesting paper by Dr. Ells on the Stratigraphy of the Quebec Group, in the Bulletin of the Geological Society of America for 1889. This, when read in the light of general geology and palæogeography, I think completely bears out the views above stated.

Dr. Ells, in his concluding summary, divides the Quebec group, as previously held, into five portions. The first of these includes older crystalline rocks, and the second contains beds which may in part be considerably older than the Calciferous. The third includes the lower part of the Quebec group proper, representing the Calciferous of the interior region. The fourth is the central part of the Quebec group, approximatly equivalent to Chazy. The fifth is, in part at least, Upper Quebec group, though I have doubts as to its being all of one age. Under the head of "Palæontological Succession," the same facts appear. The Cape Rosier or Matane (*Dictyonema sociale*) zone of Lapworth, as I had previously pointed out in 1883,[1] is palæontologically Calciferous or Tremadoc. The *Phyllograptus* zone of the same author is the typical Levis, and the *Cœnogroptus* zone is the same with Dr. Ells' fifth group above. Besides these, however, there is on the lower St. Lawrence, probably between the *Dictymema* and *Phyllograptus* zones, another fossiliferous band of black shales which may be called the *Retiolites* or *Protospongia* zone, referred to in my paper on Fossil Sponges from the Quebec group (Trans R. S. C., 1889), and probably also another between the *Phyllograptus* and *Cœnograptus* zones. Palæontologically as well as stratigraphically, all these zones are very distinct from their chronological equivalents on the American plateau to the west, and more or less akin to those of western Europe. Thus the whole Quebec group is a peculiar Atlantic development of the Calciferous-chazy horizons, as originally defined by Logan.

[1] Report of Peter Redpath Museum.

Our Winter Birds.

By F. B Caulfield.

In the second volume of the *Canadian Naturalist* (1857, p. 138) there is a paper by W. S. D'Urban on "Some Land Birds Wintering in the Neighbourhood of Montreal," and in the fifth volume of the same journal (1860, p. 425) there is a paper by H. G. Vennor on "Birds Observed at Montreal During the Winters of 1856-57-58-59-60." These contributions are of great value, being records of observations made at a season when field work has to be prosecuted under many disadvantages, as by the time the snow is drifting through the leafless trees, very few birds remain to represent the multitude that find a home with us during the summer months. As a number of years have elapsed since the publication of these papers, it may, perhaps, be well to give some additional notes, as a few species have been added to the list, and our knowledge respecting some others has been slightly increased. Our winter birds may be classed under three heads—loiterers, stragglers and residents; although in some instances it is difficult to draw the line sharply. Under the first may be placed a few species that linger with us until late in November, or the beginning of December. The second includes the gulls and hawks that occasionally visit us during the winter, while to the third belong the majority of our winter birds, consisting of species that are resident throughout the year, with the addition of those that come to us from regions still farther to the north at the setting in of cold weather.

The insectivorous species that stay with us during the winter, such as the nuthatches and titmice, generally keep in the woods, being fond of sheltered hollows with a thick growth of evergreens, finding in such localities an abundant supply of food and protection from the bitter winds that sweep across the open country. During mild weather they occasionally venture out, and may sometimes be seen passing through the trees in our streets and gardens, generally in small companies, each individual seemingly entirely occupied with its own affairs, yet taking good care to keep within call of its companions.

Our winter visitants, the grosbeaks and waxwings, which at this season live almost altogether upon berries and seeds, do not appear to be very much affected by cold, and may be seen in exposed situations during the most severe weather.

* *Rissa tridactyla*—Kittiwake.
* *Larus glaucus*—Glaucous gull.
* *Larus marinus*—Great black-backed gull.
* *Larus Delawarensis*—Ring-billed gull.
* *Larus atricilla*—Laughing gull.

All these gulls are rare in the vicinity of Montreal, but occasionally visit the open water at Lachine.

Larus atricilla may possibly be merely a loiterer, the latest date of its occurrence, known to me, being October 22nd, 1885, when an immature specimen was shot at Lachine by Mr. Charles Ralph.

* Denotes birds not given in D'Urban's or Vennor's lists.

Bonasa umbellus togata—Canadian ruffed grouse. Recorded by D'Urban as common; is now very rare in the vicinity of Montreal. A few pairs nest on the western mountain, and in the wooded parts of Mount Royal cemetery.

* *Accipiter velox*—Sharp-shinned hawk. I only know two winter records for this species. In February, 1880, a male was shot in a garden on Berthelet street, while eating a sparrow that it had captured. The second specimen, also a male, was shot on the western mountain, December 29th, 1889.

Accipiter atricapillus—American goshawk. Occasional during the autumn and winter months. The earliest date upon which I received it is October 27th, 1887, an immature specimen shot at the Back River.

Archibuteo lagopus sancti-johannis—American roughlegged hawk. This can hardly be called a winter bird with us. The latest date of its occurrence known to me is November 1st, 1889, when a specimen was shot at Cote des Neiges. Chamberlain states that it occurs in the Maritime Provinces in winter only. With us it is an autumn visitant, occaionally sloitering until November.

Asio Wilsonianus—American long-eared owl. A few specimens during November. I do not think it remains during the winter.

Asio acciptrinus—Short-eared owl. Same record as last species.

* *Syrnium Nebulosum*—Barred owl. Occasional during winter.

Ulula cinerea—Great gray owl. This fine owl, generally exceedingly rare with us, has been quite common along our southern border during the past winter. At least fifty specimens have been mounted in Montreal, and it is also reported in unusual numbers from Quebec and Toronto. I have received examples from Three Rivers, Sorel, Sherbrooke, Valleyfield and other places—the earliest on October 28th, 1889, from Grenville, P.Q.; the latest on March 28th, 1890, from Lachine. A specimen shot on the western mountain, on the 27th of November, had a freshly killed field mouse in its stomach, but they do not always confine themselves to such small game. Mr. P. W. Redpath told me that in January last, while crossing Lac Pisagouke, St. Maurice County, he saw a large gray owl attacking some animal on the ice, which, on closer investigation, proved to be a mink. Vennor, in his work on "The Hawks and Owls of Canada," states that in 1876 the unusual number of six specimens were exposed in the markets, all of which were obtained on, or in, the immediate proximity of the island of Montreal. It is worthy of notice that the winter of 1876 was mild and open.

* *Nyctala tengmalmi Richardsoni*—Richardson's owl. Occasional during the winter months. November 9th, 1888, Mount Royal Vale, one example. February, 1890, Lachine, one example. Petite Cote, March 2nd, 1890, two specimens. I have also seen it exposed in the market.

Nyctala Acadica—Saw-whet owl. Resident throughout the year.

Bubo Virginianus—Great horned owl. Apparently not common in the neighborhood of Montreal, but this may be owing to its wariness, and to its habit of keeping within the cover of the woods.

Nyctea nyctea—Snowy owl. Common during some winters; some years very scarce. Quite common during the past winter.

Surnia ulula caparoch—American hawk owl. Generally rare; some winters rather common, usually occurring in November, after which it is, I think, seldom observed in the vicinity of Montreal. D'Urban gives the following dates of its occurrence: November 19th, December, February 27th.

Dryobates villosus leucomelas—Northern hairy woodpecker. Occasional during the winter; more abundant during the migrations. In 1879 a balsam poplar on Cadieux street, badly infested by the larvæ of *Xyleutes robinia* and *Sapera moesta*, was frequently visited by one of these birds, who would hammer away busily for quite a length of time, the scattered chips and fragments of bark at the foot of the tree bearing witness to the energy with which he worked.

Dryobates pubescens—Downy woodpecker. Resident throughout the year; generally keeps in the shelter of the woods in winter.

* *Picoides Arcticus*—Arctic three-toed woodpecker.

* *Picoïdes Americanus*—American three-toed woodpecker. A few examples of both these species occur here in November, but, I think, do not remain during the winter.

* *Otocoris alpestris*—Horned lark. This species arrives from the north in the fall, and examples may perhaps winter with us, as it is found very late in autumn and early in spring, but the greater number pass farther to the south. Their breeding grounds are about the shores of Hudson's Bay, Labrador and Newfoundland. The horned lark that breeds here is the prairie form (*Otocoris alpestris praticola*), a western race that has extended its range eastward, occurring now from the western edge of the plains to Montreal. McIllwraith believes that it first appeared at Hamilton about the year 1868. I cannot ascertain the date of its first appearance at Montreal, but it appears not to have been noticed until recent years. It loiters with us until late in the fall, and individuals may winter, as it occurs in February, nesting as soon as the ground is bare of snow.

Cyanocitta cristata—Blue jay. Common until late in the fall, and a few remain during the winter. Mr. Gordon, of St. Jerome, told me that a small flock of these birds frequented his farmyard during the winter of 1887-88, and, not being disturbed, became quite tame, feeding along with the poultry.

* *Perisoreus Canadensis*—Canada jay. A specimen shot at Lachine, November, 1889.

* *Corvus corax sinuatus*—American raven. Occasionally visits the river dump.

Corvus Americanus—American crow. Specimens remain during the winter, generally keeping in the shelter of woods near farm houses; becomes numerous in March, when large flocks assemble on the river dump.

* *Coccothraustes vespertina*—Evening grosbeak. An accidental straggler in winter from the west. Not recorded from the Province of Quebec previous to 1890. Since my former note on this species,[1] I have received a pair shot at Lachine on March 9th, 1889, by Mr. J. H. Harris, who told me that he saw a flock of about thirty individuals upon that occasion.

Pinacola enucleator—Pine grosbeak. A regular winter visitant, arriving from the north by the end of October or the beginning of November; leaving at end of March or early in April.

* *Loxia curvirostra minor*—American crossbill. An irregular visitant, sometimes appearing in large flocks.

* *Loxia leucoptera*—White-winged crossbill. Also of very erratic habits, sometimes appearing unexpectedly in considerable numbers. Both species may at times be seen feeding in company, and are generally very tame and unsuspicious.

Ecanthus linaria—Redpoll. Generally common, sometimes appearing in immense flocks. They are busy little birds, ever on the move, roving about from place to place, and appear to be of a most affectionate disposition. In former years numbers of these birds were captured and exposed for sale at the Bonsecours market. On one occasion I saw a specimen escape from a cage where a number were confined, and upon its taking flight, its companions com-

[1] Record of Science, Vol. IV, p. 109.

menced calling loudly, when it at once returned and alighted near the cage. This was repeated until it was again captured and recaged. While anxious to escape, it appeared to be quite unable to resist the calls of its companions.

Spinus pinus—Pine siskin. An irregular visitant, generally appearing in November. I do not think it remains during the winter.

Passer domesticus—European house sparrow. Now thoroughly naturalized. Withdraws in winter into the towns and villages.

Plectrophenax nivalis—Snow bunting. A regular winter visitant, not so abundant as in former years. Some linger until May or beginning of June.

* *Calcarius laponicus*—Lapland longspur. A rare winter visitant. I have obtained specimens in the market.

Ampelis garrulus—Bohemian waxwing. An irregular winter visitant—some winters rather common, other years entirely absent.

* *Ampelis cedrorum*—Cedar waxwing. Occasional during winter. Abundant summer resident.

Lanius borealis—Northern shrike. Regular winter visitant, arriving from the north in October or beginning of November, leaving us in March or beginning of April. The earliest arrival known to me is October 12th, 1889, on which date a young male was shot on the western mountain. The latest date of its occurrence in spring that I can be certain of is April 11th, 1890, when an adult male was shot at St. Armands. Both D'Urban and Vennor considered it to be a loiterer, but I am satisfied that many remain with us during the winter, as I have received it at different times between October and March. The specimen on the table was shot at Lachine on the 20th of January, 1890. D'Urban gives the date of its spring arrival from the south as April 13th, but neither he nor Vennor appear to have been aware of the fact that we have along our southern border two shrikes, one a winter, the other a summer resident, the latter being the white-rumped shrike (*Lanius ludovicianus excubitorides*). This species arrives from the south just as the other is leaving for the north, so that they sometimes overlap, and as many of the northern form winter far south of Canada, both species no doubt sometimes arrive at the same time, but *L. borealis* passes on to its breeding grounds in the fur countries, while *L. excubitorides* stops with us and nests, having reached the northern limit of its range. It may be possible that the white-rumped shrike did not occur here during D'Urban's or Vennor's time, as it has come to us from the west, having been first noticed in Ontario about 1860, according to McIllwraith.

Certhia familiaris Americana—Brown creeper. D'Urban records it as common on Nun's Island in winter. I have seen it in Phillips' square in February, 1885.

Sitta Carolinensis—White-breasted nuthatch.

Sitta Canadensis—Red-breasted nuthatch. Both of these species are recorded by D'Urban as common on Nun's Island in winter. Specimens may occasionally be seen on the mountain

Parus atricapillus—Chickadee. Abundant winter resident.

* *Parus Hudsonicus*—Hudsonian chickadee. Rare winter visitant; generally seen in November.

Regulus satrapa—Golden crowned kinglet. Occasional during winter.

Vennor gives the following winter records for the American robin (*Merula migratoria*), January 1857, and February 19th, 1869, but they can only be regarded as accidental. He also states that a specimen of the pileated woodpecker (*Ceophlœus pileatus*) was shot below the city. This, too, must be considered accidental, as it is a bird that is at home only amidst the solitude of the deep woods.

These are all the birds, so far as known to me, that have been observed in the neighbourhood of Montreal during the winter months. Continued research may add a few species to the list, and will enable us to speak more definitely with regard to the time of arrival and departure of several whose winter history has not yet been clearly worked out.

Sunspots observed at McGill College Observatory during the Years 1888-89.

By C. H. McLeod.

The accompanying table gives a summary of the observations of Sunspots made at McGill College Observatory during the years 1888 and 1889. The spots were observed by projection on a screen attached to a telescope of 6 in. aperture ; the diameter of the sun's image being enlarged to 8 inches. The heliographic latitude and longitude of each spot at the time of observation, have been determined with approximate accuracy. The dates given in the first column, except January 1st, 1888, correspond with the coincidence of the assumed prime meridian of the sun, with the central meridian as defined in the "Observatory" ephemeris. The numbers in the sixth column are obtained by dividing the total number of single spot observations in a rotation, by the number of days on which observations were made during the rotation.

A large spot, which was first observed near the eastern limb on June 17th, 1889, (whole area about $\frac{450}{1000000}$ and umbra $\frac{60}{1000000}$ of the sun's hemisphere) made one complete revolution and was observed on its second rotation until it disappeared beyond the western limb on July 24th. It did not greatly alter in form or area while visible. A large group, first seen on August 2nd, 1889, was observed in the two following rotations and disappeared about the end of September, having been last seen in longitude E 12° on September 28th. On their re-appearance these groups have been counted as "new." A small spot (area about 5 units) was observed in the very high latitude S 40° on June 30th. The observations were for the greater part made by Mr. E. H. Hamilton, B.A.Sc., and the remainder by myself.

Date of Commencement of period.	No. of days on which observations were made.	Total number of spots observed.	No of. Groups.	Average distance from the Equator.	Average No. spots per day.	Spots North of the Equator.		Spots South of the Equator.	
						No.	Average heliographic Latitude.	No.	Average heliographic Latitude.
1888.				°			°		°
January 1 to Jan. 22.6.	10	5	4	5.3	1.9	0	—	5	5.0
January 22.6..........	13	11	5	4.7	1.0	0	—	11	4.7
February 18.9..........	9	20	7	3.4	5.9	5	3.6	15	4.0
March 17.3............	9	7	4	5.0	1.3	5	4.2	2	6.6
April 13.6.............	12	9	6	7.7	1.4	1	0.6	8	8.7
May 10.8.............	11	15	7	4.5	2.7	1	3.2	14	4.6
June 7.0	12	22	5	6.0	3.5	14	7.6	8	3.7
July 4.2..............	17	20	8	8.8	1 5	1	6.2	19	9.0
August 0.4............	13	11	6	8.4	0.8	6	8.6	5	8.1
August 27.7...........	11	16	11	3.9	4.6	3	3.4	13	4.0
September 23.9........	9	4	3	5.8	0.5	1	12.4	3	3.6
October 21.2...........	10	20	14	4.0	2.1	4	5.4	16	3.6
November 17.5.........	8	4	3	8.0	0.5	0	—	4	8.0
December 14.8.........	6	5	3	5.0	1.6	0	—	5	5.0
1889.									
January 11.2...........	11	14	4	4.3	2.2	14	4.3	0	—
February 7.5.	16	10	2	11.1	2.1	0	—	10	11.1
March 6.8..............	11	15	5	4.3	2.5	5	3.5	10	5.5
April 3.1.	18	7	3	3.4	0.8	3	3.5	4	3.0
May 0.4.	11	10	1	4.7	1.4	0	—	10	4.7
May 27.6..............	12	20	2	4.0	5.7	0	—	20	4.0
June 23.8..............	15	19	3	7.2	4.8	0	—	19	7.4
July 21.0..............	19	67	8	12.8	10.0	14	3 5	53	13.6
August 17.2...........	23	2	1	18.9	0.6	0	—	2	18.9
September 13.5........	8	10	2	21.0	2.4	0	—	10	21.0
October 10 8...........	15	10	1	19.6	0.6	10	19.6	0	—
November 7.1..........	11	0	0	—	0.0	0	0.0	0	—
Dec. 4.4...............	9	23	5	21.2	3.3	9	20.0	14	22.0
Year 1888........	150	157	79	5.9	2.1	37	6.7	120	5.5
Year 1889........	179	207	37	11.2	2.9	55	9.3	152	11.3

Milk.

A LECTURE DELIVERED BEFORE THE MONTREAL NATURAL HISTORY SOCIETY.

By W. Hodgson Ellis, M.A., M.D.

Milk is the food which Nature has provided for the nourishment of the young of all the higher animals in the first helpless days of their life, before they have learned to forage for themselves. It is to this wonderful fluid—the meat and drink of infancy, a draught of which will satisfy the cravings of the already imperious appetite and still it to a sweet satiety, which a few years later it will seek in vain in a dinner of a dozen courses—to this true *elixir vitae* by means of which all higher forms of life are perpetuated from generation to generation, that I have the honour of inviting your attention this evening.

Average cow's milk has a composition about as follows:—

Fat	3·8
Albuminoids	4·0
Milk sugar	4·0
Salts	0·7
Water	87·5
	100·0

The fat constitutes butter.

The greater part of the albuminoids are separated from the milk by the addition of a little acid, either purposely added or formed in the milk itself when it "curdles." The curd carries the fat with it and a portion of the salts. The sugar and the rest of the albuminoids and salts remain in solution in the "whey." On boiling the whey, dissolved albuminoids are coagulated and may be filtered off, and on evaporating the filtrate the sugar crystallizes out.

That portion of the albuminoids which is coagulated by acid is usually known as casein. The portion not so coagulated is called albumen, and is held by some to be identical with serum albumen.

If a drop of milk be examined under the microscope it is seen to consist of a clear colourless fluid, in which float innumerable minute globules which refract light strongly. These are the globules of fat, which is not dissolved in the milk, but held in suspension in it, forming what is known as an *emulsion*. The nature of these globules and the cause of their remaining suspended in the milk have given rise to much controversy, and have been very carefully studied. Fat is soluble in ether. But you may shake milk with ether and the globules will not dissolve in it, unless you add some potash or some acetic acid, and then shake with ether, when they readily dissolve. So, too, if you mix acetic acid with a drop of milk under the microscope, you may watch the globules melt together and form larger globules and irregular masses of fat.

These globules of fat are lighter than the rest of the milk, and hence on standing they rise to the surface and form a layer of cream. This separation is never complete. That is, the cream contains some of the other constituents of the milk, and the skim milk still retains a little fat—about 0·5 per cent. By violently agitating the cream, as in churning, the fat separates in the form of butter. This separation takes place more readily if the milk has become just faintly acid.

Now all these things go to show that there is some kind of envelope surrounding the fat globules which protects them from the action of solvents until it is itself either dissolved by acid or alkali, or broken up as in the violent agitation of churning.

If the milk is heated for several hours in a little dish of metal or porcelain or glass, at the temperature of boiling water, the water is all driven off and the solids—the fat, casein, albumen, sugar and salts—are left behind as a solid residue. From this solid residue ether and other solvents will readily extract the fat, so that the envelope must be broken up by this process of drying also.

Formerly it was thought that this envelope was a solid skin of casein, and this idea was supported by the fact that casein is soluble in acid and in alkalies. The circumstances that after breaking up the globules no traces of this membrane can be detected under the microscope, and that milk dried in thin layers at low temperatures leaves a residue from which ether readily dissolves the fat, have thrown the gravest doubt on this hypothesis. One recent French writer, indeed, M. Béchamp, has endeavoured to show that the milk globules are true physiological individuals, like blood corpuscles. By appropriate treatment he has succeeded in separating them by filtration fróm the rest of the milk. He states that when thus isolated and dried they dissolve in ether, leaving about 1·3 per cent. of a residue insoluble in ether, which he asserts is not casein, but of the nature of a cell-wall. These views of the French savant are, I think, opposed to the general current of modern opinion on this matter, and his facts can probably be explained without accepting his hypothesis. It seems most likely that each globule of fat is surrounded by a thin pellicle of *fluid* casein. It is a fact well known to chemists, that when a complex organic fluid is shaken with ether or chloroform for the purpose of separating some constituent soluble in these liquids, it is not uncommon for each globule of ether or chloroform to become encased in just such a liquid pellicle, which most obstinately resists our efforts to break it up and bring about the union of the globules. Milk itself very easily causes this condition of things when shaken with ether. I have had, to my great annoyance, frequent experience of this phenomenon, and have had samples of this emulsion which remained intact for weeks and even months, the ether refusing to separate as I wished it to do.

As to the chemical composition of butter fat a few words will suffice. Fats are combination of certain organic acids —"fatty acids" as they are called—with glycerine. Besides stearic, palmitic and oleic acids, which are present in most animal fats, butter is peculiar in containing more than 6 per cent. of butyric acid, which differs from those just named by being soluble in water and volatile. This fact is of great importance in enabling us to detect adulteration of butter by admixture with foreign oils and fats.

The quantity of fat in healthy cow's milk varies from 2·5 per cent. to 5·5 per cent., the average being a little under 4 per cent. The milk of the ass only contains a little over 1 per cent. of fat. That of the porpoise contains 45·8 per cent. fat.

The casein and albumen belong to the class of organic bodies called albuminoids. They differ from the other constituents of the milk in containing nitrogen, and are of great nutritive value.

In composition they very closely resemble one another, but they differ in some of their properties. The casein is coagulated by the addition of acetic acid. The albumen is not. The casein may also be separated from the albumen by filtration through porous earthenware. If a porous earthenware cell, such as is used in many forms of galvanic batteries, be closed by an indiarubber cork, perforated to admit of a glass tube which is connected with an apparatus for exhausting the air, and then plunged into a vessel of milk, the water, the sugar and the albumen will pass into the cell, while the casein and the fat will remain outside. A portion of the salts will pass into the cylinder; another and larger portion will remain in combination with the casein.

The casein can be freed from the fat by treatment with ether, which dissolves the fat and leaves the case in behind.

Magnesium sulphate also precipitates casein from cow's milk.[1] The albumen can be precipitated from the filtrate by the addition of acetic acid and boiling.

Our knowledge of the albuminoids of milk is not very exact. Some authors think that the different forms are only modifications of casein; others believe that there are several albuminous substances, and that casein itself is not a simple body. For our purposes it will be sufficient to class them under the common name of albuminoids, including in this term both casein and albumen.

The quantity of albuminoids contained in the average

[1] Not from human milk. Biedert & Schröter, *Jahresber f. Thier-Chem*, 1888, p. 103.

cow's milk is about 4 per cent. The albumen is usually about 7 per cent.

The milk sugar is a body similar in composition to cane sugar, but differing in many of its properties. It is not so soluble as cane sugar, and consequently not so sweet. It may be obtained from whey by evaporating it to a thin syrup, and allowing it to stand for a long time in a cool place, when it crystallizes out. It forms hard colourless transparent four-sided prisms. When milk is kept, after a variable time depending on temperature and other conditions, the milk sugar begins to undergo a change, by which it is converted into a peculiar acid—lactic acid. One molecule of milk sugar and one molecule of water form four molecules of lactic acid.

$$[C_{12}H_{22}O_{11} + H_2O = 4\ C_3H_6O_3.]$$

The lactic acid so formed causes the coagulation of the casein ("curdling"), and is the cause of the sour taste of spoiled milk. This change is caused by a peculiar ferment present in the milk. The activity of this ferment is destroyed for a time by boiling. Hence the peculiar effect of boiling milk.

Milk sugar, like cane sugar, belongs to that class of saccharine bodies which are not directly susceptible of alcoholic fermentation. When a solution of cane sugar is mixed with yeast, it takes up a molecule of water and is converted into a fermentable sugar or glucose, which in its turn splits up into alcohol and carbon dioxide.

$$[C_{12}H_{22}O_{11} + H_2O = 2\ C_6H_{12}O_6$$
$$C_6H_{12}O_6 = 2\ C_2H_6O + 2\ CO_2.]$$

Similarly milk sugar, under the influence of yeast, is changed first into a fermentable sugar galactose and then into alcohol and carbon dioxide. These changes are utilized in the preparation of koumiss, an aerated alcoholic beverage obtained by fermenting milk. The alcohol which koumiss contains and the carbon dioxide which gives it its sparkling effervescent character are both derived from the sugar of milk.

This drink has from time immemorial been prepared by the wandering tribes of the Steppes of Russia and Central Asia. These people live in tents for nine months in the year. During the winter they bury themselves in pits dug in the ground and covered by a rounded roof of thick felt. Their only wealth consists of herds of small hardy horses. From the milk of their mares they prepare a drink by fermenting it in bags made of smoked horse-hide, the hair being turned outwards. In spring they use as a ferment either the dried casein from strong koumiss, prepared during the preceding autumn and preserved through the winter for the purpose, or a mixture of flour and honey, or a piece of fresh horse skin, or even an old copper coin covered with verdigris.

During fermentation the milk is frequently agitated, and this agitation is absolutely necessary to the process however carried on. After once a supply of koumiss has been obtained. a fresh supply can be got by adding some of it to fresh milk, in which it at once sets up the alcoholic fermentation.

William de Rubruquis, who wrote a book of travels in Tartary as long ago as 1253, describes this beverage, and tells us that he found it very savoury. "It biteth," says he, "like wine of raspes when it is drunk. After a man has taken a draught thereof it leaveth behind it a taste like that of almond milk and maketh one's inside feel very comfortable; and it also intoxicateth weak heads."

Marco Polo also tells us that the Tartars drink "mare's milk prepared in such a way that you would take it for a white wine; and a right good drink it is."

The first to employ koumiss as a therapeutical agent was Dr. John Greive, a Scotch surgeon in the Russian army, who gave an account of it in a communication to the Royal Society of Edinburgh in 1784, and who employed it with success in wasting diseases. There are now in the Steppes several koumiss establishments where a large number of patients are treated annually. [1]

[1] *Koumiss*, G L. Carrick, M.D.

The natives of the highest part of the Caucasian Mountains prepare a similar drink from the milk of cows and goats which they call "kephir." They make it by adding to fresh milk in goatskin bottles a peculiar ferment which is also called kephir. This substance is described as consisting of white or yellow balls of different sizes with an irregularly furrowed surface. They look like little cauliflowers and are often as big as waluuts. As to the origin of this ferment we know nothing. The mountaineers themselves have only various legends concerning it.

The balls after setting up fermentation in fresh milk grow and are removed, when the preparation of the kephir is complete, dried in the sun and used again for a fresh lot. The method of preparation and character of kephir are entirely similar to those of koumiss.[1]

ANALYSIS OF KOUMISS AND KEPHIR.

Wencki & Fabian (Polish Chemists.)

	Koumiss.			Kephir.		
DAYS OLD.	1.	2.	3.	1.	2.	3.
Specific gravity	1·041	1·037	....	1·032	1.026	....
Albuminoids	2·31	2·62	2·79	3·93	4·15	3·70
Alcohol	0·56	1·42	2·11	0·41	0·81	1·20
Lactic acid	0·45	0·56	0·78	0·51	0·43	0·83
Carbon dioxide	0·10	0·12	0·35	0·03	0·03	0.16
Sugar	4·02	2·45	1·25	2·04	1·82	1·37
Ash	0·52	0·50	0·48	0·61	0·68	0·68

The salts of milk are chiefly phosphates, chlorides and sulphates of potash, soda, lime and magnesia with a trace of iron. Lactic acid is generally present in milk, though it is doubtful whether it is contained in perfectly fresh milk. The quantity increases quickly on keeping from the fermentation of the sugar. It is an interesting discovery of quite recent date that cow's milk contains about 1 gramme per litre of citric acid, the acid of lemons. A good milk cow will afford daily as much citric acid as is contained in two or three lemons.

[1] Kaunhals, *Jahrsber, f. Thier Chem.*, 1884, p. 191.

When the residue left by evaporation of milk is burnt at a low red heat, the inorganic constituents of the milk remain behind as ash. The quantity of ash contained in cow's milk usually amounts to about ·7 per cent.

MEAN COMPOSITION OF THE ASH OF COW'S MILK.
(Schrodt and Hansen.)

Potassium Oxide	25·98
Sodium Oxide	10·75
Calcium Oxide	20·87
Magnesium Oxide	2·76
Iron Oxide	·13
Sulphuric Anhydride	3·99
Phosphoric Anhydride	23·63
Chlorine	15·08

The following Table compiled from various sources will enable us to compare the milk of different animals :—

ANALYSIS OF THE MILK OF DIFFERENT ANIMALS.

	Water.	Solids.	Fat.	Albu-min-oids.	Sugar.	Salts.
Human Milk	87·8	12·2	3·9	2·5	5·5	0·3
Cow	87·5	12·5	3·8	4·0	4·0	0·7
Sheep	78·7	21·3	8·9	6·3	5·1	1·0
Buffalo	81.7	18·3	9·0	4·0	4·5	0·8
Goat	86·4	13·6	4·4	4·5	4·0	0·7
Camel	86·9	13·1	2·9	3·8	5·7	0·7
Mare	90·1	9·9	1·1	1·9	6·6	0·3
Ass	90·5	9.5	1·3	2·0	5·7	0·7
Sow	82·4	17·6	6·4	6·1	4·0	1·1
Hippopotamus	91·0	9·0	4·5	4·4	...	0·1
Bitch	76·6	23·4	9·6	9·9	3·2	0·7
Cat	81·6	18·4	3·3	9·6	4·9	0·6
Porpoise	41·1	58·9	45·8	11·2	1·3	0·6

In order to form a judgment of the value of milk as a food, a few words as to the composition of the various substances which constitute the food of man and animals will be useful.

Nutritive substances may be classed as follows :—

1. Albuminoids.
2. Fats.
3. Carbohydrates.

Under this name are included sugar, starch and similar bodies.

4. Salts, chiefly phosphates, sulphates and chlorides of potassium, sodium, calcium, magnesium and iron.

5. Water.

The following table gives the average composition of the principal kinds of food :—

	Water.	Solids.	Albuminoids.	Fat.	Carbohydrates.	Salts.
Meat	75	25	18	6	..	1
Fowl	75	25	21	3	..	1
Fish	78	22	18	3	..	1
Bread	40	60	8	3	48	1
Potatoes	75	25	2	..	22	1
Milk	87	13	4	4	4	1

Meat is rich in albuminoids, poor in carbohydrates. Bread and potatoes are rich in carbohydrates and poor in albuminoids. It follows from the table given above that a pint and a half of milk is about equal in nutritive value to half a pound of meat and half a pound of potatoes—not quite so rich in albuminoids, but a good deal richer in fat. In milk, too, the food constituents are in a liquid form, which renders them particularly easy of digestion and assimilation, a point of vital importance in the case of the infant and the invalid

This brings us to the subject of milk adulteration. There is no article of food which it is more essential to the public welfare to obtain pure than milk; none which is more easily adulterated, none which has been adulterated more extensively and more shamelessly.

When the public analysts of Canada published their first report in 1876, two-thirds of the samples analysed were reported as adulterated. In 1882, this number was reduced to less than one-fifth. This is gratifying, but it is bad enough still.

Strange stories used to be told of the substances employed to adulterate milk. It was popularly believed, for example, that calves' brains were largely used for this purpose. Chalk, also, was popularly credited with being a common adulterant. All these stories are fables. Milk is adulterated in two ways: by the addition of water and by the abstraction of cream.

The detection of adulteration depends upon our ability to determine whether cream has been abstracted or water added. Pure milk contains 87 per cent. water, and unless the added water introduces some impurity which we can detect by analysis, there is no way of distinguishing it qualitatively from that of the natural milk. Certain tests have been proposed for this purpose. Thus it has been suggested that added water may be detected by the nitrates it contains, but our public supplies from the great lakes and river are practically free from nitrates. The presence of sulphates has also been regarded as proving the addition of water, the old analysis of milk ash showing either the merest traces of sulphates or none at all. But the recent analyses of Schrodt and Hansen, already quoted, demonstrate that milk ash contains nearly 4 per cent. of its weight of sulphuric acid as sulphates, so that in nearly every case we are obliged to form an estimate of the purity of the milk by determining the amount of solids and fat it contains, and comparing our results with the composition of genuine milk.

The methods used for milk analysis have had much attention bestowed upon them. We owe a deep debt of gratitude to Mr. Wanklyn for shewing us how a milk analysis can be simply and accurately effected. His book was published in 1873, and his method was to dry the milk on a water bath in a little flat-bottomed platinum dish and weigh the residue, and to extract the fat from such a residue with ether, evaporate the ether and weigh the residual fat. In this way he obtained the total solids and the fat. By subtracting the fat from the total solids he obtained the *solids not fat*, and he was the first to show the great value of this determination. He pointed out that of all the constituents of the milk, the fat was the only one which varied very much in quantity, the percentage of the other solids only differing within comparatively narrow limits in genuine milk, whether rich or poor.

Wanklyn maintained that the solids not fat in genuine milk never fell below 9·3 per cent., and that the fat never falls below 3 per cent. The English Society of Public Analysts adopted limits rather more favorable to the milkman, namely, 9 for the solids not fat and 2·5 for the fat. If a milk contained less than 9 per cent. solids not fat, it was considered watered, and if less than 2·5 per cent. fat without a corresponding decrease of solids not fat, skimmed.

The English Public Analysts almost universally adopted Wanklyn's method of milk analysis. The German chemists, on the other hand, usually mixed the milk with some insoluble powder, like sand or plaster of Paris, during the drying, for the purpose of obtaining the residue in a fine state of division, in which condition the fat is more easily removed by ether. Of late years, too, various appli ances for continuous extraction, such as Soxhlet's, came into use. These methods are found to extract the fat from a milk residue more completely than Wanklyn's process; for milk drying up in a dish forms a horny mass, only penetrated with difficulty by solvents. Chemists using these processes got higher percentages of fat than those who used Wanklyn's. He, for example, gave 3·2 as the average percentage of fat, but Vieth, as the average of 1,300 analyses made in 1887, gives 3·82 as the average, and we found in Canada the average 3·86 per cent. of fat. Now this increase in fat lowers the solids not fat, and it gradually became evident that 9 per cent. of solids not fat was too high a limit.

In 1883, there was a famous milk case tried in Manchester, in which a milkman appealed from a conviction of selling adulterated milk. The public analyst found 8·62 per cent. solids not fat by Wanklyn's method, and reported the milk adulterated. A great number of analysts were called on both sides, and a good deal of evidence of a very conflicting character was given, the result being that the conviction was dismissed.

This contradiction of testimony drew great attention to the subject of milk analysis and milk limits. A committee of the Society of Public Analysts was appointed to investigate the matter, and the result of their labours and discussions was to show clearly that Wanklyn's method did not extract all the fat, and therefore should be discarded for one of those processes which did so, but that in that case the limit of 9 per cent. solids not fat was too high. While the committee were deliberating, one of their number, Mr. Adams, brought forward a new process which commended itself to them as the best hitherto proposed, and which they accordingly adopted.

It consisted in absorbing the milk in a paper coil, drying it and extracting the fat from the dried coil with ether in a Soxhlet's extraction apparatus. The very fine division of the milk solids enables the other to get at every particle of fat and remove it completely from them. The Society adopted the process and reduced their limit to 8·5 per cent. solids not fat.

Our chief analyst, Mr. Thos. Macfarlane, has introduced a method in which he absorbs the milk by asbestos in a special apparatus, dries and extracts with ether. This method is beautifully simple and extremely accurate, and enables a great number of samples to be analysed with a very little expenditure of time.

The public analysts of Canada had followed with deep interest this discussion, and they felt that before they could intelligently adopt this or any other limit, they ought to make a thorough trial of the new methods upon the milk of Canadian cattle. Upon representing these views to the Department of Inland Revenue, they were favourably received, and the plan was put into execution during the summer of 1887. One hundred and sixty-two samples of milk were taken by the collectors of Halifax, St. John, Quebec, Montreal and Toronto. Each sample represented the whole mixed milk of a herd of cows milked in the presence of the collector and the public analyst of the district. Altogether the samples represented the milk of about 1,600 cows. The samples were analysed in duplicate by the public analyst and (also in duplicate) by the chief analyst at Ottawa. The chief analyst used the asbestos method, and the average of this large number of analyses was as follows :—

Total Solids	12·48
Fat	3·86
Solids not fat	8·62

Those of us who used the method of the Society of Public Analysts obtained results almost identical with those of the chief analyst.

The following table summarises our results in the various districts :—

	Fat.			Total Solids.	Solids not Fat.
	Highest.	Lowest.	Average.	Average.	Average.
Halifax	5·40	3·00	4·24	12·72	8·48
St. John	4·62	3·43	3·91	12·45	8·54
Quebec	4·18	3·02	3·54	12·39	8·85
Montreal	5·17	2·80	3·82	12·29	8·47
Ottawa	5·29	3·62	4·26	12·93	8·67
Toronto	4·50	2·52	3·38	12·08	8·70
All Canada	5·40	2·52	3·86	12·48	8·67

These results demand the most serious consideration. It will be seen that in two out of the six districts the average of the solids not fat is less than 8·5. As a matter of fact, in 55 samples out of the 162 they fell below this number. In two samples from Halifax they even fell below 8 per cent., and in one sample from Toronto, which I took myself from the mixed milk of a herd of ten cows, the solids not fat were only just barely 8 per cent.

Nor are these results by any means unique. So long ago as 1863, Professor Voelcker published an analysis of the milk of a herd of fifteen cows, which gave 7·5 per cent. of solids not fat. Only the other day Mr. Lloyd read a paper before the Chemical Society of London, giving the analysis of the milk of two cows, in which the solids not fat varied for two months between, in one case, 8·63 and 7·5, and in the other case between 8·52 and 8·1.

Looking these facts fairly in the face, I do not see how we can come to any other conclusion than this: that if the solids not fat of a milk are over 8 per cent., we cannot certify that the milk is not genuine. Indeed in the case of the milk of individual cows the solids not fat may be even lower than this. But the average of the milk of our 1,600 cows was 8·62 per cent. solids not fat, and many of the samples gave over 9 per cent. of solids not fat. If, then, we pass all milks in which the non-fatty solids are over 8 per cent., we give dishonest dealers the opportunity to let their milks down to this standard. Indeed we invite adulteration if done with judgment and in moderation.

With good rich milk a gallon of water may be added to every nine gallons of milk, and still analysis will not prove, except as a matter of probability, that the milk is not genuine. Similarly half the cream may be removed from a milk like some of the Halifax samples without lowering the percentage of fat below that found in some of the samples of mixed cow's milk that we obtained ourselves.

Except then in very flagrant cases, the penalties of the Adulteration Act, as it stands at present, are but empty threats. What then, I repeat, can we do? I answer, there are two ways in which we can check this evil.

The first is publicity. If A is only judicious in his adulteration and not too much of a glutton in his use of the tap, we cannot certify that his milk is not genuine, but we *can* say that it is wretched stuff, and very much inferior to the average, and in particular to that of his rival B. And A doesn't like this. He fears, and with good reason, that his customers will forsake him for the man who gives better milk, and the chances are he will mend his ways.

This is what we have been doing. So far there has been very little prosecution under the Act, and what there has has not been very successful. The influence we have exerted has been almost exclusively that which comes from publishing our results. In 1876, when the Act came into operation, we found two-thirds of the samples of milk which we analyzed adulterated. In 1882 there were only one-fifth. Is it too much to ascribe this improvement to the moral effect of the publicity given to the work of the public analysts ?

The other method which might be adopted is to fix by legislation a standard—a reasonable, fair standard—for milk, which must be reached by all milk offered for sale. The chief analyst has proposed such a standard as follows :—

Total Solid	12·0	per cent.
Butter Fat	3·5	" "
Solids other than fat	8·5	" "

Milk falling below these limits should not be permitted to be sold.

If this scheme were adopted and vigorously carried out, I think we should soon see a marked improvement. Not only would the addition of water and the removal of cream be checked, but the quality of the cows used for milk purposes would be improved. For if a cow did not give milk up to the standard she would be better fed and better housed ; aud if she still did not give standard milk she would be sold to the butcher and replaced by a good milker. Quality as well as quantity would be sought for in dairy cows ; and we know enough of what can be done by cattle-breeders to be quite sure that within reasonable limits we can get what we want.

Hitherto we have been considering milk as a food, and as the most perfect food imaginable for the purpose for which nature provides it. We have now to see how, under certain circumstances, it may become a poison, or may become the vehicle of a poison, as deadly as that of the rattlesnake.

It has long been known that every now and then severe illness has been caused by eating cheese. Now, in its normal state cheese is a most wholesome and nutritive article of diet ; but from time to time cases of poisoning have occurred, and often cases of wholesale poisoning, which have been traced without any shadow of a doubt to cheese. It was formerly supposed that these cases were due to some mineral matter introduced into the cheese. But in many cases the poisonous cheese has been submitted to analysis and no trace of any mineral matter found. These cases of cheese poisoning, indeed, were a puzzle to both physicians and chemists. About six years ago, however, Dr. Victor C. Vaughan, of the University of Michigan, succeeded in isolating from some cheese of this character a poison which he called tyrotoxicon. This cheese had produced most alarming symptoms somewhat resembling cholera in more than 300 persons in the State of Michigan. This poison he referred to a very remarkable class of bodies, the so-called *ptomaines*, which have come greatly into notice of late years. These ptomaines are substances similar in constitution and properties to the alkaloids which are found in plants, and, like these, while many of them are quite harmless others are as deadly poisons as strychnine itself. They are found in decomposing animal matter of all kinds. It is from this circumstance that they have received the names of ptomaines, from πτωμῖα, a corpse. From their resemblance to vegetable alkaloids they are also called cadaveric alkaloids, or the alkaloids of putrefaction.. They are many of them crystalline bodies which form definite salts with acids and give well marked reactions with various chemical reagents. They appear to arise under certain conditions as products of the decomposition of albumen and allied bodies. This tyrotoxicon is derived from a peculiar decomposition of the casein of cheese.

Tyrotoxicon is a crystalline body which, when eaten in very minute quantities, produces in an aggravated form symptoms precisely similar to those of cheese poisoning. Since it is produced in cheese by the decomposition of casein, it would appear *a priori* probable that it might sometimes be formed in decomposing milk. This turned out to be the case. Soon after his discovery of this poison in cheese, Dr. Vaughan was able to detect it in a sample of milk which had been kept in a stoppered bottle for about six months, and subsequently in other samples of milk allowed to stand for three months in closed bottles.

In June, 1886, in the village of Lawton, Michigan, eighteen people were seized with most alarming symptoms after eating ice cream flavored with vanilla. A sample of the cream was sent to Dr. Vaughan, together with some of the vanilla which had been used in flavoring, which it was supposed contained the poison, since some lemon ice cream, from the same maker, had not affected those who ate it. To decide if the vanilla was poisonous or not Dr. Vaughan and his assistant applied a very practical test by swallowing three drops each of it. No ill effects following, the assistant took two teaspoonfuls more. As he remained unaffected, Dr. Vaughan decided that the poison was not in the vanilla, and proceeded to analyse the ice cream. From it he isolated tyrotoxicon, with which he next experimented. This time he did not use his assistant, but a cat. The cat was affected exactly like the Lawton patients.

Dr. Vaughan then found that by taking a small portion of the poisonous ice cream, he could, as it were, sow the infection in perfectly fresh milk, and cause the development of tyrotoxicon in it. To a quart of perfectly fresh milk he added a small piece of the Lawton ice cream and set it in his cellar. Next morning he added another quart of milk and then mixed with eggs and sugar, so as to make a custard. On the following morning Dr. Vaughan tasted the custard and was taken very ill; not so ill, however, as to prevent him isolating tyrotoxicon and poisoning a kitten with it. At 2 p.m. he took a teaspoonful himself, and was seized with violent vomiting and purging and intense headache. Delighted with the success of his experiment, and feeling a little better at 3 p.m., he took another teaspoonful, with equally satisfactory results.

Since then other workers have confirmed Dr. Vaughan's conclusions, and there is no doubt that under certain circumstances a very dangerous poison is formed in milk. It is not a product of the ordinary decomposition of milk, but is evidently caused by a peculiar ferment, which fortunately is only rarely present. In all probability it will be found that this peculiar fermentation is due to some micro-organism. It is very unstable: standing in an open vessel will often cause all trace of it to disappear from a milk in which its presence had previously been shown. It appears to be developed most readily in bottles closely stoppered. And these facts are not without their practical bearing.

Milk is sometimes supplied to dealers in glass bottles. Now unless these bottles are most scrupulously cleaned after using, before being refilled, we have all the conditions, so far as we know them, most favorable to the development of this poison.

From what has been said already it will be evident that the decomposition of milk may take place in several different ways. The usual way is what is called the "lactic fermentation." In this form the decomposition appears to start in the milk sugar, part of which becomes converted into lactic acid and the milk turns sour. The formation of this lactic acid, coagulates the caseïn and the milk curdles. Then the casein and albumen molecules break up into simpler molecules. Carbon dioxide, ammonia and other bodies are formed. Carbon dioxide is continuously evolved from milk during decomposition, but only in a very moderate quantity.

This form of decomposition has been shown to be due to a micro-organism—the *Bacterium lactis*—minute bodies in the form of beads strung together or in that of threads. They grow and increase in number by a process of *fission*—that is one of the minute cells, divides, so as to form two individuals, and these in their turn divide again. The bacteria feed upon the sugar and albuminoids of the milk, and thus in some way bring about that peculiar form of decomposition which is known as the lactic fermentation.

The presence of acid checks the lactic fermentation, so that under natural conditions only part of the sugar is converted into lactic acid. But if chalk is added to neutralize the acid as it is formed, the whole of the sugar may be changed into lactic acid.

The alcoholic fermentation which takes place in koumiss and kephir is also due to minute fungus, the *Saccharomyces cerevisiæ*, or ordinary beer yeast—the same plant which causes the fermentation of beer, wine and the wort from which spirits are distilled. It is a plant similar somewhat in appearance to the *B. lactis*, but much larger.

Sometimes another kind of fermentation occurs—the butyric. The product in this case is butyric acid, and it is attended by a most abominable stench. This kind of decomposition is due to another microbe—the *Bacillus subtilis*, or, according to others, an allied form, *Clostridium butyricum.*

There is no doubt that the peculiar fermentation which leads to the formation of tyrotoxicon is due to another of these microbes, but the particular microbe is not known.

Nature as an Educator.[1]

By Sir William Dawson.

In the winter of 1856-7 I had the honor of delivering the introductory lecture of our Sommerville course, and took as my subject "Natural History in its Educational Aspects." Now, after the lapse of thirty-three years, and after the great changes which have occurred since that time, I desire to recur to the subject, and to ask what is the present aspect of nature as an educator relatively to education in general and to a society like this.

Let us consider in the first place how early, continuous and persistent are the operations of nature as an educator, regarding nature as a general name for all those objects which come under the cognizance of our senses, and from which we derive sensations and perceptions. It is scarcely necessary here to make any exception in regard to things artificial, for in reality these are all merely adaptations and imitations of nature. Nor need we inquire as to the reality or the origin of these objects, but may take them as the environment surrounding us on every side, and at all times more or less presenting itself to us.

From the moment when we first open our eyes on the outer world we are receiving impressions from external nature, which go on extending and multiplying at least until our attention is called away by pursuits and studies relating to the artificial life of man, and even then we recur when we can to nature as our most grateful teacher, nay, the friend and companion whose teaching has no hard tasks but is all pleasure. The weary schoolboy gladly turns

[1] Annual Presidential Address before the Natural History Society of Montreal.

away from dry text-books to ramble in the fields and woods. The child whose worldly horizon is limited by a dirty street or dull backyard rejoices to see grass and flowers and trees, and drinks in inspiration from them. Sitting one Sunday afternoon at the open window looking out on the college grounds, I saw a working-man walk past with a little girl at his side. Coming opposite the bit of old-fashioned, poorly kept garden, which thirty years ago I had managed to carve out of the unwholesome swamp which then lay in front of our college terrace, the child stopped to look at it, and said, "Papa, is that the Garden of Eden?" The poor little thing, who had perhaps never seen anything of a garden but the outside of its fence, had heard that once there had been a garden of the Lord—a free and happy abode of man. Some years ago I knew of a boy dying of consumption in a poor home, to whom a kind lady sent a bunch of rich purple grapes. He gazed at them, fondled them, could scarcely be persuaded to taste them, and said, "How pretty! I have heard of grapes, but I never had any before." Coming home some time ago from a little excursion in which I had secured some deer's antlers, I happened to drive up from the station at the early morning hour when our streets are swarming with factory hands going to their work, and I noticed how everyone turned and stopped to look at my prize, and how the faces of many lighted up as they saw in imagination a view of wild woods and bounding deer, which perhaps remained with them as a pleasant thought through the day. How is it that our boasted civilization shuts out so many from contact with nature? The God who long ago led Israel out of bondage provided that every Hebrew family should have for its very own some strip or patch of the green sward of the promised land, and the Great Teacher who came long after, drew His favorite texts from the trees, the flowers, the grass, the birds and the beasts. It is not the will of God that we should imprison ourselves between four dingy walls in the midst of His beautiful world.

But it may be said that the rustic who dwells in field and forest has as little of the real companionship of nature as the dweller in towns. I doubt this, except in cases where mental or moral degradation has reduced the countryman to a mere machine. I have found much genuine love of nature and appreciation of natural things in the country, especially in those parts in which good education has been provided for the young. Even in city life this love requires but to be ever so little encouraged and it will come to the front with a bound.

If we ask how this is to be done, why should we not have teaching as to nature in homes and schools: little museums in schools, greater and really popular ones for our cities, botanical gardens open to all, zoological gardens where means permit? Why should not excursions into parks or the country, or visits to museums be made a necessary part of school instruction? The answer is simply because we are not sufficiently civilized to understand these things. Unfortunately also we make mistakes in our mode of introducing them. The mistakes in education here as in most other subjects are portentous. Mere book-learning or cramming of hard names for an examination is not study of nature, nor is mere laboratory work. Educators and the public are apt in these matters to rush from one extreme to the other. Seeing the folly of mere book tasks, it was decreed that there should be practical teaching. Teachers must dissect frogs and other creatures and teach their pupils to do the same. The result has been failure and damage to the knowledge of nature. It is one thing to see an animal alive and carrying out its natural instincts; quite another to cut up its dead carcase and learn hard names for its parts. A boy learns ten times more of nature by watching the frogs swimming and diving in a pond than by cutting them up ever so cleverly. I do not say that the laboratory teaching is useless when managed by a skilful and sympathetic teacher who can point out the meaning and uses of structures and their homologies with those of other animals. It has a real scientific use, but ordinarily it degenerates into a mere task and cram, and has as much relation to true science as the trade of a butcher has to that of an artist. A curious illustration of this was presented some years ago, when it was decreed in England that Hygiene should be taught in the schools. The subject was a popular one, and would have been taken up with enthusiasm. But unfortunately it had been represented to the Committee of the Privy Council that it was necessary that the pupils should have learned Physiology before entering on Hygiene. Here was a difficulty which the teachers at once felt. Physiology was an unpopular subject. The trained teacher had learned to take his pupils through the anatomy of a few common animals; but to him a frog or a crayfish was no more than a sum in arithmetic, something to be learned as a matter of dissection and dry anatomy. The subject consequently was repulsive both to pupils and parents, and if this ordeal had to be first gone through there was an end of hygiene. Thus by a strange inversion of education and science, one of the most attractive and useful subjects had become a bugbear. It is to be hoped that just as English educators have got over many other follies they have also surmounted this.

One would fancy, however, that there is still need for reform, from the following terse and pungent summary of the matter in a recent address before the Royal Microscopical Society by its president, Dr. Hudson :—

"Which, then, is the more scientific treatment of a group of animals—that which classifies, catalogues, measures, weighs, counts and dissects, or that which simply observes and relates; or, to put it in another way, which is the better thing to do, to treat the animal as a dead specimen or a living one?—

"Merely to state the question is to answer it. It is the living animal that is so intensely interesting, and the main use of the indexing, classifying, measuring and counting is to enable us to recognize it when alive and to help us to understand its actions."

He goes on to contrast the position of the mere learner of structures and hard names with that of the country lad who has studied nature in her own haunts :—

"He has watched the cunning flycatcher leaving her obvious, and yet invisible young, in a hole in an old wall, while it carried off the pellets that might have betrayed their presence; and has stood so still to see the male red-start that a field mouse has curled itself up on his warm foot and gone to sleep. He gathers the delicate buds of the wild rose, happily ignorant of the forty odd names under which that luckless plant has been smothered; and if, perchance, his last birthday has been made memorable by the gift of a microscope, before long he will be glorying in the transparent beauties of *Asplanchna*, unaware that he ought to crush his living prize in order to find out which of some half-dozen equally barbarous names he ought to give it."

Practically, to give young people in cities the benefit of all this, it is necessary to have museums and public gardens. A very small collection, representing any definite series of objects, properly named and associated with those relations that give them interest, is of the greatest value. Larger public museums have wider uses. I have been struck with this in visiting the Liverpool Free Museum, where every object is so labelled as to tell something of its story, and where crowds of learners are constantly receiving instruction from well-prepared specimens.

Our little museum is capable of similar uses, but it requires much better display and labelling of its treasures, and funds to enable the Society from time to time to add to its attractions by introducing new objects. Public gardens, whether botanical or zoological, are also of the greatest use. I know of nothing which any of our patriotic citizens could do of greater utility than the opening of such a place where the useful and ornamental plants and the various animals of our own Dominion and of other countries could be seen and studied. Lastly, means should be provided for taking children under competent guidance on field excursions and to visit places of note and interest.

All this may be said to be desultory and unscientific, but it will lead to more precise knowledge, and will serve to develope the tastes and powers of those who are capable of doing better and higher work.

My own early training in this matter was when there were in most parts of this country neither public museums nor laboratories nor systematic teaching, and it had for stimulus and guidance merely the encouragement given at home by parents who saw that the pursuit of natural history was an elevating one, and of one or two teachers who themselves cultivated some branches of natural science. As a boy I collected indiscriminately fossils, minerals, plants, insects, and later added to these birds, which I had learned to prepare, and the shells and other organisms of the sea. When I became the happy possessor of a microscope, such as could be had in those early days, I went largely into the minute forms of aquatic life and sketched their structures and noted their habits, becoming familiar thus with some curious animals and embryonic forms, which only long afterwards were rediscovered as described by naturalists, though most of those I met with were already known and described, but not in works then accessible to me. I had no idea of studying merely the forms and structures of these creatures and knowing their names. To me they were living things, having strange ways and modes of thinking and acting of their own. They were truly acquaintances and friends, with whom I communed in private and who were my most pleasant teachers. It was for this reason that eventually I gave up all the others for the fossil relics of former life, because these, in addition to the living interest of the modern forms, possessed that fascination which arises from antiquity and from the stimulus to imagination given by their varied and often obscure relations to the past and present.

Judging from such experiences, I believe that it is best for young people to expatiate over a wide field of natural learning and afterwards to select any special field. On the other hand young people destitute of any developed taste for general knowledge, and introduced to special studies at first, will very likely beeome the crudest and narrowest of thinkers and at once the readiest recipients of fanciful hypotheses and the most stubborn sticklers for mere details and names.

In order to bring these desultory thoughts to some more practical issue, let us think for a little on the uses of the study of nature, whether we regard these in relation to the forming of the character and promoting the happiness of the student or to business utilities to which knowledge of nature may be applied. At present we hear much of applied and technical science, and these are daily showing their inestimable value, but it must be borne in mind that the science that enables us to smelt an ore, to construct a machine or a bridge is useful only in so far as it promotes the welfare and happiness of humanity. Apart from these it would be wholly unpractical and useless. That teaching of science, on the other hand, which exalts and ennobles the man and developes his higher nature, even if it have no technical applications, is that which is directly practical in the highest sense. I do not say that these are necessarily two distinct kinds of teaching. They may be and should be combined, and while we seek principally to promote by the study of nature the well-being of the man himself, we must never forget the multiform uses of science in promoting human welfare through technical applications. We may return to this thought, but in the meantime I desire to speak of nature as an educator of the man himself, and especially of those powess which make him distinctively a man and the very image of God.

The president then referred in detail to the educational uses of nature in training the observing powers and those of comparison and causation, to its bearing on the culture of true and high art, and to the large views to which it leads of the universe as an ordered and regulated cosmos. He then proceeded as follows :—

I may be pardoned here for directing your attention for a few minutes to the testimony of a writer eminent as an authority in art and full of true feeling for nature, both in reference to its direct ability to the thinking mind and its indirect utility as a means of furthering material interest. Ruskin thus discourses on these points :—

" That is to everything created, something pre-eminently useful, which enables it rightly and fully to perform the functions appointed to it by its Creator. Therefore, that we may determine what is chiefly useful to man, it is necessary first to determine the use of man himself. Man's use and functions (and let him who will not grant me this follow me no farther, for this I purpose always to assume) is to be the witness of the glory of God, and to advance that glory by his reasonable obedience and resultant happiness.

"Whatever enables us to fulfil this function, is in the pure and first sense of the word useful to us. Pre-eminently, therefore, whatever sets the glory of God more brightly before us. But things that only help us to exist are, in a secondary and mean sense, useful, or rather, if they be looked for alone, they are useless and worse, for it would be better that we should not exist than that we should guiltily disappoint the purposes of existence.

"And yet people speak in this working age, when they speak from their hearts, as if houses and lands and food and raiment were alone useful, and as if Light, Thought and Admiration were all profitless, so that men insolently call themselves Utilitarians, who would turn, if they had their way, themselves and their race into vegetables; men who think, as far as such can be said to think, that the meat is more than the life, and the raiment than the body, who look to the earth as a stable, and to its fruit as fodder; vine-dressers and husbandmen who love the corn they grind, and the grapes they crush, better than the gardens of the angels upon the slopes of Eden; hewers of wood and drawers of water, who think that the wood they hew and the water they draw are better than the pine-forests that cover the mountains like the shadow of God, and than the great rivers that move like His eternity. And so comes upon us that woe of the preacher, that though God "hath made everything beautiful in his time, also He hath set the world in their heart so that no man can find out the work that God maketh from the beginning to the end."

"But the common consent of men proves and accepts the proposition, that whatever part of any pursuit ministers to the bodily comforts and admits of material uses is ignoble, and whatsoever part is addressed to the mind only is noble; and that Geology does better in re-clothing dry bones and revealing lost creations than in tracing veins of lead and beds of iron; Astronomy better in opening to us the houses of heaven than in teaching navigation; Botany better in displaying structure than in expressing juices; Surgery better in investigating organization than in setting limbs; only that it is ordained that, for our encouragement, every step we make in the more exalted range of science adds something also to its practical applicabilities: that all the great phenomena of nature, the knowledge of which is desired by the angels only, by us partly, as it reveals to farther vision the being and the glory of Him in whom they rejoice and we live, dispense yet such kind influences and so much of material blessing as to be joyfully felt by all inferior creatures, and to be desired by them with such single desire as the imperfection of their nature may admit; that the strong torrents which, in their own gladness, fill the hills with hollow thunder and the vales with winding light, have yet their bounden charge of field to feed and barge to bear; that the fierce flames to which the Alp owes its upheaval and the volcano its terror temper for us the metal vein and quickening spring, and that for our incitement—I say not our reward, for knowledge is its own reward—herbs have their healing, stones their preciousness, and stars their times."

But in that time of confused and bewildering philosophies in which we live it may be asked, Is this really the case? Does not the study of nature rather lead to positivism and agnosticism. That it may do so is, I fear, too obvious. That this is its legitimate tendency may be emphatically denied. The case stands thus. Nature is to any rational man of science an exhibition of superhuman force, energy, power. It is in like manner an exhibition of regulated and determined power, of power under law and working to definite ends, and this with so complete and intricate machinery that it is beyond human comprehension. That this should be a result of mere chance without will or design is infinitely improbable. That it results from the operation of an all-powerful will and intellect is a conclusion based on all we know of ourselves.

The matter has been well summarized by a former pupil of my own, now a missionary in India, Rev. A. R. MacDuff, B.A. He says in effect :—

1. The apparent universe is phenomenal. A reality must be behind it, The things which are seen (the phenomenal) are necessarily temporal, the unseen is the eternal.

2. This reality must be persistent, not temporary. God only hath immortality.

3. This Divine reality must be incomprehensible in its essence and in the extent of its working. "Canst thou by searching find out God?"

4. But this incomprehensible reality is everywhere present in the most minute as well as in the grandest phenomena, in the fall of a sparrow as in the creation of a planetary system. "Whither shall I go from thy presence? In Him we live and move and have our being."

5. This infinite reality is more nearly akin to the spiritual nature of man himself than to any other energy known to us. It is, therefore, living, personal and free. "He that made the eye shall He not see?"

So far the teaching of nature may carry any man willing to be guided by his own senses and reason. Beyond this lies the sphere of revelation, or that of direct communication of the Divinity with man. With revelation nature has nothing directly to do, except that it can see its possibility—for just as the Divine mind can reveal itself in the instincts of an animal, so it must be able to influence and inform the higher nature of man.

Here, however, we can reach an easy and plain possible solution of all the difficulties which half-informed men heap up around the relations of science and revelation. Given the admission that the phenomena of nature are not merely imaginary but based on a reality, and given the admission that the Divine reality has revealed Himself to inspired men or through a Divine Man, and supposing that scientific study on the one hand and Divine revelation on the other may deal with the same phenomena, certain conclusions as to their relations at once become obvious. (1) Scientific inquiry being inductive must proceed from individual facts by slow and gradual steps to general laws, while revelation may state the laws at once without descending to particulars. (2) It follows that these two lines of thought approach phenomena from different sides. One takes them in detail and then generalizes. The other regards them as emanations of a Divine mind. (3) At first the results reached may be far apart and may seem contradictory, but as they become more perfect they must approach and eventually coalesce.

The case is as if we imagine some great mill or machine-shop to be studied by two different persons in different ways. The first may be a skilful machinist and may enter the factory, note-book in hand, and examine each machine and process, and so arrive at last at a knowledge of the whole which may enable him accurately to describe all its machinery, and to form conclusions as to its uses and relations. The second may be no machinist, but an educated and intelligent man. He is introduced to the superintendent of the factory as his guest, and learns from him its general nature and uses, the history of its inception and growth and his plans for its future improvement and development. All this he may learn without any study of the machinery; and he also may write an account of what he has seen and heard. But how different will be the two productions, and how difficult might it be for a third person to combine the two accounts, so as to make plain their mutual coherence. This could only be done by some one enjoying the double advantage of the friendship of the superintendent and the technical knowledge of the machinery. So it must ever be with science and revelation; and until men equally appreciate both, we cannot have the best results either in Science or in Theology.

Revelation itself has been defined on the best authority as relating on its practical side to three great graces, Faith, Hope and Love, the greatest and most enduring of which is the last, for God Himself is Love. In regard to love or kindly affection as a motive and practice, science cannot doubt that however little of this may be seen in the lower strata of nature, it is and must be the soul of its higher forms. Hope as to this is apparent in all even of the speculations of rational science, for pessimism is not scientific. With reference to faith as a scientific grace there may be more doubt, but this is dispelled by the consideration already referred to, that nature itself teaches of the unseen, and that the foundation of science is a belief in our own intuitions, in the evidence of our senses and in the reality underlying phenomena. Without faith, therefore, science could not exist any more than religion. This being the case, it becomes plain that however faith or religion may for a time be dissociated from experiment, observation and induction, they must ultimately be resolved into a rational unity. Science must admit that she is the handmaid of religion, and religion must say to science that she is no more a servant but a friend. If we are true students of nature we shall all more and more approach to this conclusion as we rise from one step of knowledge to another, and obtain broader views of nature and a better comprehension of the superlative littleness and infinite greatness of man himself as a part of nature and as the image of God.

In conclusion, the address referred to the work of the Society in the past sessions. It appeared from the records that fifteen original papers were read at the monthly meetings, the greater part of which have been published in the journal of the Society — *The Canadian Record of Science.* Of these papers seven were on Geological and Mineralogical subjects, and contained many new and important facts in Canadian Geology and with reference to the mineral resources of our country. The authors were Dr. Harrington, Prof. Donald, Mr. Deeks and the President. The remainder were on new facts in Biological Science, both Zoological and Botanical. The authors were Prof. Penhallow, Prof. Wesley Mills, Rev. Dr. Campbell, Mr. Caulfield and Mr. Stevenson. Two papers of great interest in Canadian Science, as well as in relation to eminent Canadians, were that in the career of the late Prof. C. F. Hartt by Mr. G. F. Matthew and the Biographical Sketch of the late Mr. Charles Gibb by Prof. Penhallow.

Charles Gibb, B. A.

Mr. Charles Gibb, son of the late James Duncan Gibb, was born in Montreal on the 29th of July, 1845. His early education was received at the Bishop's College Grammar School, from which he proceeded to McGill University, where he graduated in 1865. The hard work of a college course told somewhat severely upon a not very rugged constitution, with the result of impaired eyesight. For the purpose of recovering his health he then visited Europe, where he spent six months, returning very much benefited by the change. Natural weakness of the lungs, however, induced him to seek some active occupation which would give the benefit of open-air employment. This led to his spending several years with some of the more prominent fruit culturists of New York and New Jersey, from whom he gained a practical insight into the most approved methods of fruit culture. It was this experience which soon aroused a decided taste for horticulture, and eventually led to his adoption of that pursuit into which he threw so much energy and enthusiasm. Fortunately for himself and for the country whose good he sought to promote, Mr. Gibb was possessed of means sufficient to enable him to execute his plans without undue restriction, and future generations will have reason to hold in respect the name of one who, in so unselfish a spirit, endeavored to promote the welfare of his country in one of the most useful directions possible.

On his return from the States in 1872, he sought for a locality where he might pursue special studies in fruit culture and arboriculture, and eventually selected the warm, western slope of Yamaska mountain at Abbotsford, as fully meeting his requirements. In 1873 he purchased a large tract of land there, planted extensive orchards, established testing grounds for exotic trees and shrubs which might prove of value in Canada, and stimulated a local interest in his chosen pursuit, hitherto unknown in that part of Quebec. Here he established a delightful home, the door of which was constantly open to his many friends, all of whom have, on more than one occasion, experienced the full measure of his most generous hospitality. This Society has special reason for holding Mr. Gibb's charming retreat and his warm hospitality in remembrance. Two of their most profitable and enjoyable Field Days were those held at Abbotsford.

Of a somewhat retiring disposition, strangers were not drawn to him as quickly as they might be to many others, but even a brief acquaintance was sufficient to reveal qualities which were certain to cement a warm and enduring friendship, while to those who knew him best, his greatest fault lay in a modesty which permitted him to sacrifice a just appreciation of his own merits. Possessed of a warm heart, it was his first desire to see others about him happy, and had this idea not been carried out rather too unselfishly, doubtless his home would have known the blessing of a partner in his useful work. Though not a man of large means, he conscientiously endeavored to make the best use of what he possessed, and while his modesty forbade any ostentatious display, he accomplished a large amount of good in many directions. He was an active supporter of the Art Association of Montreal, a contributor to most of our public charitable institutions, and a warm supporter of those societies whose work lay in the promotion of science and horticulture. He contributed in many ways to the work undertaken by McGill College in promoting the study of science, his various donations at different times being most judiciously applied. Among other gifts of a similar nature, he, on more than one occasion, made valuable donations of trees and shrubs, which are now growing in the College grounds, and constitute an important element in the foundation of the Botanic Garden now in process of development.

As a pomologist Mr. Gibb was justly accorded a high position, and his writings on this subject will have a lasting value. Whatever he undertook to do was executed with a degree of intelligent interest and thoroughness which left little to be desired, and it was his most conscientious scrutiny of facts which has given character to his various writings, as being thoroughly reliable statements. The same thoughtful care and attention to details was evident in the expressions contained in his last letter, indited only two days before his death, of the near approach of which he was conscious.

Mr. Gibb died of pneumonia at Cairo, Egypt, on the 8th March, 1890. To all who knew him his death is a personal loss; to his more intimate friends, it is the loss of a brother; to his country, for whose walfare he nobly and generously toiled, and in whose interest he was making a prolonged tour of foreign lands when death overtook him, it is the removal of one who filled an important place in our material progress, one who could not well be spared.

Although not a scientific man, he had given such close and accurate attention to fruit culture as to make him eminent among the pomologists of this continent, while his name was well and favorably known throughout Europe, It is therefore desirable that his work in the interests of improved horticulture should receive consideration.

Mr. Gibb was a life member, and in 1879-81, vice-president for Quebec of the American Pomological Society; corresponding member of the Mississippi Valley Horticultural Society; corresponding member of the Massachusetts Horticultural Society; honorary member of the Nova Scotia Fruit Growers' Association; member of the Natural History Society of Montreal, and a member and, at the time of his death and for several years previous, vice-president of the Montreal Horticultural Society and Fruit Growers' Association of the Province of Quebec. He founded the Abbotsford Fruit Growers' Association, was its leading spirit to the day of his death, and at various times held most of its leading offices. He took a most active part in the recent efforts to establish a Botanic Garden in the city of Montreal, and was at all times one of the leading and most useful members of the Montreal Horticultural Society, to whom his loss comes as a most serious one. At the time of the Indian and Colonial Exhibition at London, he was one of the principal promoters of the important fruit exhibit then made.

In 1882, acting upon a suggestion made by Prof. Wm. Saunders, while president of the Ontario Fruit Growers' Association, and impressed with the need of a better acquaintance with the fruits of the old world, in order to determine how far improvements in our own fruits could be made through the importation of and crossing with those from similar and colder climates, Mr. Gibb, in company with Prof. J. L. Budd of Ames, Iowa, visited various parts of Russia and Northern Europe, and brought back information of great value. The expenses of this journey were wholly met by the private means of these two gentlemen The knowledge gained was subsequently embodied in several valuable articles published in the reports of the Montreal Horticultural Society and elsewhere. In 1888, Mr. Gibb visited California in the interests of fruit culture, and in June, 1889, he started on a journey through the east, for the purpose of more closely examining their various fruit products. Proceeding to Japan by way of Vancouver, he traversed the "Island Empire" from one end to the other, and was particularly interested in examining the resources of the northern Island of Yeso, which, on account of its high latitude, he felt sure was likely to yield many plants which would prove of great value in Canada. There he met with every attention from various officials to whom he had letters of introduction, and through whose courtesy he was enabled to carefully examine many localities of interest. The notes he took during this part of his travels undoubtedly contain a large amount of material of special value, and it is to be hoped that it may be possible to publish them at some future time. From Japan he proceeded to Hong Kong, Ceylon, Calcutta, Bombay, and thence to Cairo, where his fatal illness overtook him.

The work undertaken by Mr. Gibb, in the line of practical horticulture, was of the greatest importance to Canada, and more especially to Quebec, where the kinds of fruit which can be successfully grown are necessarily limited. At Abbotsford he had established extensive orchards of Russian fruits, which he was testing not only for quality, but for climatic adaptation and their value for purposes of hybridizing with native and less hardy kinds. Most of these trees are yet very young, but some of them have attained that age at which they are in a condition to yield important results. An extensive plantation of fruit and ornamental trees was also an important feature of his work, and had he been spared for another decade, valuable results would have been secured from a work wisely conceived and intelligently prosecuted. Though not known as an originator, one fruit will serve to transmit his name to future generations of pomologists. The Gibb Crab, a most delightful fruit of its class, was discovered by Mr. Gibb in the orchard of Mr. Peffer of Pewaukee, Wisconsin, by whom it had been overlooked, but who promptly named it in honor of him who had rescued it from oblivion.

Mr. Gibb's writings upon horticulture are somewhat numerous and of very considerable value. Almost his first contribution was the publication of "A Fruit List for the Province of Quebec." This little pamphlet was published in 1875, by the newly organized Fruit Growers' Association of Abbotsford, and led to the issue, in the following year, of a "Report of the Fruit Committee of the Montreal Horticultural Society for 1876." The publication of this report was secured by Mr. Gibb in the face of great obstacles, but its importance demonstrated the need of an annual publication of the work of the Society. It thus came to be the first of a series of annual reports to which Mr. Gibb contributed largely, and which, through the valuable character of the material they contain, have gained a high reputation both at home and abroad. Perhaps Mr. Gibb's most important publication is his contribution to "The Nomenclature of our Russian Fruits." This paper was prepared at the request of the American Pomological Society, and offers at once a most careful, exact and authoritative revision of the names of Russian fruits imported into America, extant. It is a monument to the zealous and painstaking care of one who verified his statements in every possible way before giving utterance to them. The following list of publications will best serve to express the character and extent of his work :

1. "Report on Quebec Fruits," Rept. Amer. Pom. Soc., 1874, p. 33.
2. "A Fruit List for the Province of Quebec," published by the Abbotsford Fruit Growers' Association, 1875.
3. "Report of the Fruit Committee of the Montreal Horticultural Society," first An. Rept. M. Hort. Soc., 1876.
4. "Propagated Seedlings and Other Undescribed Fruits," Rept. Mont. Hort. Soc., 1876, p. 19.
5. "Report on the Fruit Growers' Asseciation of Abbotsford," Rept. Mont. Hort. Soc., 1876, p. 67.
6. "Notes on Outdoor Grapes," Rept. Mont. Hort. Soc., 1879, p. 54.
7. "Ornamental and Timber Trees," Rept. Mont. Hort. Soc., 1881, p. 58.
8. "The Work of the State Agricultural College at Ames, Iowa," Rept. Mont. Hort. Soc., 1881, p. 151.
9. "Russian Fruits," Rept. Mont. Hort. Soc., 1882, p. 17.
10. "Hasty Notes on Trees and Shrubs of Northern Europe and Asia," Rept. Mont. Hort. Soc., 1882, p. 99; Rept. Ont. Fruit Growers' Association, 1883, p. 302.
11. "Catalogue of Russian Fruits Imported by the U.S. Department of Agriculture in 1870," Rept. Mont. Hort. Soc., 1883, p. 52.
12. "Report on Russian Apples Imported by the U.S. Department of Agriculture in 1870," Rept. Mont. Hort. Soc., 1883, p. 58.
13. "Report on Russian Fruits with Notes on Russian Apples Imported in 1870 by the U.S. Department of Agriculture," Rept. Ont. Fruit Growers' Association, 1883, p. 192.
14. "Siberian Apples and Their Hybrids," Rept. Mont. Hort. Soc., 1884, p. 33.
15. "Hardy Fruits in Wurtemburg," Rept. Mont. Hort. Soc., 1884, p. 19.
16. "Ornamental Trees," Rept. Mont. Hort. Soc., 1884, p. 50.

Proceedings of the Society.

The regular monthly meeting was held on Monday the 21st of April, Sir Wm. Dawson presiding.

Mr. Shearer, on behalf of the Excursion Committee, reported that Lachute had been selected for the annual field day, and that Saturday the 7th of June had been decided upon.

The following donation to the museum was reported by the Curator :—

Prairie horned lark, by Mr. F. B. Caulfield, for which the thanks of the Society were tendered the donor.

It was moved by Mr. Sumner, seconded by Mr. Beaudry, "that proposals for membership may be submitted to the Council at their monthly meetings and balloted for at the first meeting of the Society following." Carried. Balloting for new members resulted in the election of James Paton, Dr. F. J. Shepherd and George Boulter.

The Corresponding Secretary was instructed to invite the Ottawa Field Naturalists' Club and other societies from that city to participate in the field day excursion of this Society.

Sir William Dawson offered a paper "On the name Quebec Group as applied to certain Canadian Rocks."

Mr. H. T. Martin submitted a few notes on the beaver, and Mr. F. B. Caulfield read a contribution on the subject of "Our Winter Birds."

The annual meeting of the Society was held on Monday the 26th of May, when the following reports were read and adopted[1] and ordered to be printed in the *Record of Science.*

Mr. President, Gentlemen,

On behalf of your Council I have the honor to report.

The work of the Society for the year has been successful and attended with much interest.

The Society has had six general meetings, the Council ten meetings, three of which were special ones.

[1] The Presidential address will be found printed in full on p. 171.

Twenty-three new members were added to the list, five less than last year against twelve the year previous.

It is my painful duty to record the removal by death of the following of our members:—Chas. Gibb, Andrew Robertson, Jas. Hutton, Thos. Workman, Hon. Thos. Ryan and Dr. Barnes.

All the departments have received due care. The library has received more attention than any other year, and special thanks are due to the honorary librarian, who has attended regularly every week arranging the books and the catalogue.

Thanks are also due to the honorary curator for the time he has devoted to the museum. An important change has been made by the appointment of a Museum Committee, with the object of dividing the work, which had become very onerous.

We are also indebted to the Editing Committee and its chairman for the success of our journal.

The Sommerville course of lectures—seven in number—attracted more interest than previously. They were as follows:—

February 20—Food without and within the body, Dr. Wesley Mills, M.A.

February 27—Tea and coffee, Dr.J.P. Girdwood, F.R.S.C.

March 6—Flour, Prof. J. T. Donald, M.A.

March 13—Drinking water, Dr. R. F. Ruttan, B.A.

March 20—Food diseases, Dr. W. G. Johnston.

March 27—Jewish dietary law, Rev. Meldola de Sola.

April 3—Milk, Prof. W. H. Ellis, M.A., M.D.

Mr. P. S. Ross, our late treasurer, is entitled to our gratitude for a donation of $25 for the special purpose of illustrating *The Record.*

But Messrs. J. S. Brown and J. S. Shearer deserve more than a passing notice of the successful efforts and zeal displayed in finding the funds and improving the interior of the building.

The members and friends who have contributed to present to the Society the portrait of our worthy and respected president are also deserving your thanks.

The Government grant of $400 has been received and used for the publication of our journal.

The Council has passed a new by-law, so that proposals for membership to the Society are submitted to the Council and balloted for at the following general meeting, thus avoiding delays and yet leaving the names of candidates posted a sufficient length of time.

Our delegate to the Royal Society of Canada has been instructed to ask that Society to hold its meeting of 1891 in Montreal. It is to be hoped that there will be no serious objection to that project.

The field day was held on the 8th of June, at St. Eustache, and was enjoyed by a large number of members and their friends. There was only one collection entered for prizes —a collection of 34 specimens of named plants by Dr. Blackader.

In closing I may mention the attentive assistance your superintendent cheerfully renders to all the officers of the Society.

The whole respectfully submitted,

J. A. U. Beaudry,
Pres. of Council.

CURATOR'S REPORT, 1889-90.

The past year has been one of marked activity in the museum, owing chiefly to the extra work required in carrying out the alterations and reforms referred to in the last annual report.

It was found necessary to repaint the wall-cases on the main floor, and in consequence the animals and birds had all to be removed while that was being done. Specimens could not be displayed to advantage in the upper portions of these cases; it was, therefore, deemed advisable to frost the top row of glass and shelve off that part, thus affording space for duplicate specimens.

New cases have been ordered for the centre of this floor. They are now being made, and within the next month it is expected they will be placed in position, and the objects intended to occupy them arranged.

An important change has been made in regard to the management of the museum. It was generally acknowledged that a better arrangement and more scientific classification of specimens were necessary; and, as the carrying out of such a scheme would occupy more time than was at the disposal of your curator, at his suggestion a committee was formed and the museum divided into different departments, each member taking charge of one, according to natural inclination, as follows:—

Mammalogy—Mr. Horace T. Martin.

Ornithology—Mr. F. B. Caulfield.

Ichthyology— ———

Conchology—Mr. E. T. Chambers.

Geology and Mineralogy—Dr. Harrington and Mr. E. H. Hamilton.

Anthropology— ———

Should a botanical department be formed, Prof. Penhallow has signified his willingness to take charge of it.

At the first meeting of this committee a general plan of conformation was adopted, whereby all zoological specimens will occupy the main floor, the gallery being reserved for geological, anthropological and other specimens.

For obvious reasons the work of re-arranging could not be commenced simultaneously, but as one department is finished another is begun, and unnecessary confusion thus avoided.

Considering the late season at which these measures were introduced, it is pleasing to note the splendid progress made amongst the mammals and birds by Messrs. Martin and Caulfield respectively, whilst the re classification and labelling of the entomological collection by Mr. Winn and his friend Mr. Dawson have been almost completed.

There were 2,094 visitors admitted to the museum during this year, as against 1,192 last year. Considering that we had no carnival this year and that the museum was practically closed for two months during repairs, this result is very gratifying.

The admission fees for the year amount to $50.15, or about $20 less than last year, which may be accounted for in admitting the schools and colleges free, and which concession has been largely taken advantage of by the scholars and students attending the various schools and colleges of the city.

The thanks of the Society are due to the gentlemen of the Museum Committee, whose names have already been mentioned, for their valuable assistance in re-arranging specimens, as well as to the superintendent, Mr. Griffin, for his attention to visitors, and for the admirable manner in which the museum has been kept clean and free from dust.

The oil painting of our worthy president, Sir William Dawson (by Harris), which was presented to the Society by a number of members and friends, has been hung in an appropriate part of the museum.

The following specimens have been added to the museum during the year :—

DONATIONS.

A various collection of birds.

Small ant-eating bear.

Specimen of sponge.

Beaver wood and chips.

A collection of game birds.

Specimen of quartz rich from Mount Stephen.

Piece of (Norway?) pine taken from foot of St. Francois Xavier street, supposed to be part of Maisonneuve's fort.

Ulster County *Gazette*, N.Y., of January 4th, 1800, containing account of death and entombment of General Washington.

Chinese Testament.

Olive-sided fly-catcher, "Contopus borealis."

Black-crowned night heron (spring) "Nycticorax nævius."

Head of Maskinonge.

Great blue heron.

Evening grosbeak.

Brown rat (young male).

Pine grosbeak (young male).

Alligator.
Peregrine falcon or duck hawk.
Indian war club found at Guelph, Ont

PURCHASED.

Evening grosbeak (female).

BY EXCHANGE.

Northern shrike.

Respectfully submitted,
J. STEVENSON BROWN,
Hon. Curator.

To the President and Council of the Natural History Society.

GENTLEMEN,

The Library Committee beg to report that during the past year the work of sorting and arranging the parts and numbers of exchanges and periodicals belonging to the Society has been completed. One hundred and eleven volumes are now ready for the binder, and efforts are being made to obtain the parts required to complete about twenty other volumes, of which parts are missing.

Progress has been made in locating and noting in the catalogue the books on the south side of the library, but this work cannot well be finished till the books waiting to be bound be returned from the binder.

It was arranged at the special meeting of the Council, held on May 27th, 1889, that the periodicals and other works received in exchange for the *Record of Science* should be received and acknowledged by the Librarian. This has been done, and the works received immediately placed in the case for the use of members.

The Committee beg to acknowledge the following donations, for which, in the name of the Society, they desire to thank the donors:—

"Winchell's Pre-Adomites," from Mrs. E. P. Hannaford.

"New Species of Fossil Sponges," from Sir J. W. Dawson.

"Cretaceous Rocks of the North west," from Dr. G. M. Dawson.

"On the Ore Deposits of Treadwell Mine," from Dr. G. M. Dawson.

"Glaciation of British Columbia," from Dr.G.M. Dawson.

Seven papers on mathematical subjects, from Professor Hennesey.

"Tertiary Deposits of Manitoba," from J. B. Tyrrel.

"Stratigraphy of the Quebec Group," from Dr. Ells.

"Catalogue of Canadian Minerals at Philadelphia," from F. Emberson.

"Report on North Shore of Lake Huron Exhibition," from F. Emberson.

"Report on Geology of Newfoundland," from F. Emberson.

"Report of Geological Survey for 1844 and 1849-50, from F. Emberson.

Bulletins of the Agricultural Departmer t, Washington.

Bulletins of Inland Revenue Department, Ottawa.

Bulletins of Smithsonian Museum.

"Catalogue of Sponges in Australian Museum," from the Trustees of the Australian Museum.

Geology, Zoology, etc., of Lord Howe Island.

Your Committee are glad to report that more use has been made of the library by members during the past year, and believe that its usefulness will be greatly enhanced when a more simple catalogue is made out. This, it is hoped, will be taken in hand at once, now that the whole library has been looked over and in a great measure arranged.

Respectfully submitted on behalf of the Library Committee.

E. T. Chambers,
Chairman.

MEMBERSHIP COMMITTEE—REPORT 1889-90.

A meeting of this Committee was held on March 17th, 1889, when the treasurer, Mr. Gardner, reported that there were only 181 ordinary members, and as these from time to time were dropping out, it was highly important that the list of life members should be increased.

A list of those who had lately resigned was read over, those present noting such as they wished to call upon with the view to having them continue their subscriptions.

It is the opinion of this Committee that, by the individual efforts of the members of the Society, the membership roll could be greatly increased, and the members are, therefore, specially appealed to to assist in this matter.

Respectfully submitted.

J. Stevenson Brown,
Chairman.

The Treasurer's statement for the year shows the following gratifying position of the Society :—

NATURAL HISTORY SOCIETY OF MONTREAL IN ACCOUNT WITH JAS. GARDNER, TREASURER.

RECEIPTS.

To Balance from last year	$ 16.80
" Rents	1202.00
" Annual Subscriptions	645.00
" Government Grant	400.00
" Entrance Fees, Museum	50.15
" Field Day Surplus	8.72
" Interest	4.36
" Special Donation P. S. Ross, Esq., towards illustrating Record	25.00
" Special Subscriptions collected by Messrs. J. S. Shearer and J. S. Brown for Improvements and Alterations	588.75
	$2940.78

Disbursements.

By Salary Superintendent and Commissions.........	$ 453.80
" Sundry Expenses....................................	306.98
" Light..	207.95
" Fuel...	136.70
" Insurance..	69.60
" Taxes	32.64
" Lectures...	114.86
" Museum...	48.80
" Soil Temperatures................................	13.75
" Record of Science................................	766.40
" Improvements and Alterations in Building.......	101.50
" " " from Special Fund Expended by Messrs. J. S. Shearer and J. S. Brown..............................	586.74
" Balance on hand..................................	101.53
	$2940.78

Examined and found correct.

GEO. SUMNER,
JOHN S. SHEARER.

Montreal, 26th May, 1890.

Sir Wm. Dawson having signified his desire to be relieved from the presidential office, he was, on motion of Hon. Senator Murphy, seconded by Mr. J. S. Shearer, elected to the position of Honorary President.

The following officers were then elected for the ensuing year :—

Honorary President—Sir J. Wm. Dawson.

President—Dr. B. J. Harrington.

Vice-Presidents—J. S. Shearer, Hon. E. Murphy, Prof. D. P. Penhallow, Rev. Robt. Campbell, Sir Donald A. Smith, J. H. R. Molson, George Sumner, H. J. Joseph, Very Rev. Dean Carmichael.

Recording Secretary—Albert Holden.

Corresponding Secretary—Horace T. Martin.

Curator—J. Stevenson Brown.

Members of Council—J. S. Shearer (Chairman), J. A. U. Beaudry, Dr. R. F. Ruttan, S. Finley, Dr. J. W. Stirling, R. W. McLachlan, Dr. J. C. Cameron, Major Latour, Rev. Canon Empson.

Editing Committee—Prof. D. P. Penhallow, Dr. B. J. Harrington, Dr. T. Wesley Mills, G. F. Matthew, J. F. Whiteaves.

Library Committee—E. T. Chambers (Chairman), J. A. U. Beaudry, F. B. Caulfield, R. W. McLachlan, Joseph Fortier.

Lecture Committee—Dr. Harrington (Chairman), Rev. Robt. Campbell, P. S. Ross.

House Committee—J. S. Shearer (Chairman), J. Stevenson Brown, Albert Holden.

Membership Committee—J. S. Brown (Chairman), S. Finley, P. S. Ross, Dr. Stirling, Geo. Sumner, Dr. Birkett, J. A. U. Beaudry, R. W. McLachlan, Henry Hamilton, A. F. Winn, Dr. J. C. Cameron.

Taxidermist—F. B. Caulfield.

NOTE.

The Duck Hawk at Abbotsford, P.Q.—A pair of this species (*Falco peregrinus anatum*) were recently presented to the Society by Mr. N. E. Fisk. They were shot at Abbotsford, P.Q., on May 7th, 1890, by his son Charles Albert Fisk. Mr. Fisk states that they had a nest in a recess in the western side of the mountain (Yamaska) and that one or two pairs of these birds have been observed there for the past forty-five years. This information is very interesting as this species although occurring throughout the entire Dominion is one of our rarest hawks and the records of its nesting in the southern parts of its range are very few indeed.

F. B. CAULFIELD.

Field Day.

The annual field day of the Society was held on Saturday, June 7th. At ten o'clock about one hundred and fifty ladies and gentlemen assembled at the Windsor street station, where, through the courtesy of the Canadian Pacific Railway, four fine drawing-room cars were placed at their disposal. In addition to members of the Natural History Society, there were strong representations of the Camera Club, the Entomological Society and the Agassiz Association. On arriving at their destination the party met a delegation from Ottawa, consisting of the Ottawa Field Naturalists' Club and their friends, in all about fifty.

The objective point, Lachute, was reached in season for an early lunch. On disembarking, the excursionists were cordially welcomed by the mayor, Dr. Smith. In the absence of the president, Dr. Harrington, and of the honorary president, Sir Wm. Dawson, Prof. Penhallow, as vice-president, replied to the mayor on behalf of the Society, welcomed the Ottawa delegation and announced the programme for the day. Immediately after lunch the various parties dispersed in different directions under their respective leaders. Many visited the Lachute paper mills, to which an invitation had been extended by Mr. J. C. Wilson. Another large party visited the cartridge factory, where they received many courtesies at the hands of the manager, Capt. Howard. The entomologists under Mr. Jas. Fletcher and Mr. Caulfield; the geologists under Dr. Ells, Mr. Whitman and Mr. McOuat; the botanists under Prof. Penhallow, and the Camera Club under Mr. Henderson, all found, in their respective fields, opportunities for profitable employment.

At four o'clock the party assembled at the Post Office, where the various collections were examined and prizes announced. Mr. Whitman made some remarks upon the geology of the district, pointing out that in the immediate vicinity were localities which had gained great repute among geologists on account of the special work of Sir Wm. Logan in connection with them. Remarks on the insects

ABSTRACT FOR THE MONTH OF APRIL, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range	*BAROMETER. Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	27.90	32.5	23.8	8.7	30.3103	30.398	30.194	.204	.0902	59.7	15 8	S.W.	22.1	1.8	10	0	89	....	.. .	....	1
2	30.97	37.0	21.1	15.9	30.3263	30.454	30 214	.240	.1167	67.2	21.3	S.W.	32.0	6.7	10	0	43	....	....	....	2
3	40.50	48.1	32.5	15.6	30.0885	30.211	29 905	.306	.1480	58.7	27.2	S.W.	25.0	4.2	10	0	94	....	....	....	3
4	40.40	48.0	32.6	15.4	29.6580	29 781	29.507	.274	.2297	89.5	37 5	S.W.	21.3	10.0	10	10	00	0.65	.	0.65	4
5	29.88	36.0	24.8	11.2	30.1103	30.243	29.923	.320	.0928	56.0	16.7	W.	21.3	2.2	10	0	83	....	Inapp.	0.00	5
SUNDAY........ 6	.... .	45.5	27 8	17.7	....	......	......	.	. .	....	....	S.W.	20.9	....	..	.	37	0.02	....	0 02	6 ....SUNDAY
7	40.95	47.0	35.2	11.8	29.8825	29.934	29.836	.098	.1693	67.0	29.7	W.	13.0	5.0	10	0	56	....	....	....	7
8	33.80	41.3	28.8	12 5	29 9108	30.047	29.729	.318	.1265	64.7	23.0	N.E.	15.1	6.7	10	0	50	0 03	0 2	0.06	8
9	40.52	44.9	35 7	8.2	29.4505	29.665	29 220	.445	.2145	84.8	36 5	S.E.	19.9	10.0	10	10	00	0.15	....	0.15	9
10	36.02	43.7	31.7	12.0	29.5372	29.833	29.249	.584	.1573	73.5	28 5	S.W.	25 6	10.0	10	3	06	....	Inapp.	0.00	10
11	32.87	40.8	25 8	15.0	30.0502	30.120	29 957	.163	.1173	62.8	21.7	W.	12.1	4.0	10	c	71	....	....	....	11
12	46.17	58.2	30 8	27.4	30.0792	30 191	30 003	.188	.1723	55 0	30.2	S.	18.6	1.0	4	0	91	....	....	....	12
SUNDAY. 13	.....	62.8	40.5	22.3	....	......	......	....	.. .	....	....	N. W.	7.0	....	.	..	77	....	....	....	13 ....SUNDAY
14	46.05	57.0	37.6	19.4	29 9110	30.055	29.773	.282	.2080	66.3	35 0	N.	12 4	8 2	10	0	40	0.05	....	0.05	14
15	39.20	47.4	31.7	15.7	30.2778	30.375	30.165	210	.0858	37.7	13.8	N.W.	19.2	0.0	0	0	99	....	....	...	15
16	40.87	52.0	30.7	21.3	30.2328	30.367	30.103	.264	.1363	53 8	25.2	S. W	17.4	2.0	10	0	82	....	....	....	16
17	37.30	46 8	30.7	16.1	29 9652	30.009	29 929	080	.1138	51.3	20.7	N.W	17.0	7.2	10	0	61	....	....	....	17
18	27 27	31.6	21.6	10.0	29.9883	30.067	29.945	122	.0738	49.3	11.3	N.W.	16 7	6 7	10	0	36	....	Inapp.	0.00	18
19	39.05	49.1	27.7	21.4	30 2027	30.301	30.120	.181	.1208	50.7	22.3	W.	12.3	1.8	10	0	87	....	....	....	19
SUNDAY.. 20	.... .	54.4	33.7	20 7	....	......	.....	..	.....	....	....	N.W.	14.8	...	..	..	95	....	....	....	20 ....SUNDAY
21	44.47	53 8	36.6	17.2	30.2615	30.333	30 227	.106	.1855	62.7	32 0	S.W.	23.8	3.2	10	0	45	0.12	....	0.12	21
22	48.77	58.3	36.2	22.1	30.3020	30.409	30.178	.231	.1538	44.2	27.5	S.	12 2	3.8	10	0	46	Inapp.	....	....	22
23	55.57	66 9	44 6	22.3	29.9813	30.203	29.874	.329	.2683	61.3	41.5	S.W.	24.2	6.0	10	0	34	Inapp.	....	....	23
24	40.80	54.1	33.8	20.3	30.2552	30.294	30.158	.136	.1258	48.7	22.7	N.	15 5	2 5	8	0	95	....	......	....	24
25	38.02	49.9	29.7	20.2	30.3513	30.422	30 284	.138	.1065	47.0	19.3	N	17.9	1 7	10	0	76	....	....		25
26	41 75	53.0	29.6	23 4	30.3073	30.456	30.123	.333	.1277	49.8	23.0	S.E.	13.8	6 5	10	0	73	0.02	....	0 02	26
SUNDAY....... 27	.....	40.5	32.7	7 8	. ...	....	......	....	..	....	....	N.E.	12 3		..	..	00	0 13	2.8 (?)	0 41	27 ....SUNDAY
28	45.58	54.0	35.7	18.3	30.0542	30.116	29.994	.122	.1548	52.0	28.2	W.	15.3	0.5	2	0	98	....	....	...	28
29	49.27	59.6	38.6	21.0	29.8660	30 055	29 698	357	.2325	66.8	37 3	S.	16.8	7.8	10	0	41	0.31	....	0.31	29
30	46.43	49.7	41.7	8.0	29.7198	29.777	29 660	.117	2595	82.0	41.0	S.W.	21.8	10.0	10	10	00	0.32	....	0.32	30
....Means	40.01	48.80	32 13	16.66	38 0415	......	.... .	0 236	.1534	60 1	26 5	....	17.9	4.98	..	.	56.8	1.80	3.0	2.11	Sums ....
16 yrs. means for & including this mo.	39.60	47.68	31.73	15.94	29.9425	......	......	0 201	.1683	66.7	....	......	....	5.84	..	..	¶53.2	1.59	6.5	2 24	16 years means for and including this month

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N. W.	Calm
Miles............	1277	664	287	1122	872	5517	1628	1534	—
Duration in hrs..	89	50	25	68	52	236	95	99	6
Mean velocity...	14.4	13.3	11.5	16.5	16.8	23.4	17.1	15.5	

Greatest mileage in one hour was 41 on the 10th. Greatest velocity in gusts 49 miles per hour on the 10th.
Resultant mileage, 5,760.

Resultant direction, S. 61°5 W.
Total mileage, 12,901.
Average mileage per hour 16.94.

*Barometer readings reduced to sea-level and temperature of 32° Fahr

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 66.9 on the 23rd; the greatest cold was 21.1 on the 2nd, giving a range of temperature of 45.8 degrees. Warmest day was the 23rd. Coldest day was the 18th. Highest barometer reading was 31.456 on the 26th; lowest barometer was 29.220 on the 9th, giving a range of .236 inches. Maximum relative humidity was 96 on the 4th. Minimum relative humidity was 15 on the 15th.

Rain fell on 12 days.

Snow fell on 5 days.

Rain or snow fell on 13 days.

Auroras were observed on 3 nights.

Lunar halo on 1 night.

Fogs on 2 days.

Meteorologica C. H. McLEOD, *Superintendent.*

DAY.	TH… Mean.	…possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	41.30	20	Inapp.	....	0.00	1
2	41.32	71	....	....	....	2
3	53.53	57	0.46	....	0 46	3
SUNDAY........ 4	....	00	0.38	....	0.38	4 ....SUNDAY
5	42.78	00	0.13	....	0.13	5
6	45.88	00	0.98	....	0.98	6
7	44.27	45	....	....	....	7
8	44.53	88	....	....	....	8
9	46 03	06	0.18	....	0.18	9
10	45.77	32	0.09	....	0.09	10
SUNDAY........11	.....	00	....	....	....	11 ....SUNDAY
12	48 70	06	....	....	....	12
13	50.55	00	0.13	....	0.13	13
14	54.83	16	0.09	....	0.09	14
15	57 67	51	Inapp.	....	0.00	15
16	51 07	60	....	....	....	16
17	47.30	28	0.21	....	0.21	17
SUNDAY........18	.....	66	Inapp.	....	0.00	18 ....SUNDAY
19	57.48	00	0.18	....	0.18	19
20	46.40	00	1.31	......	1.31	20
21	49 72	91	....	....	...	21
22	57.32	22	....	....	....	22
23	56.25	45	0.02	....	0.02	23
24	58.62	47	....	....	.....	24
SUNDAY........25	.....	56	....	....	....	25 ....SUNDAY
26	58.65	16	0.05	....	0.05	26
27	56.23	49	0.44	....	0.44	27
28	57.33	54	0.20	....	0.20	28
29	56.78	7	.	....	....	29
30	59.63	9	....	....	....	30
31	62.88	0	....	....	....	31
....Means	51.59	3	4.85	....	4 85	Sums ....
16 yrs. means for & including this mo.	54.58	3	2.98	....	2 99	16 years means for and including this month.

AN…

Direction........	N.	N…
Miles............	1099	
Duration in hrs..	81	
Mean velocity...	12.5	1…

Greatest mileage in one ho…
Greatest velocity in gusts 6…
the 17th.

…he 5th and 6th. Minimum relative humidity 27 on the 11th.

…ain fell on 18 days.

…lar halos on 2 days.

…nar halo on 1 night.

…g on 3 days.

…under on 2 days.

…e month was characterized by being unusually …and cold.

ABSTRACT FOR THE MONTH OF MAY, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	41.30	48.4	32.5	15.9	29.8543	30.089	29.668	.421	.1778	65.3	29.8	W.	17.5	6.5	10	0	20	Inapp.	....	0.00	1
2	41.32	50.9	28.3	22.6	30.0842	30.143	30.014	.129	.1235	46.8	22.8	S.W.	14.5	4.5	10	0	71	....	....	....	2
3	53.53	71.5	39.7	31.8	29.8427	29.925	29.739	.186	.2533	63.2	40.0	S.	21.0	5.2	10	0	57	0.46	.. .	0 46	3
SUNDAY........ 4	.. .	47.0	36.2	10.8	....	......	......	....	... .	....	....	N.E.	25.0	....	..	..	00	0.38	.. .	0.38	4 ....SUNDAY
5	42.78	47.3	38.1	9 2	29.6063	29.707	29.558	.149	.2665	96.3	41.8	N.E.	18.6	10.0	10	10	00	0.13	....	0.13	5
6	45.88	49.0	42 1	6.9	29.6558	29.739	29.585	.154	.2775	90.0	42.8	S.W.	16 5	9.8	10	9	00	0.98	....	0.98	6
7	44 27	49.4	37.8	11.6	30 0070	30.234	29.828	.406	.1777	61 0	31.5	S.W.	15 2	4.8	10	0	45	....	....	....	7
8	44.53	53.0	35.7	17.3	30.1140	30.191	30.042	.149	.1560	54 0	28 3	....	9 8	1.8	4	0	88	....	....	....	8
9	46 03	58.0	38.4	19 6	29.8825	30.015	29.763	.252	.2472	77.7	39.2	S.W.	19.6	8.3	10	c	06	0.18	....	0.18	9
10	45.77	51.8	39 6	12.2	29.9253	29.961	29 876	.085	.1862	60.5	32.5	W.	7 8	7.2	10	0	32	0.09	....	0.09	10
SUNDAY. 11	.....	59.0	35.8	23 2	....	......	......	....	.....	....	....	N.W.	13 3	....	.	..	100	....	...	....	11 ....SUNDAY
12	48 70	57.5	35.7	21.8	30.0107	30.220	29.862	.358	.1802	52.5	31.5	S.W.	10 4	9.2	10	5	06	....	....	....	12
13	50.55	54.8	44 5	10.3	29.7057	29.851	29.605	.246	.3120	84.3	45 7	S.W.	7.6	9.8	10	9	00	0.13	....	0.13	13
14	54.83	62.0	50.3	11.7	29.6742	29.718	29.610	.108	.3147	74 2	46 2	S.W.	12 4	8.3	10	0	16	0.09	....	0.09	14
15	57 67	67 0	46 4	20.6	29.7558	29 808	29.720	.088	.3182	67.8	46.5	S.W.	14 3	8.2	10	0	51	Inapp.	....	0.00	15
16	51 07	60.5	45.6	14.9	29 8980	29.962	29.800	.162	.2348	63.2	38.7	S.W.	17 4	7.5	10	0	60	....	....	....	16
17	47.30	55.5	39.6	15.9	29.7943	30.022	29.635	.387	.2218	69.3	37.0	S.W.	24 1	6.0	10	0	28	0.21	....	0.21	17
SUNDAY........18	.....	55.5	37.6	:7.9	....	......	.....	....	.....	....	....	W.	15.1	....	..	..	66	Inapp.	....	0.00	18 ....SUNDAY
19	57.48	64 0	51.3	12 7	29.7930	29.811	29.768	.043	.3737	78.2	50.7	S.	16.2	9.2	10	5	00	0.18	....	0.18	19
20	46.40	55 9	40 7	15.2	29.6952	29.930	29.562	368	.2890	89.8	43.7	W.	18.8	8 7	10	2	00	1.31	......	1.31	20
21	49 72	59 0	38 3	20.7	30.1855	30.283	29 971	.312	.1962	56 0	34 0	S.W.	10.3	4.7	10	0	91	....	....	...	21
22	57.32	67.9	48 2	19.7	30.2680	30.311	30.212	.099	.2912	62.0	44.0	S.E.	8.1	5.0	10	0	22	....	....	....	22
23	56.25	63.2	46.5	16.7	30.0082	30.178	29.890	.288	.2823	62.8	42.2	S.E.	14.2	7.8	10	0	45	0.02	....	0.02	23
24	58.62	65.7	51.4	14.3	30.0413	30.083	30.012	.071	.3550	72.8	48.2	N.E.	8.0	7.3	10	2	47	....	....	.....	24
SUNDAY.. 25	.....	73.0	53.4	19.6	....	......	......	....	... .	....	....	S.E.	20.2	....	..	..	56	....	....	....	25 ....SUNDAY
26	58.65	65.0	55.3	9.7	29.9808	30.062	29.890	.172	.3943	80.2	52.2	S.E.	16.2	10.0	10	10	16	0.05	....	0.05	26
27	56.23	66.6	50 9	15.7	29.8517	29.890	29.811	.079	.3608	81.0	50.0	....	9 5	8.5	10	2	49	0.44	....	0.44	27
28	57.33	67.9	50.5	17.4	29.9053	30 022	29.840	.182	.3252	71 7	47 2	N.	10.5	5.8	10	0	54	0.20	....	0.20	28
29	56.78	66.0	45 5	20.5	30.0390	30.112	29.972	.140	3138	68.3	46.2	N.E.	4.9	1 5	3	0	97	.	....	....	29
30	59.63	68.6	49.5	19.1	29.9033	29.999	29.804	.195	.3043	61.5	45.3	N.E.	6 6	0.8	4	0	89	....	....	....	30
31	62.88	74.1	48.4	25.7	29.7927	29.814	29.768	046	.2588	45.7	41.0	....	9 5	0.2	1	0	100	....	....	....	31
....Means	51.59	59.84	43 03	16.81	29 8991	......	......	.195	.2664	68 7	40 7	....	14.0	6.54	..	.	42.3	4.85	....	4 85	Sums ....
16 yrs. means for & including this mo.	54.58	63.70	45.61	18.09	29.9342	......	......	.163	.2851	65.4	....	. ...	....	6.30	..	..	¶51.3	2.98	....	2 99	16 years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N. W.	Calm.
Miles............	1099	1486	238	1352	1140	3560	1155	454	....
Duration in hrs..	81	108	24	92	92	222	82	41	2
Mean velocity...	12.5	13.8	9.9	14.7	12.4	16.0	14.1	11.1	

Greatest mileage in one hour was 42 on the 17th. Greatest velocity in gusts 66 miles per hour on the 17th.

Resultant mileage, 2,842.
Resultant direction, S. 38° W.
Total mileage, 10,394.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 74.1 on the 31st; the greatest cold was 28.3 on the 2nd, giving a range of temperature of 45.8 degrees. Warmest day was the 25th. Coldest day was the 1st. Highest barometer reading was 30.311 on the 22nd; lowest barometer was 29.558 on the 5th, giving a range of 0.753 inches. Maximum relative humidity was 100 on the 5th and 6th. Minimum relative humidity was 27 on the 11th.

Rain fell on 18 days.

Solar halos on 2 days.

Lunar halo on 1 night.

Fog on 3 days.

Thunder on 2 days.

The month was characterized by being unusually wet and cold.

. C. H. McLEOD, *Superintendent.*

DAY.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY.......	100	....	....	....	1 .... .SUNDAY
	84	....	....	....	2
	56	....	.. .	....	3
	00	0.89	...	....	4
	00	0.22	....	....	5
	07	0.05	....	....	6
	28	0.05	....	...	7
SUNDAY......	67	Inapp.	.. .	....	8 ....SUNDAY
	74	....	....	....	9
	60	....	....	....	10
	76	Inapp.	....	....	11
	00	0.25	....	....	12
	00	0.25	....	....	13
	02	0.08	....	....	14
SUNDAY.......	63	....	....	....	15 ....SUNDAY
	55	....	....	....	16
	69	0.11	......	....	17
	82	....	....	....	18
	48	....	....	....	19
	100	....	....	....	20
	97	....	....	....	21
SUNDAY.......	13	Inapp.	....	....	22 .... SUNDAY
	74	0.32	....	....	23
	33	0.49	....	....	24
	97	0.01	....	....	25
	88	....	....	....	26
	56	....	....	....	27
	100	....	....	....	28
SUNDAY.......	88	....	....	....	29 ....SUNDAY
	100	....	....	....	30
............Me	57.2	2.72	....	....	Sums ....
16 yrs. means f including this	¶55.2	3.16	....	....	16 yrs. means for and including this month.

0.638 inches. Maximum relative humidity was 100 on the the 4th. Minimum relative humidity was 29 on the 1st.

Direction.....

Miles.........

Duration in hr

Mean velocity

Rain fell on 14 days.

Lunar halo on 1 night.

Fog on 3 days.

Thunder on 6 days.

Greatest mil

Resultant m

Resultant di

Total milea

ABSTRACT FOR THE MONTH OF JUNE, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	.... .	77.0	58.3	18.7	....	......	......	...	....	....	....	N.W.	19.9	....	..	..	100	....	....	....	1 .... SUNDAY
2	57 18	67.0	49.4	17.6	30.0358	30.092	29.974	.118	.2172	46.2	36.3	N.W.	17.8	3.2	8	0	84	....	....	....	2
3	58.93	65.9	47.4	18.5	30.0973	30.172	30.026	.146	.2155	43.5	36.3	E.	4.0	6.7	10	0	56	....	... .	....	3
4	55 77	60.0	52.4	7.6	29.9068	29.991	29.870	.121	.4293	96.0	54 5	E.	7 2	10.0	10	10	00	0.89	..	....	4
5	60.38	66.7	55.1	11.6	29 9060	29.931	29.869	.062	.4988	94.7	58 8	N.E.	5 0	10.0	10	10	00	0.22	....	....	5
6	64 95	72.5	61.2	11.3	29.7878	29.916	29.640	.276	.5540	90.2	61.8	S.E.	4.4	10.0	10	10	07	0.05	....	....	6
7	58.65	67.8	46.8	21.0	29.7685	30.070	29.632	.438	.3640	71.5	49.2	S.W.	20.2	9.5	10	0	28	0.05	....	...	7
SUNDAY...... . 8	.... .	59.4	40.8	18.6	....	......	......	....	....	....	....	W.	18.6	....	..	.	67	Inapp.	.. .	....	8 .... SUNDAY
9	58.78	66.2	54 4	11.8	30 1885	30.257	30 033	.224	.2415	48.8	39.2	W.	18.3	4 8	10	0	74	....	....	....	9
10	62.47	71.0	50.3	20.7	30.1182	30 270	29.951	.319	.3518	60.3	48.2	S.W.	8.4	8.0	10	0	60	....	....	....	10
11	69.98	81.0	57.3	23.7	29.8353	29.924	29.767	.157	.5305	72 8	60 7	S.W.	13 4	6.3	10	c	76	Inapp.	....	....	11
12	57 93	64.2	52.4	21.8	29 8472	29.880	29 818	.062	.4175	86.7	53 7	E.	14.0	9.2	10	5	00	0.25	....	....	12
13	55.02	60.2	50.3	9.9	29.8632	29.874	29.850	.024	.4018	92 3	53.0	E.	7.7	10.0	10	10	00	0.25	. ..	....	13
14	56.80	63.0	52.4	10.6	29.9502	30.040	29.881	.159	.3963	86.2	52.5	N E.	16.2	9.8	10	9	02	0 08	....	....	14
SUNDAY. 15	.....	74.0	53.7	20.3	....	.....	......	....	....	....	....	N.E.	5.0	....	.	..	63	....	....	....	15 ....SUNDAY
16	68.35	79.0	55.1	23.9	30.1245	30.196	30.060	.136	5053	73 7	59 2	S.W.	6.5	5.2	10	0	55	....	....	....	16
17	71.32	79.9	64 8	15.1	29.9087	30.081	29.741	340	.5897	77.7	63.3	S.W.	15 4	8.2	10	4	69	0.11	......	....	17
18	70.58	80.0	65.0	15.0	29.7290	29.779	29.692	.087	.5178	69.8	59.7	S W.	20.6	4.2	10	0	82	....	....	....	18
19	61.35	69.0	53 4	15.6	29.9598	30.105	29 802	.303	.3323	61.7	47 7	N.	12 8	4.7	10	0	48	....	....	....	19
20	63 68	72 5	48 6	23.9	30.0880	30.165	30.010	155	.3242	56.5	47.2	S.W.	11 7	1.8	9	0	100	....	....	....	20
21	68.03	79 4	57.6	21.8	29.8910	30.002	29.824	.178	.4177	61 5	53.5	S.W.	15 2	1.8	6	0	97	....	....	....	21
SUNDAY....... 22	.....	70.0	58.7	11.3	....	......	.....	....	....	....	....	N.E.	11.2	...	..	..	13	Inapp.	....	....	22 .... SUNDAY
23	69.35	82.3	58.3	24 0	29.9108	29.943	29.868	.075	.5485	77.2	61.5	S.W.	7.9	6.3	10	1	74	0 32	....	....	23
24	69.22	80.4	62.3	18.1	29.8297	29.917	29.686	.231	.5842	82.3	63.5	S.W.	13.5	8 0	10	2	33	0.49	....	....	24
25	72 65	82.0	62 8	19.2	29.7120	29 757	29.683	.074	5323	63 2	60.8	W.	21 2	3.2	8	0	97	0.01	....	....	25
26	68.92	79.0	59 2	19 8	29.7928	29.838	29.750	.088	3838	55 7	51.8	N.W.	16 7	2 5	9	0	88	....	....	....	26
27	66.60	75.7	58.3	17.4	29 8532	29.919	29 815	.104	4058	62.3	53.0	N.W.	11 0	7.3	10	2	56	....	....	....	27
28	68.75	77.8	60.1	17 7	29 7912	29.830	29.746	084	.3940	57.2	52.3	N.E.	6.2	0.5	3	0	100	....	....	....	28
SUNDAY........29	.....	78.5	56 3	22.0	.....	......	......	...	....	...	....	E.	6.5	....	..	..	88	....	....	....	29 ....SUNDAY
30	75.63	85.3	66.2	19.1	29 8697	29.898	29.855	.043	.4757	54.5	57.5	S.W.	9.0	0.5	2	0	100	....	....	....	30
............Means.	64.45	72.88	55.63	17.25	29.9106	......	......	.160	.4252	69.7	53.4	....	12.2	6.07	..	..	57.2	2.72	....	....	Sums ....
16 yrs. means for & including this mo.	64.46	73.10	55.92	17.17	29.8978	. ....	......	.155	.4225	68.9	...	......	....	5.70	.	..	¶55.2	3.16	....	....	16 yrs. means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles............	410	1121	337	404	413	2889	1417	1779	....
Duration in hrs..	49	126	49	49	44	194	81	111	17
Mean velocity...	8.4	8.9	6.9	8.2	9 4	14.9	17.5	16.0	

Greatest mileage in one hour was 29 on the 9th
Resultant mileage, 3,315
Resultant direction, S. 85° W.
Total mileage, 8,770.

NOTE.—The mileage for the first 11 days of the month is for the greatest part taken from the City Hall record, which has been multiplied by 1 25 to reduce it to the mountain anemometer record.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 85.3 on the 30th; the greatest cold was 40.8 on the 8th, giving a range of temperature of 44.5 degrees. Warmest day was the 30th. Coldest day was the 8th. Highest barometer reading was 30.270 on the 10th; lowest barometer was 29.632 on the 7th, giving a range of 0.638 inches. Maximum relative humidity was 100 on the the 4th. Minimum relative humidity was 29 on the 1st.

Rain fell on 14 days.

Lunar halo on 1 night.

Fog on 3 days.

Thunder on 6 days.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. IV. OCTOBER, 1890. NO. 4.

The Relations of Men of Science to the General Public.[1]

By T. C. Mendenhall.

Just fifty years have passed away since a small body of enthusiastic students of Geology and Natural History organized themselves into an Association which was, for the first time in the history of this country, not local in its membership or its purpose. As the "Association of American Geologists and Naturalists," it was intended to include any and all persons, from any and all parts of the country, who were actively engaged in the promotion of Natural History studies, and who were willing to re-inforce and strengthen each other by this union. So gratifying was the success of this undertaking, that after a few years of increasing prosperity under its first name, the Association wisely determined to widen the fields of its operations, by resolving itself into the American Association for the Advancement of Science, thus assuming to be in title what it had really been in fact, from the beginning of its existence. One of the articles of its first constitution, adopted at its first meeting, provided that it should be the duty of its president to present an address at a General Session following that

[1] Address by the retiring President of the American Association for the Advancement of Science. Indianapolis, August, 1890.

over which he presided. The performance of this duty cannot, therefore, be easily avoided by one who has been honored by his fellow members, in being called upon to preside over the deliberations of this Association; nor can it be lightly disposed of, when one realizes the importance of the occasion, and recalls the long list of his distinguished predecessors, each of whom in his turn has brought to this hour at least a small measure of the work of a lifetime devoted to the interests of science.

The occasion is one that offers an opportunity and imposes an obligation. The opportunity is in many ways unique and the obligation is correspondingly great. In the delivery of this address, the retiring president usually finds himself in the presence of a goodly number of intelligent people, representatives of the general public, who, knowing something of the results of scientific investigation, have little idea of its methods, and whose interest in our proceedings, while entirely cordial and friendly, is often born of curiosity rather than a full appreciation of their value and importance. Mingled with them are the Members and Fellows of the Association, who have come to the annual gathering laden with the products of many fields, which they have industriously cultivated during the year; each ready to submit his contribution to the inspection and criticism of his comrades, and all hoping to add in some degree to the sum total of human knowledge.

The united presence of these two classes, intensifies the interest which naturally attaches to an occasion like this, and not unnaturally suggests, that a brief consideration of the relations which do exist and which should exist between them, may afford a profitable occupation for us this evening.

In the beginning it may be truthfully affirmed, that no other single agency has done as much to establish these relations on a proper basis, as the American Association for the Advancement of Science. In the first article of its constitution the objects of the Association are defined as follows: —"by periodical and migratory meetings, to promote intercourse between those who are cultivating science in different parts of the United States, to give a stronger and more generous impulse and a more systematic direction to scientific research in our country, and to procure for the labors of scientific men, increased facilities and a wider usefulness." So perfectly do these words embody the spirit of the Association, that when more than thirty years later the constitution was thoroughly revised, none better could be found to give it expression. That it has been successful in promoting intercourse between those who are cultivating science in different parts of the United States, may be proved by the testimony of thousands who have come to know each other through attendance at its meetings. In a country whose geographical limits are so extensive as ours, and whose scientific men are so widely scattered, it is difficult to overestimate its value in this particular.

In giving a stronger and more general impulse and a more systematic direction to scientific research in our country, it has been singularly fortunate. Its meetings have been the means of disseminating proper methods of investigation and study throughout the land; hundreds of young students, enthusiastic but often not well trained, have found themselves welcome (sometimes to their own astonishment), and by its influence and encouragement, have been moulded and guided in the utilization of their endowments, occasionally exceptional, to the end that they have finally won a fame and renown which must always be treasured by the Association as among its richest possessions. Wherever its migratory meetings have been held, the pulse of intelligence has been quickened, institutions have been encouraged and strengthened, or created where they did not before exist, and men of science have been brought into closer relations with an intelligent people.

But it is in relation to the last of the three great objects, to accomplish which the Association was organized, namely, "to procure for the labors of scientific men, increased facilities and a wider usefulness" that it has been, on the whole, less successful. It is true that when we look at the history of science in America during the past fifty years; when we see at every point evidences of public appreciation, or at least appropriation of scientific discovery; and most of all, when we observe the enlargement of older institutions of learning to make room for instruction in science, and the generous donations to found new technical and scientific schools, together with an occasional endowment of research, pure and simple; in view of all these, I say, we are almost constrained to believe that scientific men have only to ask, that their facilities may be increased, and that their labors could hardly have a wider usefulness.

Unfortunately, this pleasing picture is not a true reflection of the actual condition of things. The attentive observer cannot fail to discover that the relation between men of science and the general public, is not what it should be in the best interests of either or both. In assemblages of the former, it is common to hear complaints of a lack of appreciation, and proper support on the part of the latter, from whom, in turn, occasionally comes an expression of indifference, now and then tinctured with contempt for men who devote their lives and energies to study and research, the results of which cannot always be readily converted into real estate or other forms of taxable property. It cannot be denied that the man of science is at some disadvantage as compared with his neighbor, the successful lawyer or physician, when it comes to that distribution of confidence with responsibility which usually exists in any well ordered community, although the latter may possess but a fraction of the intellectual power and sound judgment which he can command. To his credit it may be said that he is usually considered to be a harmless creature, and to render him assistance and encouragement is generally regarded as a virtue. The fact of his knowing much about things which do not greatly concern the general public, is accepted as proof that he knows little of matters which seriously affect the public welfare.

It is true, that when the public is driven to extremities it sometimes voluntarily calls upon the man of science, and in this emergency it is often unpleasantly confronted with the fact that it does not know where to find him. The scientific *dilettante*, or worse, the charlatan, is often much nearer the public than the genuine man of science, and the inability to discriminate, sometimes results in disaster in which both science and the public suffer.

In venturing to suggest some possible remedies for this condition of things, it will be logical, if not important, to roughly define the two classes under consideration, the scientific and the non-scientific. One is the great majority, the general public, including in the United States over sixty millions of people in all conditions, cultured and uncultured, educated and uneducated, but in average intelligence, we are proud to say, superior to the people of any nation in the world. Out of these it is not easy to sift by definition, the small minority properly known as men of science. Only a rough approximation may be reached by an examination of the membership of scientific societies.

The American Association for the Advancement of Science, includes in its membership about two thousand persons. It is well known, however, that many of these are not actually engaged in scientific pursuits, either professionally or otherwise; indeed it is one of the important functions of the society to gather into its fold as many of this class as possible. The fellowship of the association is limited however, by its constitution, to such members as are professionally engaged in science, or have by their labors aided in advancing science. They number about seven hundred, but in this case it is equally well known that the list falls far short of including all Americans, who by their labors in science, are justly entitled to a place in any roll of scientific men. On the whole, it would not, perhaps, be a gross exaggeration to say, that not more than one in fifty thousand of our population could be properly placed upon the list, even with a liberal interpretation of terms.

In this estimate it is not intended, of course, to include that large class of active workers whose energies are devoted to the advancement of applied science. Although their methods are often the result of scientific training, and while the solution of their problems requires much knowledge of science, the real advancement of science at their hands is rather incidental than otherwise. In certain particulars they may be likened to the class known as "middle men" in commercial transactions, the connecting link between producer and consumer. It is in no way to their discredit that they usually excel both of these, in vigilance and circumspection and in their quick perception of utility. By them the discoveries of science are prepared for and placed upon the market, and it is difficult to overestimate their usefulness in this capacity. It is true that the lion's share of the profit in the transaction is generally theirs, and that they are often negligent in the matter of giving the philosopher the credit to which he is entitled, but for the latter, at least, it is believed that the philosopher is himself often responsible.

If this statement of the relative numbers of the scientific and the non-scientific is reasonably correct, the scientific man may at least congratulate himself on wielding an influence in affairs vastly greater than the census, alone, would justify, and this fact encourages the belief that if there is anything "out of joint" in his relations with the general public, the remedy is in his own hands. Let our first inquiry be, then, in what particulars does he fail in the full discharge of his duties as a man of science, and especially as an exponent of science among his fellows?

Without attempting to arrange the answers which suggest themselves in logical order, or, indeed, to select those of the first importance, I submit, to begin with, his inability or unwillingness, common but by no means universal, to present the results of his labors in a form intelligible to intelligent people. When inability, it is a misfortune, often the outgrowth, however, of negligence or indifference; when unwillingness, it becomes at least an offence, and not one indicative of the true scientific spirit. Unfortunately, we are not yet entirely out of the shadow of the middle ages, when learning was a mystery to all except a select few, or of the centuries a little later, when a scientific treatise must be entombed in a dead language, or a scientific discovery embalmed in a cipher.

Many scientific men of excellent reputation, are to-day guilty of the crime of unnecessary and often premeditated and deliberately planned mystification; in fact almost by common consent, this fault is overlooked in men of distinguished ability, if, indeed, it does not add a lustre to the brilliancy of their attainments. It is usually regarded as a high compliment to say of A that when he read his paper in the mathematical section, no one present was able to understand what it was about; or of B and his book that there are only three men in the world who can read it. We greatly, though silently, admire A and B, while C the unknown, who has not yet won a reputation and who ventures to discuss something we do understand, (after his clear and logical presentation of the subject) must go content with the patronizing admonition that there is really nothing new about this, and that if he will consult the pages of a certain journal of a few years ago, he will find the same idea, not developed, it is true, but hinted at and put aside for future consideration, or, that he will find that Newton or Darwin declared what is essentially the same principle, many years before. No one can deny that there is great reason and good judgment displayed in all this, but the ordinary layman is likely to inquire whether it is distributed and apportioned with nice discrimination; and it is the standpoint of the layman which we are occupying at the present moment.

All will admit that there are many men whose power in original thinking and profound research is far greater than their facility of expression, just as on the other hand, there are many more men whose linguistic fluency is unembarrassed by intellectual activity, and representatives of both classes may be found among those usually counted as men of science. It is with the first only, that we are concerned at the present moment, and it is sufficient to remark, that their fault is relatively unimportant and easily overlooked. Among them is often found that highly prized but imperfectly defined individual known as the "genius," for whose existence we are always thankful, even though his interpretation is difficult and laborious.

Concerning those who, although able, are unwilling to take the trouble to write for their readers or speak for their hearers, a somewhat more extended comment may be desirable. It is always difficult to make a just analysis of motives, but there can be little doubt, that some of these are influenced by a desire to imitate the rare genius, whose intellectual advances are so rapid and so powerful, as to forbid all efforts to secure a clear and simple presentation of results. The king is lame and the courtier must limp. With others there is a strange and unwholesome prejudice against making science intelligible for fear that science may become popular. It is forgotten, that clear and accurate thinking is generally accompanied by the power of clear, concise and accurate expression, and that as a matter of fact the two are *almost* inseparable. The apparent success before the people of the *dilettante* and the charlatan, has resulted, in the case of many good and able men, in a positive aversion to popular approval. It should never be forgotten that the judgment and taste of the public in matters relating to science, are just as susceptible of cultivation as in music and the fine arts, and that scientific men owe it to themselves to see that opportunity for this culture is not withheld. A just appreciation by the people of real merit in art has resulted in the production of great painters, sculptors, musicians and composers, and there is every reason to believe that the best interests of science would be fostered by similar treatment. Even the great masters in science, then, can well afford to do what is in their power to popularize their work and that of their colleagues, so that through closer relations with a more appreciative public their opportunities may be enlarged and their numbers increased.

Another error into which the man of science is liable to fall, is that of assuming superior wisdom as regards subjects outside of his own specialty. It may seem a little hard to accuse him of this, but nevertheless, it is a mistake into which he is easily and often unconsciously led. That this is the day of specialization and specialists, every student of science learns at the very threshold of his career; but that one man can be expected to be good authority on not more than one or two subjects, is not generally understood by the public. It thus frequently happens that the man of science is consulted on all matters of a scientific nature, and he is induced to give opinions on subjects only remotely, if at all, related to that branch of science in which he is justly recognized as an authority. Although going well for a time, these opinions often prove to be erroneous in the end, resulting in a diminution of that confidence which the public is, on the whole, inclined to place in the dictum of science.

Examples of this condition of things are by no means wanting, and they are not confined, as might at first be assumed, to the lower ranks of science. A distinguished botanist is consulted, and advises concerning the location of the natural gas field; a mathematician advises a company in which he is a stockholder in regard to the best locality for boring for oil, and a celebrated biologist examines and makes public report upon a much-talked-of invention in which the principles of physics and engineering are alone involved.

In these and many other instances which might be related, the motives of those concerned, at least on one side of the transaction, cannot be questioned, but certainly their judgment is open to criticism, and the outcome of it all, is that the confidence of the people in scientific methods and results is weakened. Fifty years ago, or a hundred years ago, there was good reason for much of this sort of thing. Specialization was neither as possible nor as necessary as now; the sparseness of the population of the country, the absence of centres of learning and scientific research, the obstacles in the way of easy and rapid communication between different parts of the country, all these and other circumstances contributed to the possibility of a Franklin, who wrote and wrote well upon nearly all subjects of human thought; whose advice was sought and given in matters relating to all departments of science, literature and art. Combining in an extraordinary degree the power of profound research with a singularly simple and clear style in composition, together with a modesty which is nearly always characteristic of the genuine student of nature, he wisely ventured further than most men would dare to-day, in the range of topics concerning which he spoke with authority.

But at the present time and under existing conditions there is little excuse for unsupported assumption of knowledge by men of science, and, fortunately, the danger of humiliating exposure is correspondingly great. The specialist is everywhere within easy reach, and the expression of opinions concerning things of which one knows but little, is equally prejudicial to the interests of science and society.

The scientific man should also be at least reasonably free from egotism in matters relating to his own specialty, and particularly in reference to his own authority and attainments therein. In controversy he has the advantage over most disputants in that he can usually call to his support an unerring and incontrovertible witness. A well conducted experiment or an exhaustive investigation, carried out with scrupulous honesty, deservedly carries great weight, but it must not be forgotten that it does not, in a very great degree, depend upon the personality of him who directs the experiment or plans the investigation. One must not confound himself and his work, to the extent of assuming that upon him ought to be bestowed the praise and admiration to which his work is, perhaps, justly entitled. This blunder is analogous to that of the mechanic in whom the first symptom of insanity appeared as a conviction that he was as strong as the engine which he had built, evidence of which he unpleasantly thrust upon any who might deny the truth of his assertion. "By your works shall ye be judged" may be especially affirmed of men of science, not only as regards the judgment of the public, but particularly that of their colleagues and fellow-workers. Least of all should title, degree, membership in learned societies or the possession of medals or other awards of distinction and honor, be paraded unduly, or offered by himself, in evidence of his own fitness. In general these are honorable rewards which are justly prized by scientific men, but some of them have been so indiscriminately bestowed and, in some instances, falsely assumed that the general public, not yet properly educated in this direction, does not attach great value to them as an index of real scientific merit. Where real merit actually exists, nothing is usually gained, and much is likely to be lost by boastful announcements of high standing or of accumulated honor. A distinguished man of science at the end of a controversy into which he had been called as such, complained that he had not been recognized as a Fellow of the Royal Society. "You gave us no reason to suspect your membership," quietly, but severely, replied a man of the world.

As another element of weakness in the scientific man I venture to suggest that he is often less of a utilitarian than he should be. This is a sin, if it be such, which seems especially attached to those who, unconsciously or otherwise, are imitators of men of science of the highest type. The latter are so entirely absorbed in profound investigation and their horizon is necessarily so limited by the very nature of the operations in which they are engaged, that they are altogether unlikely to consider questions of utility nor, indeed, is it desirable that they should. The evolution of processes and methods by means of which the complex existence of the present day is maintained, is largely the result of specialization or the division of labor. In such a scheme there is room for those who never demand more of a fact than that it be a fact; of truth that it be truth. But even among scientific men the number of such is small and as a class they can never be very closely in touch with the people.

Strong to imitate, even in those characteristics which are akin to weakness, many persons of lesser note affect a contempt for the useful and practical which does not tend to exalt the scientific man in the opinion of the public. Even the great leaders in science have been misrepresented in this matter. Because they wisely determined in many instances to leave to others the task of developing the practical applications of their discoveries, it has often been represented that they held such applications as unworthy a true man of science. As illustrating the injustice of such an opinion one may cite the case of the most brilliant philosopher of his time, Michael Faraday, who in the matter of his connection with the Trinity House alone, gave many of the best years of his life to the service of his fellow-men. The intensely " practical " nature of this service is shown by the fact that it included the ventilation of light-houses, the arrangement of their lightning conductors, reports upon various propositions regarding lights, the examination of their optical apparatus and testing samples of cotton, oils and paints. A precisely similar illustration is to be found in the life of our own great physicist, Joseph Henry, who sacrificed a career as a scientific man, already of exceptional brilliancy, yet promising a future of still greater splendor, for a life of unselfish usefulness to science and to his countrymen as Secretary of the Smithsonian Institution, as a member of the Light House Board, and in other capacities for which he was especially fitted by nature as well as by his scientific training.

There is an unfortunate, and perhaps a growing tendency among scientific men to despise the useful and the practical in science, and it finds expression in the by no means uncommon feeling of offended dignity when an innocent layman asks what is the use of some new discovery ?

Referring to the theoretically extremely interesting spar prism of Bertrand, which under certain conditions may be used to detect traces of polarization of light, a recent writer remarks, " But for this application the prism would possess, in the eyes of the true votary of science, the inestimable value of being of no practical utility whatever."

Much is said, everywhere and at all times, about the pursuit of science for the sake of science, and on every hand it is sought to convey the impression that no one who has any other object in view in interrogating Nature than the mere pleasure of listening to her replies, is unworthy of a high place among men of science. So old, so universally accepted, so orthodox, is this proposition, that it is with much hesitation that its truth is questioned in this presence. In so far as it means that one cannot do anything well unless it is done *con amore*, that pecuniary reward alone will never develop genius, that no great philosopher, or poet, or artist will ever be other than unselfishly devoted to and in love with his work, just so far it is true, although it does not, as is often assumed, furnish a motive of the highest order. It is a trite saying, but perhaps it cannot be too often repeated, that he who lives and labors in the interest of his fellows, that their lives may be brightened, that their burdens may be lessened, is above all others worthy of the highest praise. By this standard, the value of a discovery must at last be fixed, bearing in mind, of course, that the physical comfort of man is not alone to be considered. Judged by this standard, the work of Newton, of Watt, of Franklin, Rumford, Faraday, Henry and a host of others, is truly great. There should be, and there usually is, no controversy as to relative merit between the discoverer of a gem and the artist who polishes and sets it. In science, the genius of the former is unquestionably rarer and of a higher order, but his work will always be incomplete and in a great degree useless until supplemented by that of the latter.

Another demand which the public may justly make upon the man of science is that his interest in public affairs should not be less than that of other men. Through his failure in this particular, science has long suffered, and is suffering in an increasing degree. This criticism is especially applicable in this country, where in theory every man is supposed to bear his share of the public burden, and to take his part in the performance of public duties. Unfortunately, the attitude of the scientific man is too often one of criticism and complaint concerning matters in the disposition of which he persistently declines to interfere, It cannot be denied, I think, that men well trained in the logic and methods of scientific research, ought to be exceptionally well equipped for the performance of certain public duties constantly arising out of local, state or national legislation ; yet the impression is well-nigh universal, that the scientific man has no genius for "affairs." Indeed it has been more than once affirmed that he is utterly devoid of administrative or executive ability, and even that he cannot be trusted with the direction of operations which are almost wholly scientific in their nature. That there are many examples which seem to justify this belief is too true, but that there are other instances in which administrative and scientific ability have been combined is also true. Little search is required to reveal cases in which men of science have so ignored all ordinary rules and maxims of business procedure as to merit severe criticism, in which, unfortunately, the public does not discriminate between the individual and the class which he represents. It seems astonishing that one who is capable of successfully planning and executing an elaborate research, in which all contingencies are provided for, the unexpected anticipated and, all weak points guarded and protected may utterly break down in the management of some much less complicated business affair, such as the erection of a laboratory, or the planning of an expedition, and I am unwilling to believe that such failures are due to anything other than culpable negligence on the part of the individual.

It is generally recognized that, aside from all questions of a partisan, political nature, this country is to-day confronted by several problems of the utmost importance to its welfare, to the proper solution of which the highest intellectual powers of the nation should be given. The computation of the trajectory of a planet is a far easier task than forecasting the true policy of a great republic, but those qualities of the human intellect which have made the first possible, should not be allowed to remain idle while an intelligent public is striving to attain the last. That men of science have not, thus far, made their full contribution to the solution of some of these great problems, is due to the fact that many have exhibited an inexcusable apathy toward everything relating to the public welfare, while others have not approached the subject with that breadth of preparation in the close study of human affairs which is necessary to establish the authenticity of their equations of condition.

As already intimated, we do not seem to be getting on in this direction. Our own early history and the history of other nations is full of examples of eminent scientific men who were no less distinguished as publicists and statesmen. The name of Franklin is imperishable alike in the history of science and of politics. On many questions relating to exact science, the Adamses spoke with confidence; Thomas Jefferson was a philosopher, and on assuming the duties of the highest office in the gift of the people, counted his opportunities for association with men of science as one of its chiefest rewards. Other illustrations might be selected from the pages of the history of our own country, while in Europe, where science has long been cultivated and under more favorable conditions, they are much more common. This is notably so in France, whose roll of scientific men, who have distinguished themselves and their country during the past century, includes many names prominent alike for the importance of their performance in her various crises of peace and war. The present president of the French Republic, himself an engineer, bears a name made famous in the history of science by the rich contributions of his ancestors, one of whom voted for the execution of Louis XVI, and was a member of the committee of Public Safety. It would be difficult to overestimate the value to science as well as to the public, of the presence in the halls of legislation of even a very small number of men who might stand as exponents of the methods of science and as competent authorities on the results of their application. Our national congress, especially, is almost constantly dealing with questions of great moment to the people, which can only be thoroughly understood and wisely dealt with by scientific men, and the presence of one or two such in each branch of that body would be of decided advantage to the whole country. In the nature of things, opportunities for such representation will be rare, but when they occur they must not be suffered to escape.

Finally, if the conclusions reached in the foregoing should be thought wise, and should any young man at the threshold of his scientific career determine to be guided by them in establishing his relations with the general public, he will find splendid examples among the distinguished leaders of all departments of science. Should he desire to present the results of his labors in such a way that they may be understood by intelligent people, he may imitate Franklin, whose literary style, as to simplicity and clearness, commanded the highest praise from literary men; or Faraday, who was able to give expression to the most involved conceptions in simple English; or Tyndall, the appearance of whose "Heat considered as a Mode of Motion," was an epoch in the history of Physical Science, in its relation to an intelligent constituency, without which it cannot thrive. He will learn that there is no discredit in "popularizing" science; that popularizing what is not science is the thing that is to be shunned and prevented. The arrogance of genius is not less disagreeable than that of riches, although it is less common.

Should he wish to cultivate modesty in estimating his own attainments, he need only follow Newton, Darwin, and, in fact, the whole list of distinguished men of science down to the present time, with a few rare and unexplainable exceptions, the existence of which serves, like a whistling buoy, to point out what should be avoided.

Should he aspire to be of some use to the world and to leave it better because of his life, he will be encouraged by the fact, already considered, that in the long run those discoveries are most highly esteemed, and justly so, which are the most potent in their influence upon civilization and society by ameliorating the condition of the people, or by enlarging their opportunities, and that all really great men of science have not lost sight of this fact: that "science for the sake of science" does not represent the highest ideal, nor can the "almighty dollar" ever be bartered for the "Divine Afflatus."

All of these questions will serve to enlarge his interest in public affairs, because he will come to recognize that he is himself but a part of the public. He will remember the delight of Faraday, when near the end of his life he saw a huge dynamo illuminating the tower of a light-house. That which he had given to the world as an infant, in his splendid discovery of induction, had, through the fostering care of others, grown to a brilliant manhood, and he experienced exquisite pleasure in the reflection that it might be the means of saving the lives of his fellow-men. The ideal of duty which ought to be present in the mind of every man of science may well be higher than that growing out of mere selfish pleasure in the acquisition and possession of knowlenge.

Perhaps it is hardly becoming in me, at this time and in some sense representing this large body of scientific men, to make even a simple remark in criticism of the general public, the party of the second part of the question which we have considered to-night. I venture to suggest, however, that whenever the public is disposed to consider its obligations to science and her votaries, there are some things which must not be forgotten;—things so important and so numerous, indeed, that many volumes would be inadequate to their enumeration. Prove this by comparing the world *with* science with the world *without* science. Take as an illustration that which less than two hundred years ago was but a spark, a faint spark, exhibited on rare occasions by the scientific man of the time. With this spark, thanks to science, the whole world is now aflame. Time and space are practically annihilated; night is turned into day; social life is almost revolutionized, and scores of things which only a few years ago would have been pronounced impossible, are being accomplished daily. Many millions of dollars of capital, and many thousands of men, are engaged in the development of this agent, so purely a creation of science, that the Supreme Court of the land has already decided that it has no material existence. Surely science, which has brought us all these blessings, together with thousands besides, is worthy of every care and consideration at the hands of a generous and appreciative public.

THE BLOOD AND BLOOD–VESSELS IN HEALTH AND DISEASE.[1]

By WESLEY MILLS, M.A., M.D.

Professor of Physiology in McGill University, Montreal.

Our knowledge of any subject may perhaps be regarded as a perception of relations. As these, however, are innumerable, the great question becomes, What relations are of the most importance? From what point of view shall we look at a subject? Necessarily, this must vary with the progress of all knowledge and with that of the department under consideration.

When the period of derision and skepticism that followed at once the announcement of the discovery of the circulation of the blood by Harvey had passed away, and a body of practitioners, less prejudiced than the great man's own contemporaries, considered the subject, a reaction took place. Undue attention was given the blood in all discussion on the ætiology of disease.

In comparatively recent times the investigations of blood-pressure and kindred problems by Ludwig and his school, diverted attention unduly to that subject, and the influence of this is evident in almost every text-book on physiology at present extant. Believing, myself, that physiology has been confined within extremely narrow limits, that it must in consequence suffer from the intellectual myopia of its cultivators, I have within the past year endeavoured to present to the student of this science a work[2] on a new plan; and it is my purpose this evening to ask your consideration to its advantages, which I shall endeavour to present in so far as they apply to the subject of this

[1] An address delivered before the Ottawa Medical Society, May 1890. Reprinted from the *New York Medical Journal* for September 13. 1890.

[2] *A Text-book of Animal Physiology.* D. Appleton & Co., New York, October, 1890.

address, and leave you to judge for yourselves whether this method of viewing the subject gives a wider and truer view of physiological truths than the older plan or not.

We all recognize the fact that any individual can be but indifferently understood apart from his antecedents; hence the importance we attach to biographical sketches of those persons that interest us. It is really an acknowledgment of the influence of the environment on the organism, both during its own life-time and that of its ancestors.

Why, then, is not the consideration of every function of the body preceded by an account of the development of the structures involved, as well as by ordinary anatomical or histological details?

No advanced morphologist hopes to clear up the relations of any animal group without taking its embryology into consideration. Up to the present, this method has been almost wholly ignored by physiologists. Allow me to suggest in this connection a few considerations which seem to put the student in the possession of a clew to otherwise very obscure relations.

All are agreed that the blood-cells, whatever their later history, arise in the embryonic mesoblast at the same time as the heart and blood-vessels themselves. To consider, therefore, the heart, blood-vessels, and blood wholly separately, or without a perception of their unity, is a mistake that has practical as well as theoretical consequences. When we bear this relation in mind, it is possible to understand that there may be cases in which the whole vascular system, including the contained blood, may be imperfectly developed, and with all the consequences of recurrent anæmia. There can be no doubt that any crop of blood-cells must bear relations to the preceding one, and if the original ancestors are defective, their descendants are likely to be similarly weak, apart from any unfavorable circumstances in the environment.

Until recently, the functions of the white corpuscles, if considered at all in works on physiology, were dismissed in a very few lines. When we remember that the leucocytes of the blood correspond to the original undifferentiated embryonic cells, which alone have made up the entire embryo, and are preserved as floating organisms with a latent capacity for further development, much light is thrown upon both physiological and pathological processes. Whatever the view that finally prevails as to their relations to invading micro-organisms, there can be no doubt that as scavengers, porters, or phagocytes their function is of great importance; yet, apart from a consideration of their origin, this can be but indifferently understood. It is well known that the undifferentiated cells of the embryo are more or less amœboid organisms; hence, it is perfectly natural that their descendants should, under suitable circumstances, exhibit those qualities which recent investigators are showing more and more that they possess. The great part they play in inflammation is also more readily comprehended. In this condition there is a profound alteration in the environment, as will be shown later.

At present our positive and clear knowledge of the red cells of the blood is confined to their oxygen-carrying function; but I feel satisfied that this does not include all their work and that we must look for a very considerable enlargement of our knowledge of the range of their duties. Indeed, it would seem that we are in great danger now of going to an extreme the opposite of that of our ancestors, and attributing too little to the blood, especially its cells. It is not to be forgotten that the blood as a whole is to be regarded as a tissue, and there is no more reason why this tissue should be devoid of functions than any other.

Most of our works on physiology so present the subject to the student that he has no clear ideas as to *how* the blood does minister to the tissues, though everyone is ready to say at once that the function of the blood is "to nourish the tissues." In truth, some very remarkable doctrines have been taught in regard to the relations of the blood and blood-vessels. As a rule, students have the most misty notions of the relations and importance of the lymph. They know that it flows in "the lymphatics," that it gets into the blood-stream finally, that it is in some way derived from the blood, etc. But there is no clear perception of these relations, and it is impossible that there should be with the teachings that are prevalent.

The books represent the lymph as passing through the capillaries; but, if any explanation of this process is given at all, it is represented as a filtration—very much of the character of that "filtration" of urine through the capillaries of the Malpighian capsules, which has been so commonly taught up to the present as dependent almost solely on blood pressure.

This doctrine has seemed to me so utterly at variance with all sound biological laws, that for three or four years I have been accustomed to teach in my lectures, and have recently published in my text-book, a theory which I must present to you with brevity, but which I am sure you will see places the physiologist, the pathologist, and the practitioner of medicine on an eminence from which they can view the events of the body in an entirely new light. It is simply this: *The capillaries of the body are glands.* They are glands not only in the glomeruli of the kidney, but everywhere else. So far as I know, I have been the first to teach this doctrine; I must therefore give you, at least in a general way, the reasons for my conviction.

In the first place, I should be prejudiced against any biological doctrine that would represent a living structure as acting as a mere filter, or as teaching that osmosis played any considerable part or, in the strict sense, any part at all when living structures, "membranes" or other, were concerned. There seem to be no facts that can not be better explained without such an assumption; and, even if this were not the case, it is better not to construct a theory at all, but simply confess ignorance and wait, than one which like this is radically opposed to all sound conceptions of living structure.

To believe that the lymph which bathes the various tissues is everywhere identical in composition, is to overlook the relations of the blood and blood-vessels to the tissues among which they have been developed. But the lesson Nature everywhere teaches is that things do work in relation to each other.

What a crude conception of life processes to suppose that the capillaries pour out a fluid around the cells of the tissues whose composition is not specially related to the needs or peculiarities of each one!

But the facts we do know are opposed to such a view.

All exudations or transudations are not alike in chemical composition; nor are passive exudations identical with inflammatory ones. Can osmosis explain this? Can it explain why an inflammatory exudation does not correspond with the normal tissue-lymph? Can it give a reason why there are coagulable proteids in lymph, or any of the fluids that are derived from the blood at all? While the facts cannot be explained by osmosis, they are all simple enough when we view the capillaries as glands—*i.e.*, as passing from the blood to the tissues, and the reverse, an elaborated fluid which varies with the condition of the cells composing the capillary and the tissue-cells that surround it. That the condition of the blood can modify the capillaries, the latter the blood and the tissues both, is to my mind clear enough. To put it otherwise: The tissue-cells around a capillary, the capillary cells themselves, and the blood are always in a sort of balanced relation. They understand each other, so to speak, and act in harmony. One cannot be disturbed without affecting the other.

When a great derangement occurs, what we call inflammation arises, and, sooner or later, all the parts of this inseparable trio become involved. In inflammation we have changes in the blood-cells, changes in the vessel-walls, and changes in the surrounding tissue-cells. The embryological history should have led us to expect all this.

When this relation of the capillaries as secreting mechanisms is understood, many of the difficulties that surround "digestion" and "absorption" will be removed. Time will not allow of my developing this part of the subject at length now. In my opinion, there is no sharp line to be drawn between digestion and absorption. They are parts of one great series of processes. Not only so, but the term absorption is misleading, as it suggests purely physical processes, which latter must always be dealt with very cautiously by physiologists.

If, for example, we regard the capillaries of the alimentary tract as glands, it will no longer be impossible to understand that the peptones of digestion are not represented by peptones in the blood, the great stumbling-block of physiologists for long enough.

Intracellular digestion is not confined to invertebrates. The cells of the digestive tract, those of the capillaries included, have not wholly forgotten the amœboid habits of their embryonic ancestors. They are specialized, it is true, but not wholly altered. To suppose that digestion, or the physical and chemical alteration of food ends within the cavity of the alimentary tract, is to overlook a large part of the truth. Food is changed there by virtue of the digestive secretions, but all is not thus done. In fact, what is commonly termed digestion is only the beginning of a long series of processes which go on in the cells of the structures of the tract, the capillaries included, in the blood itself to some extent, and which continue under the name of metabolism in the tissues themselves. But it is the separation and isolation in the mental conception of the student, of what must be linked in one long chain, that is to be especially dreaded in the modern teaching of physiology.

A student may throw a great part of the facts of his physiology overboard after his examination, but the influence of his teaching must last for good or evil in all his thinkings as a practitioner. That a sounder view of the processes of digestion, etc., would greatly modify practice, and especially would explain present failures and successes, is clear to myself. Any attempt, however, to make this evident to others must be left for another occasion.

It may, without exaggeration, be said that the application of the principles of evolution to morphology has revolutionized the teaching of that subject. But, strangely enough, its great doctrines have thus far made very little impression on physiology, especially the teaching of the subject; and my own text-book is the first and only one in which an attempt has been made to light up the student's path with this theory; and you will be glad to hear that this effort has been rewarded by increased interest in physiology on the part of my own classes during the four years of trial of the new methods of presenting the subject.

But if this is good for students that are undergraduates, may it not also prove helpful to practitioners to regard disease in the light of evolution?

Physicians have given but little attention to the subject. To this statement, however, there are at least two notable exceptions: the late brilliant Milner Fothergill, and that profound thinker, of whom we are so proud the world over, Hughlings Jackson.

Turning to the vascular system in the wider sense (the blood and blood-vessels), by the help of evolution and embryology not only are many anomalies of vessels understood, but also of the blood itself.

Does not a case of extreme multiplication of leucocytes in the blood indicate a condition at once embryonic and ancestral? In other words, is not this an example of physiological or pathological reversion? In the early embryo, leucocytes are very abundant everywhere, and in invertebrates, almost without exception, they or their equivalents, are alone found, while in the lower vertebrates they are both numerous and of very much more pronounced amœboid character than in the higher. Is not this tendency, then, on the part of the higher mammals and man, under certain circumstances, to an excess of leucocytes in the blood better understood than without the explanation of evolution? Why this particular form of derangement, and not some other, if higher forms are not related by descent to the lower?

Again, in the various forms of anæmia we find red cells that are nucleated, cells smaller or larger than normal, distorted cells, corpuscles resembling the genetic marrow-cells, etc.

All these forms occur in the embryo, apparently normally; some of them are certainly transition forms. They also bear a resemblance to the red cells of lower vertebrates. Are these not clear cases of reversion to an earlier condition, both embryonic and ancestral? Even that form of anæmia in which the cells are fairly normal, excepting a deficiency in hæmoglobin, points to the lower vertebrate and invertebrate blood, which is, relatively to the higher groups of animals, poor in hæmoglobin.

Inflammation itself, both as regards the vascular system and the tissues, becomes clearer from the standpoint of evolution. The increased amæboid activity of the leucocytes, the alterations in the latter and the vessel walls permitting of the ready "wandering" of the colorless blood-cells, point to a condition of things common in lower vertebrates. Inflammation is clearly a reversion.

Reference might be made to the resemblance between the condition of things in the young mammal—in which, after birth the usual changes that fit it to its altered environment do not take place—and the permanent state of the heart and vessels in lower vertebrates, as reptiles. However, the illustrations employed may suffice to show that evolution does concern the physiologist, the pathologist, and the physician; and, did time permit, I think I could demonstrate that such views may be made to have a bearing on the treatment of disease by the most enlightened methods. The subject has been dealt with further in its relations to medicine elsewhere.[1]

I shall not pursue this line of thought further at present, but leave you to judge for yourselves whether the time has come when students and practitioners should be provided with text-books of physiology in which attention is paid to general biology, comparative embryology, and evolution, with a view of giving a wider and truer grasp of the functions of those organisms with which the great art of medicine is concerned.

[1] Physiological and Pathological Reversion. *Canada Med. and Surg. Journal*, April, 1888.

On Canadian Spessartite and Mountain Cork

By B. J. Harrington, McGill College.

Read before the Natural History Society, March 31st, 1890.

1.—Spessartite.

The Villeneuve Mica Mine, on the thirtieth lot of Range 1, Villeneuve, Ottawa County, P.Q., is already known to many on account of the interesting minerals which it has afforded. The vein, which was at one time worked for mica, is a coarse granite, traversing grey garnetiferous gneiss, and consisting of quartz, muscovite, orthoclase and albite, with occasionally black tourmaline and garnet It has also yielded the rare minerals uraninite and monazite.[1] The garnet occurs imbedded in both the feldspar and the muscovite, and crystals of that found in the latter have recently been analysed by the writer. The crystals are much distorted and more or less flattened in the direction of the cleavage planes of the mica. They range, in the few specimens examined, from one up to about ten mm. in greatest diameter, and are of a beautiful red colour. They are rather brittle, but possibly some might be obtained which would stand being cut as gems. The specific gravity was found to be 4·117 and analysis of carefully selected material gave the following percentage composition :—

Silica	36·30
Alumina	19·20
Ferrous Oxide	10·66
Manganous Oxide	30·06
Lime	3·07
Magnesia	0·43
Loss on ignition	0.31
	100.03

[1] G. C. Hoffmann, Ann. Rep. Geol. Can. 1886, p. 11 T., and F. A. Genth, Am. Jour. Sci., 1889, p. 203.

The atomic and quantivalent ratios deduced from the above figures are:—

	Atomic.			Quantivalent.		
Si ...	605 × 4	=	2420	2420	2420	1
Al ...	378 × 3	=	1134	1134	2408	1
Fe″ ..	148 × 2	=	296	1274		
Mn ..	423 × 2	=	846			
Ca ...	55 × 2	=	110			
Mg...	11 × 2	=	22			

The analysis shows that the mineral is a manganese garnet, approaching very nearly in composition to the original spessartite, but containing more lime. The iron was proved to be all in the ferrous state. The figures given as loss on ignition indicate the loss on heating for about fifteen minutes. Further heating caused a gain in weight, owing to oxidation of the iron.

2.—Mountain Cork.

In 1877, the writer found on the dump at the "Grant Phosphate Mine," in the township of Buckingham (south ½ of lot 18, Range 12), specimens consisting of mountain cork and mountain leather. Under the latter name they were referred to in his "Report on the Minerals of some of the Apatite-bearing Veins of Ottawa County," but were not then analysed quantitatively. During the past few years, in the Emerald Mine, on the same lot as the above, similar material has been obtained in masses of considerable size, one specimen presented to the Peter Redpath Museum by Mr. F. W. Warwick, containing about half a cubic foot.

It consists mainly of mountain cork, though on the surface it is in places slightly foliated or leather like. Some portions contain irregular grains of quartz and minute crystals of copper pyrites[1]; but fragments were selected for

[1] The crystals are mostly 1 to 2 mm. in diameter and many of them black superficially. When freshly fractured they have the colour of copper pyrites, with which they also agree in blowpipe characters. To the eye the crystals look like regular octahedrons but may be tetragonal. They require further examination.

examination which were apparently free from intermixed impurities. They were creamy-white in colour, and were found to have a specific gravity of 3·05.[1] An analysis made in the college laboratory by Mr. Sidney Calvert, gave the following results :—

Silica	53·99
Alumina	0·55
Ferric Oxide	1·00
Ferrous Oxide	10·99
Manganous Oxide	2·19
Lime	12·53
Magnesia	16·25
Loss on ignition	2·56
	100·06

The atomic and quantivalent ratios deduced from the above analysis are given below, and it will be seen that the mineral is a true bisilicate.

	Atomic.			Quantivalent.		
Si	899 × 4	=	3596	3596	2
Al	10 × 3	=	30		
Fe‴	12 × 3	=	36		
Fe″	152 × 2	=	304	1692	1
Mn	31 × 2	=	62		
Ca	224 × 2	=	448		
Mg	406 × 2	=	812		

It is interesting on account of the large proportion of ferrous and manganous oxides which it contains, and differs considerably in composition from the mountain cork of Zillerthal, examined by Scheerer. His analysis gave :—

Silica	57·20
Ferrous Oxide	4·37
Lime	13·39
Magnesia	22 85
Loss on ignition	2·43
	100·24

[1] Dry fragments float upon water for a time, owing to the air which they contain. In determining the specific gravity, the air was got rid of by soaking under water in vacuo.

Pyroxene crystals converted into asbestus have been found at the same locality as the mountain cork in Buckingham, and this suggests that the latter may also be a secondary mineral derived from pyroxene, one of the most constant constituents of the apatite-bearing veins.

SOIL TEMPERATURES.

BY C. H. McLEOD, MA. E., AND D. P. PENHALLOW, B. SC.

During the past two years, observations of soil temperature have been taken daily, at the McGill College Observatory; the primary object being to establish somewhat more definitely, the relation of such temperatures to vegetation. An important part of this work relates to the changes attending the penetration of frost in autumn; the influence of snow as a protective covering; and the changes incident to the opening of the ground in spring. For this reason the period of observation embraces the entire year, instead of covering only the spring and summer months as is customary. It may also be stated in this connection, that observations are being made on root penetration and the movement of sap in trees, in order to complete the necessary data. These will be published as soon as circumstances will permit.

This work, which it is expected will be carried on continuously for some years, is conducted under the auspices of the Natural History Society of Montreal. The expense attending the construction of the necessary instruments, was met by a grant from the Elizabeth Thompson Science Fund. Reference may be made to the Annual Reports of the University, for further information concerning the inauguration of this work. The following is a brief description of the instrument used :—Couples of copper and iron are placed in the ground at the required depths. A wire passes from each couple to a switch-board in the observing room, and there is a return wire common to all the couples, which, in the observing room passes through a delicate galvanometer and a couple similar to those in the ground, to make connection with the other wires at the switch-board. The galvanometer is made to read zero on the circle when the circuit is open, If now the circuit be closed at the switch-board the needle will be found to deflect, but may be brought back by bringing the inside couple to the same temperature as that in the ground. For this purpose the inside couple is immersed in water, or in winter, in a mixture of snow and water. When the balance is established, the temperature of the water is the same as that of the ground at the depth of the outside couple.

In this the first report upon the work of the committee, it is proposed simply to place on record the results thus far obtained, leaving to the future, such deductions as it may be possible to draw. The temperatures in degrees centigrade—as given—are averages of ten-day periods, while the figures for snow and rainfall express the total precipitation for the same periods. The accompanying chart of curves will exhibit the relations thus far established.

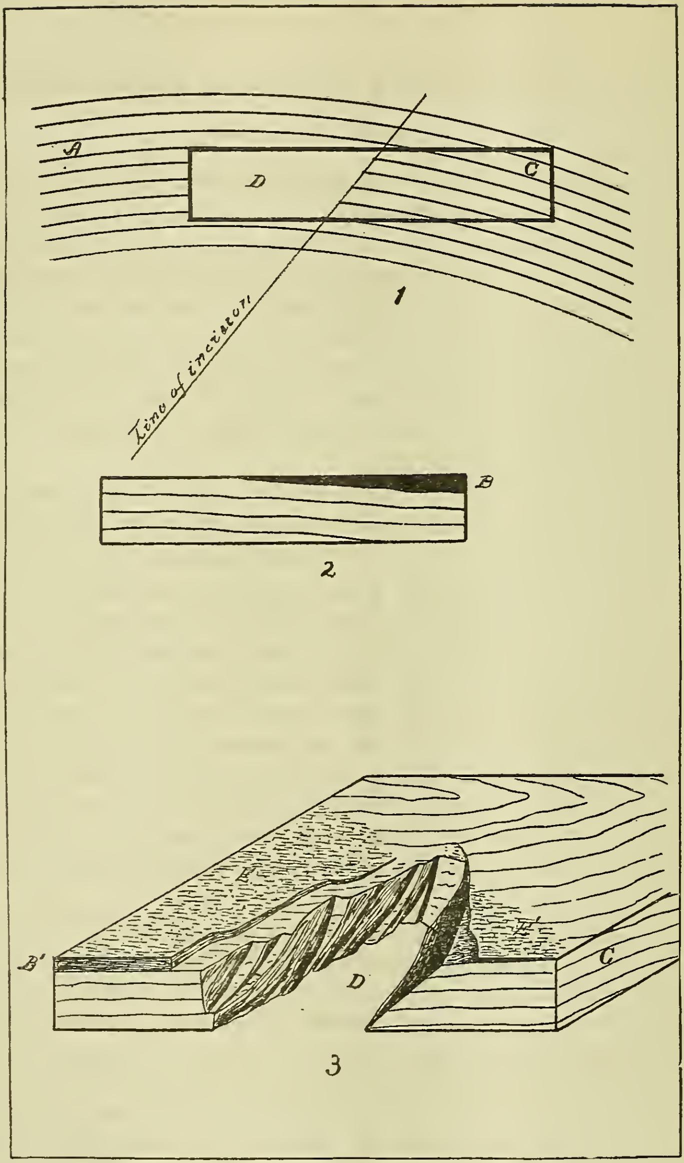
The soil terminals of the thermometer are located at a distance of about fifty feet from the air terminal, and about twenty feet from the observatory. The depths thus far operated upon are one, two, three and four feet from the surface, a limitation imposed by the formation of the locality—which is at present the only one available within working limits of the instrument.

The soil in which the instrument is placed, is a well-drained and rather gravelly loam for a depth of four feet three inches, at which point the bed rock is reached. It will, therefore, be observed that the lowest point of observation is only about three inches from the rock. Grass has been allowed to grow freely about the instrument, though kept rather short, thus establishing the conditions of land in sod.

The observations recorded below have been taken by Mr. E. H. Hamilton, B.A.Sc., assistant in the McGill College Observatory.

Date.	Temperatures in Degrees Centigrade.					Total Precipitation.		Estimated depth of snow on the ground
	1 Ft.	2 Ft.	3 Ft.	4 Ft.	Air.	Rain.	Snow.	
1888.								
Nov. 11...	6.3	6.9	8.0	9.3	6.0	3 83	0.5	......
21...	2.3	4.2	6.8	10.1	− 2.0	0.41	3.1	1.4
Dec. 1...	0.4	2.4	5.4	8.5	− 4.5	0.76	7.4	4.5
11...	0.9	2.3	4.7	7.8	− 2.5	0.01	2.20	3.6
21...	0.8	2.6	4.6	7.5	−10.2	0.81	10.90	3.6
31...	0.4	1.4	4.0	6.6	− 3.1	0.75	3.80	4.7
1889.								
Jan. 10...	0.5	2.2	3.7	5·6	− 2.5	1.62	6.30	2.5
20...	0.6	2.1	3.5	5.5	− 5.7	0.23	2.40	4.0
30...	0.2	1.4	3.0	4.7	− 9.2	0.03	29.40	19.0
Feb. 9...	0.2	0.9	2.8	3.0	−14.5	0.00	22.00	28.6
19...	−0.4	0.7	2.2	4.1	− 8.3	0.30	10.20	35.5
Mch. 1...	−0.1	0.9	2.2	3.5	−11.5	0.00	2.40	31.0
11...	−0.3	0.6	2.2	3.5	− 2.2	0.34	11.10	29.0
21...	− 0.2	0.9	2.4	3.3	− 1.4	0 08	3.10	26.7
31...	−0.5	0.4	1.8	2.8	− 1.8	0.20	1.10	21.0
Aprl. 10...	−0.5	0.2	1 5	2.7	1.9	0.00	0.10	12.0
20...	3.7	1.0	0.2	0.0	8.8	0.15	.....	2.6
30...	6.4	7.0	4.7	2.4	8.6	2.04	.....	......
May 10...	12.7	9.5	6.4	3.3	14.8	0.14	.....	......
20...	15.3	12.9	9.6	4.3	16.3	1.36	.....	......
30...	14.7	13.3	12.6	7.7	10.9	1.55	.....	......
June 9...	15.5	13.1	11.3	7.9	14.9	2.35	.....	......
19...	18.8	16.5	13.6	8 9	17.5	0.93	.....	......
29...	19.2	16.9	14.6	9.8	18.4	1.47	.....	......
July 9...	21.1	19.9	17.1	11.1	21.7	1.39	.....	......
19...	20.4	18.8	16.9	12.6	19.1	1.56	.....	......
29...	21.5	19.1	17.8	13.6	19.3	4.17	.....	..
Aug. 8...	21.2	19.4	17.9	14.3	19.2	1.12	.....	......
18...	18.7	17.5	17.4	14.6	16.6	1.50	.....	......
28...	18.9	17.3	16.8	14.2	18.5	0.25	.....	......
Sept. 7...	19.6	17.6	16.8	14.1	19.9	0.12	.....	......
17...	18.4	17.7	17.2	14.5	19.1	1.59	.....	......
27...	13.6	14.3	15.9	15.7	11.5	2 68	.....	.....
Oct. 7...	11.0	12.2	14.0	14.7	8.6	2.46	.....	......
17...	7.1	8.1	10.4	12.9	5.7	0.12	.....	......
27...	5.0	6.3	8.7	11.1	3.1	0.47	.....	......
Nov. 6...	4.7	5.7	7.9	10.7	4.3	1.11	0.80	......
16...	4.3	5.4	7.3	9.8	2.1	0.29	0.06	......
26...	3.0	4.4	6 7	9.3	1.7	1.39	.....	......
Dec. 6...	1.2	3.5	6.0	9 1	− 7.1	0.00	17.50	13.00
16...	1.0	2.7	4.9	7.9	− 3.6	1.39	2.00	9.00
26...	0.9	2.2	4.2	6.5	− 1.1	1.55	8.50	5.00

Date.	Temperature in Degrees Centigrade.					Total Precipitation.		Estimated depth of snow on the ground
	1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.	Rain.	Snow.	
1890.								
Jan. 5...	1.3	2.7	4.4	6.6	– 6.1	0.70	7.00	5.00
15...	1.9	2.3	3.9	5.7	–11.9	1.00	11.40	10.00
25...	1.4	1.8	3.2	5.0	–11.9	0.18	12.80	19.00
Feb. 4...	1.1	1.6	3.3	5.1	– 6.6	0 41	0.60	17.00
14...	0.8	1.6	3.2	4.8	– 8.1	1.29	13.20	20.00
24...	0.8	1.5	2 8	4.1	–11.7	0.20	13.90	30.00
Mch. 6...	1.0	1.6	3.0	4.1	– 5.1	0.96	0.00	28.00
16...	0.7	1.5	2.7	3.7	– 2.6	0.30	0.00	20.00
26...	0.4	0.9	2.3	2.9	– 1.6	0.18	1.40	11.0
Aprl. 5...	0.5	1.1	2.3	2.8	– 0.4	0.65	10.30	11.0
15...	0.6	0.2	0.9	1.1	4.7	0.25	0.20	6.0
25...	5.3	2.8	2.0	1.5	5.3	0.12	.....	1.0
May 5...	7.4	5.2	4.5	2.6	6.7	1 75	2.80	......
15...	9.1	7.1	5.9	3.6	9.2	1.47	.....	......
25...	11.7	10.0	8.2	4.9	11.8	1.72	.....	......
June 4...	15 0	12.1	9.6	5.9	15.1	1.58	.....	......
14...	15.5	13.5	11.7	7.8	15.3	0.90	.....	......
24...	17.6	14.7	12.4	8.2	19.4	0.92	.....	......
July 4...	21.1	17.8	14.8	9.8	21.7	0.65	.....	......
14...	20.7	18.3	16.1	11.5	19.4	0.20	.....	......
24....	20.7	18.3	16.5	12.1	18.5	1.02	.....	......
Aug. 3...	21.7	18.8	16.6	12.2	22.8	1.07	.....	......
13...	21.9	19.9	17.8	13.3	20.8	1.56	.....	......
23...	18.7	17.5	17.0	14.5	15.7	2.71	.....	......
Sept. 2...	16.5	15.3	15.4	14.5	15.5	3.65	.....	......
12...	17.2	15.7	15.4	13.9	17.0	2.29	.....	......
22...	14.9	14.6	15.1	14.1	14.3	0.98	.....	......
Oct. 2...	11.1	12.0	13.5	13.8	14.1	0.30	.....	......
12...	10.1	11.1	12.9	13.5	8.7	0.80	.....	......
22...	8.8	8.0	10.8	12.3	7.7	1.64	.....	......
Nov. 1...	6.8	7.6	9.7	11.7	4.6	0.30	.....	... ..


A
D
C
Line of incision
1
B
2
B'
D
C
3

Note on a Peculiar Growth in Black Walnut.

By D. P. Penhallow.

The specimen herewith described, was handed to me by the Hon. Senator Murphy, it having been sent to him by the Huntingdon Organ Company, who purchased the lumber from which it was cut, in the United States. The block is one-half inch thick by three by four inches. As the board to which it originally belonged was being cut up, a portion, occupying the space D^1 (Fig. 3), fell out, disclosing a cleft made by an axe, evidently the result of an abandoned effort to cut the tree down many years before that event actually occurred.

Upon examination it appears that the block occupying the space D^1 was originally continuous with the shaded areas E, E^1, from which it became separated by the action of the saw—the line of fracture appearing as shown in the figure. This block also completely filled the space D^1, and evidently extended—in the entire tree—much above and below the limits of thickness in the specimen. The entire surface of the intruded mass, where brought in contact with the surfaces of the cleft, is covered with a thin layer of carbonized material, showing the effects of decay in the first formed tissues, under exclusion of air—a result always to be observed in similar cases; while the grain is found to run at various angles—chiefly right angles—to that of the surrounding parts.

The intruded mass is the result of growth following injury, and an effort on the part of the plant to repair it—a result commonly observed, as in the obliteration of surveyors blazes, and as illustrated in the case of a remarkable blaze described a few years since.[1] This case offers nothing new, but presents some features of interest as showing the extent to which an injury may be repaired under the ordinary conditions of growth. This will be more obvious from

[1] *Science,* iii, 354.

an examination of the relation between the specimen and the original tree.

From the curvature of the growth rings it would appear that the tree— at the time of injury—had a diameter of about eighteen inches. The relationship of parts is shown in figure 1, where C represents an end view of the specimen (Fig. 3 C^1), in relation to the growth rings of the tree: D shows the intruded mass as exposed on a line of section passing through the center of D^1 (Fig. 3). The slope of the cleft shows the line of incision to have had the direction given by the line in figure 1, from which it is evident that the incision was a somewhat deep one, and that our specimen came from one end of it. It is also obvious that this injury must have been inflicted in the winter, or at least before the growth for the season began, since the intruded mass is part of the ring formed at A (Fig. 1), and B, B^1 (Figs. 2 and 3). In Fig. 3, the left-hand side of the incision represents the basal portion of the cut. Whether the original cleft was filled throughout by the new growth, or whether this was only partial, cannot be determined from the specimen before us.

"On Burrows and Tracks of Invertebrate Animals and other Markings in Palæozoic Rocks."[1]

By Sir J. William Dawson, LL.D., F.R.S., F.G.S.

This paper, which is illustrated by photographs and drawings, indicates some new facts in connection with the markings produced by the burrows and tracks of animals, and other causes. *Rusichnites* and *Cruziana* are regarded, like *Climactichnites* and *Protichnites*, as representing probable burrows or tracts of Crustaceans and Chætopod worms, *Scolithus canadensis* is shown to be a cylindrical burrow, with accumulations of earthy castings at its mouth. The relation of these burrows to the forms known as *Scotolithus*,

[1] From Proceedings of London Geological Society.

Asterophycus, Monocraterion and *Astrapolithon* is pointed out.

Under the new generic name of *Sabellarites,* the Author describes certain tubes, composed of shelly and other fragments cemented by organic matter, found in the Trenton Black-river Limestone. They resemble the burrows or tubes formerly described by the Author from the Hastings and Quebec Groups, and appear to be the tubes of worms allied to the recent *Sabellariæ*; but they are liable to be mistaken for Algæ of the genera *Palæophycus* and *Buthotrephis.*

Some large cylindrical bodies from the Potsdam Sandstone, are described as having been supposed to be trunks of trees; but the Author regards them as probably concretions formed around slender stems, like some now forming in the alluvial mud of the St. Lawrence, (and described in a recent number of this Journal.)

Some curious combinations of worm-tracks with ripple-marks and shrinkage-tracks, are described; as also branching or radiating worm-trails which present some resemblance to branching Fucoids. Finally, the Author describes the formation of rill-marks on the mud-banks of the tidal estuaries of the Bay of Fundy, and indicates their identity with some impressions in slabs of rock, which have been described as Fucoids under several generic names.

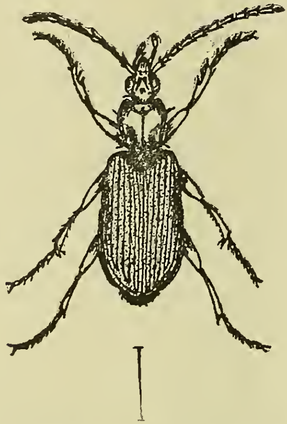
The paper will probably be published in full, with illustrations, in the November number of the Journal of the Geological Society.

A New Canadian Platynus.

By J. T. Hausen.

PLATYNUS HORNII sp. nov.

Piceus, subviridiæneus, non nitidus, subtus fuscus vel rufo-fuscus, elytris obscure vividibus, satis strialis, striis impunctatis, interstitiis paullum complanatis, rugulose punctulatis, costa tertia quinque foveolata; capite viridi, bisulcato; antennis nigris, scapo, palpis, mandibulis, pedisbusque rufes centibus. prothorace latitudine paullo longiori, subcordato, eanaliculato, valde basi foveis oblongis impressis, margine laterali postice reflexo. Long. .375in.



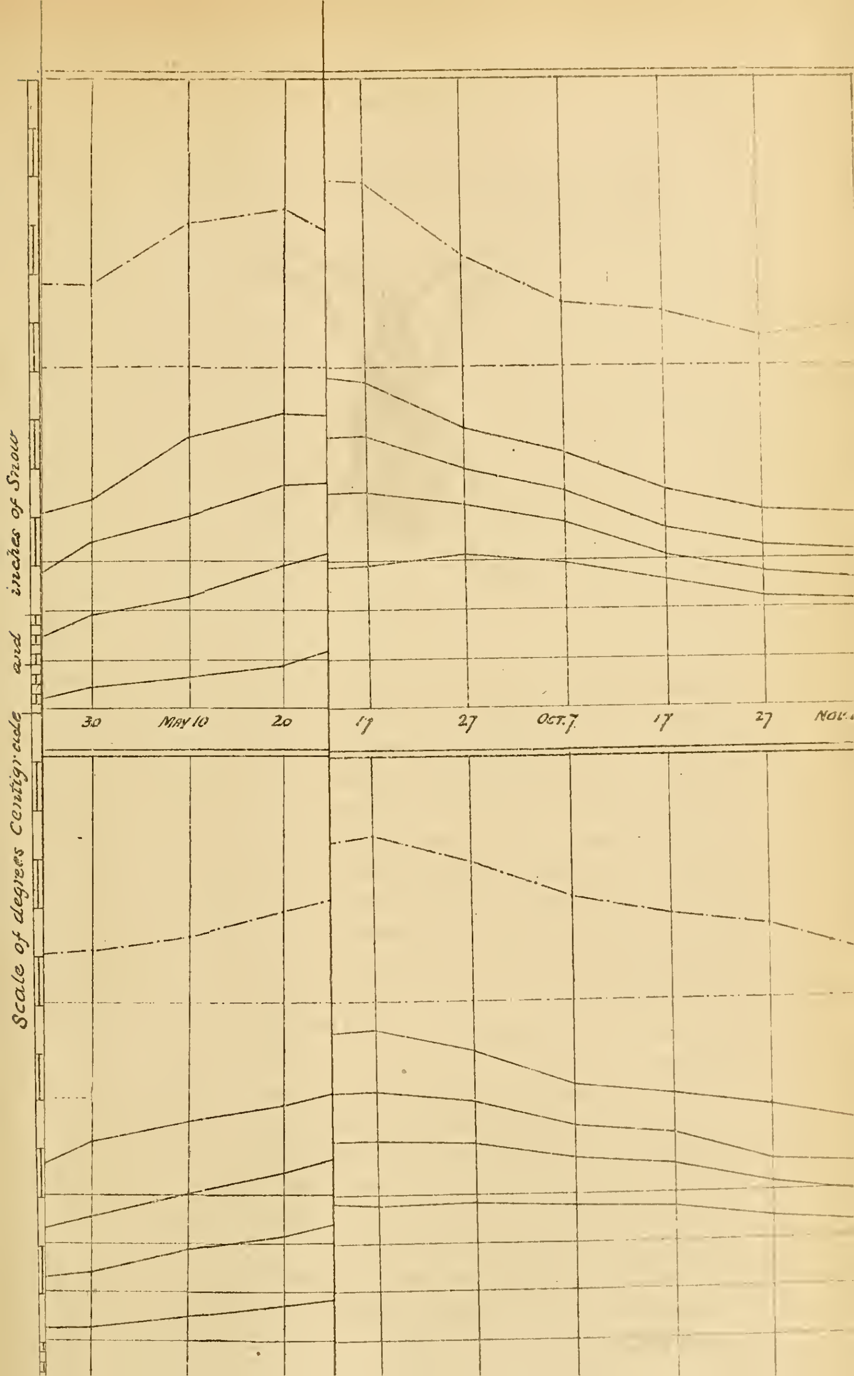
Dark with a greenish tint, not shining, beneath reddish brown passing into dirty yellow on the prosternum and gula; first joint of antennæ, mouth-parts and legs testaceo-rufous; prothorax obcordate, scarcely sinuate in front of posterior angles, which are obliquely cut off and slightly rounded, finely channelled at middle, with the anterior angular impression almost obsolete. Head dark bronzy green, sometimes with a small punchform impression at the middle above the frontal impressions. Elytra moderately convex, furrows well-marked, not punctate, interspaces punctulate.

Var. *α*. Prothorax brown, lighter than head and wing covers.

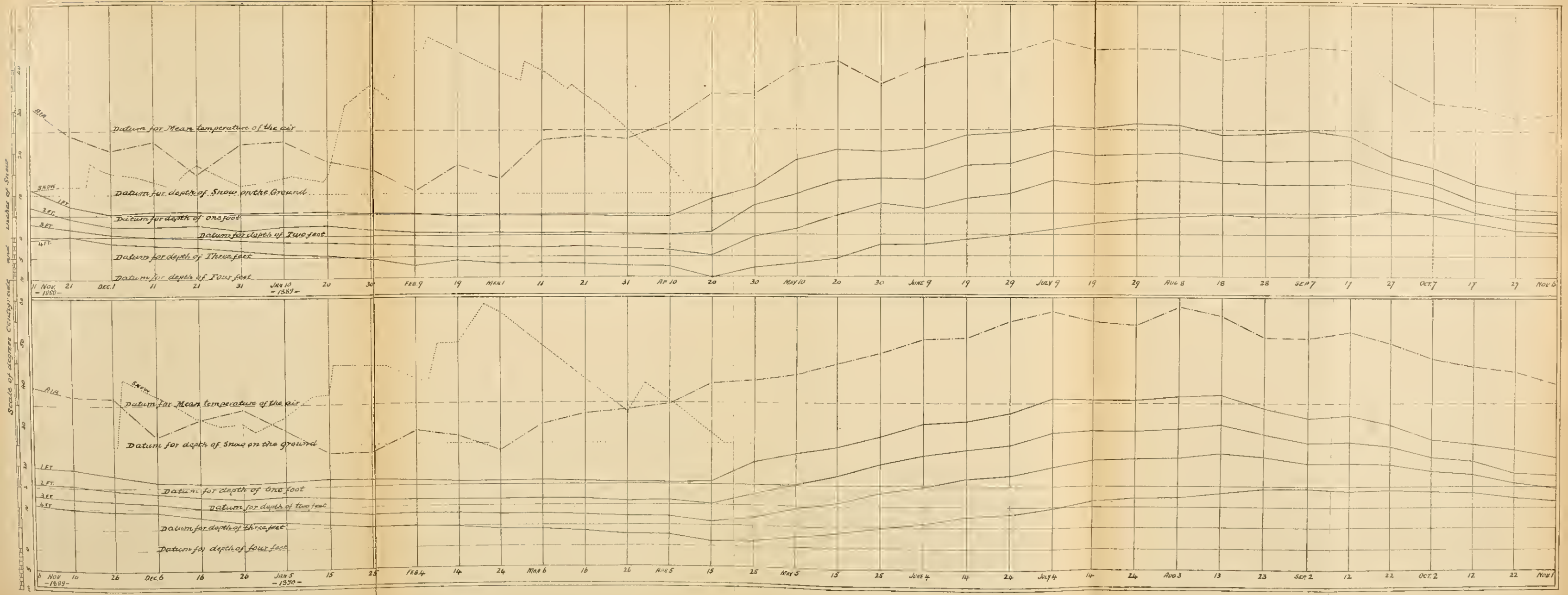
Var. *β*. Head and thorax black, underside dark brown.

On being shown a specimen. Dr. Horn declared he doubted the American origin of this species, but as I have individuals from Ste. Rose and Ile Perrot, P.Q., both rather out-of-the-way places and somewhat distant from each other, I venture to describe it as new.

I wish to dedicate it to Geo. H. Horn, M.D., of Phila., the distinguished American coleopterist, who well deserves such an honor.



Scale of degrees Centigrade and inches of Snow
30
MAY 10
20
17
27
OCT. 7
17
27


Scale of degrees Centigrade and inches of Snow
AIR
SNOW
1 FT.
2 FT.
3 FT.
4 FT.
Datum for Mean temperature of the air
Datum for depth of Snow on the Ground
Datum for depth of one foot
Datum for depth of Two feet
Datum for depth of Three feet
Datum for depth of Four feet
11 NOV. 21 DEC. 1 11 21 31 JAN 10 20 30 FEB. 9 19 MAR. 1 11 21 31 AP. 10 20 30 MAY 10 20 30 JUNE 9 19 29 JULY 9 19 29 AUG. 8 18 28 SEP. 7 17 27 OCT. 7 17 27 NOV. 6
- 1888 -
- 1889 -
Datum for depth of Snow on the ground
Datum for depth of One foot
Datum for depth of two feet
Datum for depth of three feet
Datum for depth of four feet
6 NOV 10 26 DEC. 6 16 26 JAN 5 15 25 FEB. 4 14 24 MAR. 6 16 26 APR. 5 15 25 MAY 5 15 25 JUNE 4 14 24 JULY 4 14 24 AUG. 3 13 23 SEP. 2 12 22 OCT. 2 12 22 NOV. 1
- 1889 -
- 1890 -

ɪR, 1890.

ʼ feet. C. H. McLEOD, *Superintendent.*

D	Clouded Tenths. Max.	Clouded Tenths. Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	10	0	99	....	....	....	1
	10	1	03	.	....	...	2
	3	0	97	....	.. .	....	3
	10	3	47	....	..	....	4
	10	0	50	0.02	....	....	5
	10	0	22	....	....	....	6
Sunda	..	..	47	....	....	...	7 ....Sunday
	10	0	51	0.26	.. .	....	8
	10	0	59	....	....	....	9
	10	5	9	..	....	....	10
	10	10	00	0.27	...	....	11
	10	10	00	1.74	....	....	12
	10	2	27	0.62	....	....	13
Sunda	..	..	91	....	....	....	14 .... Sunday
	10	3	32	....	....	....	15
	10	10	00	0.26	....	....	16
	10	0	35	....	......	....	17
	0	0	99	....	....	....	18
	2	1	96	..	....	....	19
	10	0	35	0.10	....	....	20
Sunda	..	..	98	....	....	....	21 ....Sunday
	10	4	48	Inapp.	....	....	22
	10	2	39	0.03	....	....	23
	10	0	81	....	....	....	24
	1	0	99	....	....	....	25
	10	0	07	0.19	....	....	26
	10	0	00	0.08	....	....	27
Sunda	..	..	85	....	....	....	28 .... .Sunday
	2	0	97	....	....	....	29
	1	0	96	....	....	....	30
.....	..	..	51.6	3.57	....	....	Sums ....
16 yrs. includ	.	..	¶5.41	3.34	....	....	16 yrs. means for and including this month

ɜl and

Direc

Milesʸ.

Durat

Mean; the

ʼing a

Greɪ rmest

Greɪ 28th.

the 30ⁿ the

Resʾ 13th,

giving a range of 0.784 inches. Maximum relative humidity was 100 on the 12th and 13th. Minimum relative humidity was 48 on the 24th.

Rain fell on 11 days.

Aurora were observed on four nights.

Hoar frost on four days.

Fog on four days.

Slight earthquake at three minutes past three on the morning of the 26th.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	§Max.	§Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	61.82	68.7	53.8	14.9	30.1640	30.198	30.120	.078	.3807	69.5	51.7	S.W.	15.3	3.7	10	0	99	....	....	....	1
2	59.90	65.9	55.4	10.5	30.1853	30.211	30.160	.051	.4380	84.7	55.3	S.W.	15.2	8.5	10	1	03	.	....	...	2
3	57.07	66.0	48.0	18.0	30.2427	30.293	30.211	.082	.3120	68.0	46.0	N.E.	7.8	0.5	3	0	97	....	.. .	...	3
4	61.72	72.9	48.4	24.5	30.1040	30.215	29.978	.237	.4402	79.0	54.5	S.E.	9.2	7.2	10	3	47	....	..	....	4
5	70.10	77.0	63.0	14.0	29.9870	30.012	29.962	.050	.5458	74.3	61.0	S.W.	15.0	6.3	10	0	50	0.02	....	....	5
6	64.02	71.0	58.3	12.7	30.0402	30.076	30 012	.064	.4737	79.3	57.3	N.E.	5.1	6.3	10	0	22	.. .	....	....	6
SUNDAY 7	. ...	77.7	56.5	21.2	....	......	......	....	.....		....	S.	6.8	....	..	..	47	....	....	...	7 ....SUNDAY
8	69.37	80.0	61.3	18.7	30.0107	30.124	29.935	.189	.6080	83.8	64 2	S.	13.6	7.2	10	0	51	0.26	.. .	....	8
9	60.12	67.0	54.4	12.6	30.2457	30.292	30.164	.128	.3595	70.0	49.8	N.E.	9.9	8.2	10	0	59	....	....	....	9
10	58.57	64.5	54.5	10.0	30.3445	30.367	30.313	.054	.3795	77.3	51.3	E.	6.0	9.2	10	5	9	..	....	....	10
11	56.18	60.7	52.6	8.1	30.3118	30.381	30.220	.161	.3783	83.7	51.3	S.E.	10.1	10.0	10	10	00	0.27	...	....	11
12	61.65	67.2	55.0	12.2	30.0050	30.153	29.871	.282	.5435	98.0	61.0	S.	10.8	10.0	10	10	00	1.74	....	....	12
13	67.95	76.8	58.4	18.4	29.7580	29.885	29.666	.219	.5975	85.3	63.0	S.W.	15.7	7.5	10	2	27	0.62	.. .	....	13
SUNDAY. .... .14	.... .	62.8	48.3	14.5	......	......	......	....	.....	....	....	S.W.	11.5	....	.	..	91	....	....	....	14 .... SUNDAY
15	57.80	65.9	49.7	16.2	30.0518	30.106	29.978	.128	.3937	82.8	52.3	S.E.	5.3	8.0	10	3	32	....	....	....	15
16	58.07	62.1	54.3	7.8	29.9637	29.982	29.929	.053	.4633	95.8	56.8	N.	5.3	10.0	10	10	00	0.26	....	....	16
17	58.70	64.6	54.3	10.3	29.9842	30.047	29 942	.105	.4008	81.7	52.8	N.E.	19.7	4.7	10	0	35	....	......	....	17
18	61.60	69.9	53.6	16.3	29.9723	30.002	29.953	.049	.3683	67.8	50.5	W.	12.5	0.0	0	0	99	....	....	....	18
19	62.42	71.1	52.1	19.0	29.9217	30.020	29.792	.228	.4002	71.8	52.7	S.	14.6	0.5	2	1	96	..	....	....	19
20	54.87	63.1	44.8	18.3	29.9812	30.183	29.819	.364	.3238	73.3	46.3	S.W.	17.8	5.5	10	0	35	0.10	....	....	20
SUNDAY. 21	.....	53.8	39.5	14.3	... ...	......	......	....	.....	....	....	S.W.	6.9	....	..	..	98	...	....	....	21 ....SUNDAY
22	52.95	59.6	44.0	15.6	29.9422	30.094	29.808	.286	.3187	79.5	46.3	S.W.	7.5	9.0	10	4	48	Inapp.	....	....	22
23	52.33	59.6	46 0	13.6	29.8165	29.971	29.743	.228	.3137	79.3	45.7	W.	16.3	9.2	10	2	39	0.03	....	....	23
24	45.97	51.8	40.6	11 2	30.2100	30.295	30.058	.237	.1920	62.2	33.2	N.W.	13.5	2.3	10	0	81	....	....	....	24
25	49.27	56.9	40.8	16.1	30.1422	30.314	30.006	.308	.2360	69.0	38.7	S.W.	15.1	0.2	1	0	99	....	....	....	25
26	50.57	58.0	43 1	14.9	29.9518	30.004	29.926	.078	.3200	86.3	46.5	S.W.	10.4	8.3	10	0	07	0.19	....	....	26
27	45.42	51.8	41.5	10.3	30.1408	30.280	29.990	.290	.2405	79.2	39.2	N.	10.0	6.7	10	0	00	0.08	....	....	27
SUNDAY........28	.....	52.0	38.6	13.4	....	......	......	....	....	....	. ..	N.	5.8	....	.	..	85	....	....	....	28 .... .SUNDAY
29	47.00	55.0	38.1	16.9	30.3598	30.450	30.279	.171	.2348	73.3	38.5	S.W.	6.2	0.3	2	0	97	....	....	....	29
30	57.10	65.3	46.0	19.3	30.2083	30.230	30.179	.051	.3360	71.3	47.7	S.W.	19.0	0.2	1	0	96	....	....	....	30
....Means	57.79	64 62	49.83	14.79	30.0786	......	......	.160	.3846	77.9	50.5	....	11.3	5.75	..	.	51.6	3.57	....	....	Sums ....
16 yrs. means for & including this mo.	58.51	66.47	50.77	15.71	30.0110	. ....	......	.178	.3807	75.1	...	....	....	5.69	.	..	¶5.41	3.34	....	....	16 yrs. means for and including this month

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles..	792	602	150	709	1070	3262	917	620	....
Duration in hrs..	77	65	27	83	99	231	72	61	5
Mean velocity...	12.9	9.3	5.6	8.5	10.8	14.1	12.7	10.2	

Greatest mileage in one hour was 38 on the 30th.
Greatest velocity in gusts, 42 miles per hour on the 30th.
Resultant mileage, 3410.

Resultant direction, S. 49° W.
Total mileage, 8,122.
Average mileage, 11.3.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.
§ Observed.
† Pressure of vapour in inches of mercury.
‡ Humidity relative, saturation being 100
¶ Nine years only.

The greatest heat was 80.0 on the 8th; the greatest cold was 38.1 on the 29th, giving a range of temperature of 41.9 degrees. Warmest day was the 5th. Coldest day was the 28th. Highest barometer reading was 30.450 on the 29th; lowest barometer was 29.666 on the 13th, giving a range of 0.784 inches. Maximum relative humidity was 100 on the 12th and 13th. Minimum relative humidity was 48 on the 24th.

Rain fell on 11 days.
Aurora were observed on four nights.
Hoar frost on four days.
Fog on four days.
Slight earthquake at three minutes past three on the morning of the 26th.

1890.

feet. C. H. McLEOD, *Superintendent.*

	UDED NTHS. Max.	Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	o	0	100	....	....	....	1
	7	0	98	....	....	...	2
SUNI		..	60	0.16	.. .	....	3 .... .SUNDAY
	ɔ	0	59	0.37	...	....	4
	o	3	50	0.60	....	....	5
	9	0	88	0.30	....	....	6
	o	0	66	....	....	...	7
	o	0	71	....	.. .	....	8
	ɔ	2	79	0.28	....	....	9
SUNI		..	63	0.01	....	....	10 ....SUNDAY
	ɔ	0	70	Inapp.	...	....	11
	ɔ	0	97	....	....	....	12
	ɔ	0	84	....	....	....	13
	ɔ	0	46	0.02	....	....	14
	5	0	90	....	....	....	15
	ɔ	0	84	....	....	....	16
SUNI		..	00	0.42	......	....	17 ....SUNDAY
	ɔ	0	100	....	....	....	18
	ɔ	2	01	0.57	....	....	19
	S	0	84	0.04	....	....	20
	ɔ	0	39	0.32	....	....	21
	ɔ	0	82	....	....	....	22
	ɔ	10	00	1.34	....	....	23
SUNI		..	00	0.83	....	....	24 ....SUNDAY
	ɔ	0	62	....	....	....	25
	ɔ	0	69	Inapp.	....	....	26
	ɔ	10	13	1.61	....	....	27
	ɔ	0	71	0 20	....	....	28
	ɔ	0	36	Inapp.	....	....	29
		7	38	0 87	....	....	30
SUND		..	00	0.14	....	....	31 ....SUNDAY
.....		..	58.1	8.08	....	....	Sums ....
16 yr inclu		..	¶60.1	3.15	....	....	16 yrs. means for and including this month.

and

Dire

Mile

Dura

Mea the

ng a

mest

Gre 23rd.

Gre 16th;

the 21

ing a

Res

range of 0.728 inches. Maximum relative humidity was 99 on the 27th and 31st. Minimum relative humidity was 34 on the 12th.

Rain fell on 20 days.

An aurora was observed on one night.

Solar halos on two days.

Fog on two days.

Thunderstorms on five days.

NOTE.—The wind directions in broad-faced type are from the City Hall record.

ABSTRACT FOR THE MONTH OF AUGUST, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				*BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	Max.	Min.	Range.				General direction.	Mean velocity in miles per hour	Mean.	Max.	Min.					
1	71.90	80.3	60.3	20.0	29.9948	30.061	29.900	.161	.4248	54.7	54.5	W.	6.8	0.0	0	0	100	....	....	....	1
2	75.15	84.9	61.5	23.4	30.0883	30.135	30.051	.084	.5250	61.3	60.3	S.	8.4	2.5	7	0	98	....	....	...	2
SUNDAY........ 3	.....	86.8	66.3	20.5	....	......	......	....	.....	...	....	S.	15.8	....	..	..	60	0.16	....	...	3 .... SUNDAY
4	75.85	88.8	71.5	17.3	29.9250	29.969	29.878	.091	.7980	81.8	72.3	S.W.	10.6	7.2	10	0	59	0.37	....	....	4
5	75.05	85.0	69.1	15.9	29.9200	29.974	29.852	.122	.7023	80.2	68.5	S.	12.7	8.3	10	3	50	0.60	....	....	5
6	68.18	75.0	62.0	13.0	29.9632	30.011	29.933	.078	.4947	72.2	58.7	S.W.	18.7	4.7	9	0	88	0.30	....	....	6
7	68.55	79.0	61.6	17.4	30.0782	30.110	30 019	.091	.4668	67.7	57.0	W.	10.4	2.8	10	0	66	....	....	...	7
8	69.40	79.0	60.2	18.8	30.0335	30.114	29.936	.178	.5112	72.2	59 7	S.	6.6	1.7	10	0	71	....	....	....	8
9	72.75	82.7	64.1	18.6	29.77:8	29.905	29.671	.234	.5768	73.3	63.0	S.	13.8	6.2	10	2	79	0.28	....	....	9
SUNDAY........10	.....	72.8	56.2	16.6	......	......	......	....	.....	....	....	S.W.	16.6	....	..	..	63	0.01	....	....	10 ....SUNDAY
11	64.23	75.1	55.1	20.0	29.8980	30.051	29.761	.290	.3610	61.5	50.0	N.	14.5	2.2	10	0	70	Inapp.	...	....	11
12	66.17	75.9	56.0	19.9	30.1552	30.183	30.134	.049	.3645	58.5	50.0	N.E.	10.3	0.0	0	0	97	....	....	....	12
13	70.25	81.1	57.2	23.9	30.1022	30.198	29.999	.199	.4770	66.0	57.5	N.E.	2.5	4.7	10	0	84	....	....	...	13
14	70.13	79.8	61.3	18.5	29.8650	29.954	29.814	.140	.4682	64.5	57.0	**W.**	8.8	7.0	10	0	46	0.02	....	....	14
15	62.32	68.8	54.4	14.4	30.0292	30.167	29.858	.309	.3222	57.0	46.5	**N.W.**	15.0	1.2	5	0	90	....	....	....	15
16	59.18	67.0	48.3	18.7	30.1818	30.261	30.069	.192	.2727	54.5	42.2	**N.W.**	7.0	4.0	10	0	84	....	....	....	16
SUNDAY........17	.....	69.9	57.7	12.2	....	......	......	....	.....	....	....	**W.**	14.9	....	..	..	00	0.42	......	....	17 ....SUNDAY
18	58.90	67.8	51.4	16.4	30.1725	30.200	30.098	.102	.2932	59.7	44.2	**N.W.**	8.2	0.0	0	0	100	....	....	....	18
19	57.53	64.7	52.4	12.3	30.0775	30.198	29.960	.238	.3853	81.5	51.8	**N.E.**	8.7	8.7	10	2	01	0.57	....	....	19
20	60.10	68.9	53.0	15.9	30.0882	30.130	30.015	.115	.3805	73.5	51.5	**N.W.**	7.2	3.7	8	0	84	0.04	....	....	20
21	62.22	72.5	51.5	21.0	29.8297	30.112	29.533	.579	.4622	82.0	56.3	**W.**	18.6	6.7	10	0	39	0.32	....	....	21
22	59.92	68.1	53.4	14.7	29.8733	30.031	29.760	.271	.3828	74.3	51.2	W.	15.8	6.2	10	0	82	....	....	....	22
23	48.57	53.5	47 4	6.1	30.1035	30.133	30.056	.077	.2912	85.2	44.3	N.	17.6	10.0	10	10	00	1.34	....	....	23
SUNDAY........24	.....	55.9	48.3	7 6	....	......	......	....	....	....	....	N.	11.2	....	.	..	00	0.83	....	....	24 ....SUNDAY
25	58.95	68.5	49.3	19.2	29.9287	29.973	29.901	.072	.3616	73.0	50.0	S.W.	14.3	4.5	10	0	62	....	....	....	25
26	65.17	73.5	52 9	20.6	29.8833	29.999	29.769	.230	.4180	67.7	53.7	S.	5.7	6.7	10	0	69	Inapp.	....	....	26
27	61.98	66.1	58.4	7.7	29.6215	29.686	29.589	.097	.5262	94.7	60.2	N W.	5.2	10 0	10	10	13	1.61	....	....	27
28	63.42	70.9	58.3	12.6	29.8148	29.931	29.680	.251	.4263	73.0	54.0	W.	13.2	6.0	10	0	71	0 20	....	....	28
29	60 07	66.8	50.9	15.9	29.8740	29.964	29.718	.246	.3305	64.0	47.7	E.	6.7	7.7	10	0	36	Inapp.	....	....	29
30	59.38	67.9	55.4	12.5	29.6735	29.746	29.625	.121	.4423	87.5	55.7	S.W.	10.8	9.3	10	7	38	0 87	....	....	30
SUNDAY........31	.....	61.2	53.3	7.9	.... .	.....	.....	....	.....	..	..	N.W.	11.6	....	..	..	00	0.14	....	....	31 ....SUNDAY
....Means.	64.82	72 84	56.73	16.11	29 9595	......	......	.178	.4409	70.8	54.5	....	11.26	5.08	..	..	58.1	8.08	....	....	Sums ....
16 yrs. means for & including this mo.	66.96	75.22	58.82	16.40	29.9409	. ....	......	.323	.4813	72.37	...	... .	....	5 24	..	..	¶60.1	3.15	....	....	16 yrs. means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles............	1308	380	182	367	1171	1964	1839	1169	....
Duration in hrs..	119	45	28	47	111	137	139	112	6
Mean velocity...	11.0	8.4	6.5	7.8	10.5	14.3	13.2	10.4	

Greatest mileage in one hour was 33 on the 21st.

Greatest velocity in gusts, 60 miles per hour on the 21st.

Resultant mileage, 3,370.

Resultant direction, S. 83° W.

Total mileage, 8,380.

Average mileage, 11.26.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 83.8 on the 4th; the greatest cold was 47.4 on the 23rd, giving a range of temperature of 41.4 degrees. Warmest day was the 4th. Coldest day was the 23rd. Highest barometer reading was 30.261 on the 16th; lowest barometer was 29.533 on the 21st, giving a range of 0.728 inches. Maximum relative humidity was 99 on the 27th and 31st. Minimum relative humidity was 34 on the 12th.

Rain fell on 20 days.

An aurora was observed on one night.

Solar halos on two days.

Fog on two days.

Thunderstorms on five days.

NOTE.—The wind directions in broad-faced type are from the City Hall record.

R, 1890.

feet. C. H. McLEOD, *Superintendent.*

DAY	CLOUDED TENTHS. Max.	Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	10	0	99	....	....	....	1
	10	1	03	.	....	...	2
	3	0	97	....	..	....	3
	10	3	47	....	..	....	4
	10	0	50	0.02	....	....	5
	10	0	22	....	....	....	6
SUNDAY..	..	..	47	....	....	...	7 ....SUNDAY
	10	0	51	0.26	...	....	8
	10	0	59	....	....	....	9
	10	5	9	...	....	....	10
	10	10	00	0.27	...	....	11
	10	10	00	1.74	....	....	12
	10	2	27	0.62	....	....	13
SUNDAY. .	..	..	91	....	....	....	14 .... SUNDAY
	10	3	32	....	....	....	15
	10	10	00	0.26	....	....	16
	10	0	35	....	......	....	17
	0	0	99	....	....	....	18
	2	1	96	..	....	....	19
	10	0	35	0.10	....	....	20
SUNDAY.	..	..	98	...	....	....	21 ....SUNDAY
	10	4	48	Inapp.	....	....	22
	10	2	39	0.03	....	....	23
	10	0	81	....	....	....	24
	1	0	99	....	....	....	25
	10	0	07	0.19	....	....	26
	10	0	00	0.08	....	....	27
SUNDAY...	..	..	85	....	....	....	28 .... .SUNDAY
	2	0	97	....	....	....	29
	1	0	96	....	....	....	30
....	..	..	51.6	3.57	....	....	Sums ....
16 yrs. mea including t	.	..	¶5.41	3.34	....	....	16 yrs. means for and including this month

evel and

Direction..

ury.

Miles..... 100

Duration ir

3th ; the

Mean velo giving a

Warmest

Greatest the 28th.

Greatest 10 on the

the 30th. the 13th,

Resultant

giving a range of 0.784 inches. Maximum relative humidity was 100 on the 12th and 13th. Minimum relative humidity was 48 on the 24th.

Rain fell on 11 days.

Aurora were observed on four nights.

Hoar frost on four days.

Fog on four days.

Slight earthquake at three minutes past three on the morning of the 26th.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				*BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	§Max.	§Min.	Range.				General direction.	Mean velocity in miles per hour	Mean.	Max.	Min.					
1	61.82	68.7	53.8	14.9	30.1640	30.198	30.120	.078	.3807	69.5	51.7	S.W.	15.3	3.7	10	0	99	....	....	....	1
2	59.90	65.9	55.4	10.5	30.1853	30.211	30.160	.051	.4380	84.7	55.3	S.W.	15.2	8.5	10	1	03	.	....	...	2
3	57.07	66.0	48.0	18.0	30.2427	30.293	30.211	.082	.3120	68.0	46.0	N.E.	7.8	0.5	3	0	97	....	.	...	3
4	61.72	72.9	48.4	24.5	30.1040	30.215	29.978	.237	.4402	79.0	54.5	S.E.	9.2	7.2	10	3	47	....	.	....	4
5	70.10	77.0	63.0	14.0	29.9870	30.012	29.962	.050	.5458	74.3	61.0	S.W.	15.0	6.3	10	0	50	0.02	....	....	5
6	64.02	71.0	58.3	12.7	30.0402	30.076	30 012	.064	.4737	79.3	57.3	N.E.	5.1	6.3	10	0	22	.. .	....	....	6
SUNDAY 7	. ...	77.7	56.5	21.2	....	......	......	....	.....		....	S.	6.8	...	..	..	47	....	....	...	7 ....SUNDAY
8	69.37	80.0	61.3	18.7	30.0107	30.124	29.935	.189	.6080	83.8	64 2	S.	13.6	7.2	10	0	51	0.26	.. .	....	8
9	60.12	67.0	54.4	12.6	30.2457	30.292	30.164	.128	.3595	70.0	49 8	N.E.	9.9	8.2	10	0	59	....	....	....	9
10	58.57	64.5	54.5	10.0	30.3445	30.367	30.313	.054	.3795	77.3	51.3	E.	6.0	9.2	10	5	9	..	....	....	10
11	56.18	60.7	52.6	8.1	30.3118	30.381	30.220	.161	.3783	83.7	51.3	S.E.	10.1	10.0	10	10	00	0.27	...	....	11
12	61.65	67.2	55.0	12.2	30.0050	30.153	29.871	.282	.5435	98.0	61.0	S.	10.8	10.0	10	10	00	1.74	....	....	12
13	67.95	76.8	58.4	18.4	29.7580	29.885	29.666	.219	.5975	85.3	63.0	S.W.	15.7	7.5	10	2	27	0.62	.. .	....	13
SUNDAY. .14	.... .	62.8	48.3	14.5	......	......	......	....	.....	....	....	S.W.	11.5	....	.	..	91	....	....	....	14 .... SUNDAY
15	57.80	65.9	49.7	16.2	30.0518	30.106	29.978	.128	.3937	82.8	52.3	S.E.	5.3	8.0	10	3	32	....	....	....	15
16	58.07	62.1	54.3	7.8	29.9637	29.982	29.929	.053	.4633	95.8	56.8	N.	5.3	10.0	10	10	00	0.26	....	....	16
17	58.70	64.6	54.3	10.3	29.9842	30.047	29 942	.105	.4008	81.7	52.8	N.E.	19.7	4.7	10	0	35	....	......	....	17
18	61.60	69.9	53.6	16.3	29.9723	30.002	29.953	.049	.3683	67.8	50.5	W.	12.5	0.0	0	0	99	....	....	....	18
19	62.42	71.1	52.1	19.0	29.9217	30.020	29.792	.228	.4002	71.8	52.7	S.	14.6	0.5	2	1	96	..	....	....	19
20	54.87	63.1	44.8	18.3	29.9812	30.183	29.819	.364	.3238	73.3	46.3	S.W.	17.8	5.5	10	0	35	0.10	....	....	20
SUNDAY 21	.....	53.8	39.5	14.3	... .	......	......	....	.....	....	....	S.W.	6.9	....	..	..	98	...	....	....	21 ....SUNDAY
22	52.95	59.6	44.0	15.6	29.9422	30.094	29.808	.286	.3187	79.5	46.3	S.W.	7.5	9.0	10	4	48	Inapp.	....	....	22
23	52.33	59.6	46 0	13.6	29.8165	29.971	29.743	.228	.3137	79.3	45.7	W.	10.3	9.2	10	2	39	0.03	....	....	23
24	45.97	51.8	40.6	11 2	30.2100	30.295	30.058	.237	.1920	62.2	33.2	N.W.	13.5	2.3	10	0	81	....	....	....	24
25	49.27	56.9	40.8	16.1	30.1422	30.314	30.006	.308	.2360	69.0	38.7	S.W.	15.1	0.2	1	0	99	....	....	....	25
26	50.57	58.0	43 1	14.9	29.9518	30.004	29.926	.078	.3200	86.3	46.5	S.W.	10.4	8.3	10	0	07	0.19	....	....	26
27	45.42	51.8	41.5	10.3	30.1408	30.280	29.990	.290	.2405	79.2	39.2	N.	10.0	6.7	10	0	00	0.08	....	....	27
SUNDAY.... ...28	.....	52.0	38.6	13.4	......	......	......	....	....	....	..	N.	5.8	....	..	..	85	....	....	....	28 .... .SUNDAY
29	47.00	55.0	38.1	16.9	30.3598	30.450	30.279	.171	.2348	73.3	38.5	S.W.	6.2	0.3	2	0	97	....	....	....	29
30	57.10	65.3	46.0	19.3	30.2083	30.230	30.179	.051	.3360	71.3	47.7	S.W.	19.0	0.2	1	0	96	....	....	....	30
....Means	57.79	64 62	49.83	14.79	30.0786	......	.....	.160	.3846	77.9	50.5	....	11.3	5.75	..	.	51.6	3.57	....	....	Sums ....
16 yrs. means for & including this mo.	58.51	66.47	50.77	15.71	30 0110	-	......	.178	.3807	75.1	...	... .	....	5.69	.	..	¶5.41	3.34	....	....	16 yrs. means for and including this month

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles............	792	602	150	709	1070	3262	917	620	....
Duration in hrs..	77	65	27	83	99	231	72	61	5
Mean velocity...	12.9	9.3	5.6	8.5	10.8	14.1	12.7	10.2	

Greatest mileage in one hour was 38 on the 30th.

Greatest velocity in gusts, 42 miles per hour on the 30th.

Resultant mileage, 3410.

Resultant direction, S. 49° W.

Total mileage, 8,122.

Average mileage, 11.3.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100

¶ Nine years only.

The greatest heat was 80 0 on the 8th; the greatest cold was 38.1 on the 29th, giving a range of temperature of 41.9 degrees. Warmest day was the 5th. Coldest day was the 28th. Highest barometer reading was 30.450 on the 29th; lowest barometer was 29.666 on the 13th, giving a range of 0.784 inches. Maximum relative humidity was 100 on the 12th and 13th. Minimum relative humidity was 48 on the 24th.

Rain fell on 11 days.

Aurora were observed on four nights.

Hoar frost on four days.

Fog on four days.

Slight earthquake at three minutes past three on the morning of the 26th.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. IV. JANUARY, 1891. NO. 5.

Clay Concretions of the Connecticut River.[1]

By Miss J. M. Arms.

The concretions with which I am most familiar are found between Brattleboro, Vt., and Sunderland, Mass., a distance of about thirty miles. Between the two towns named, few clay beds occur on the right bank, it being either green with vegetation, sandy or rocky, but on the left shore the beds are numerous.

You are first attracted by the deep blue color of the clay, which can be seen a distance from the shore. In some places, as between the two ferries known as Rice's and Whitemore's, this clay occurs interstratified with sand; in others, as at Sunderland bridge, it forms projecting shelves into the stream which are often thickly strewn with concretions washed from the beds above.

Again, as at the mouth of Saw Mill River, a little stream that empties into the Connecticut, the clay forms a high cliff rising perpendicularly from the water's edge. It is one of the finest exposures to be seen. Stratification planes cut it horizontally, and joint planes obliquely, while the peculiar blue color presents a striking contrast to the green vegetation above, and the sparkling waters below. I have

[1] Abstract of a paper on "Concretions of the Connecticut River," now in course of preparation.

never seen concretions exposed from this wall of apparently pure clay excepting close to the water's edge, where there is no possible way of getting them but to stand in the river and dig, a trowel or stout carving-knife being the best implement for the work.

In collecting claystones it is better to row *up* the stream than down, for in the latter case the dislodged clay renders the water so turbid it is impossible to see the claystones which have been washed into it, and which often have a story to tell. The concretions of each clay bed should be kept separate, and when this is done the fact is proved that *each bed has a form of concretion peculiar to itself.* You would never find, for instance, a circular disk and a cylindrical claystone imbedded together, or a botyoidal mass and an animal form; these are four typical concretions of as many separate beds.

While each bed has its characteristic form, this is not attained with an unvarying degree of perfection. There seems to be an ideal and a struggle to attain it; the resulting concretion being more or less perfect as the conditions are favorable or adverse. When the conditions are favorable and constant, the typical form is repeated many times. One of the most striking examples of this fact we found in a bed nearly opposite Whitemore's ferry. Out of twenty-six concretions, twenty-four had the same peculiar markings. One of the two exceptions, I have little doubt, was the incipient form of the others, and would have developed like them had we let it remain. The other was not found imbedded, and therefore, I presume to say, came from some bed up the river. I have seen in a private collection, forty-eight specimens from one bed so similar one could not tell them apart.

Occasionally the typical form is doubled or trebled in the same specimen, as shown in those from Saw Mill River.

Very long concretions are seldom found, although we have one in our collection measuring twenty-two and a half inches. Imitative forms are abundant. We have spectacles, a money bag, boot, arrow-head, geometrical figures, a seal, goose, fish, rooster, elephant, bird and a baby.

Prof. Hitchcock speaks of receiving a concretion from an able English geologist labeled, "Kimmeridge Coal Money (use and age unknown), found abundant in the Kimmeridge clay, Dorset coast---supposed turned in a lathe, and anciently used as money."

Three questions must be asked: How does the composition of a claystone differ from that of the surrounding clay, and is this composition definite?

What first determines the formation of a concretion?

What are the favorable and adverse conditions of which I have spoken?

Chemical analyses answer the first question by the following results:

Deerfield claystone (opposite Whitemore's ferry), contains, beside clay and iron, 42 p.c. carbonate of lime (Ca CO_3). Clay immediately surrounding claystone, 2–3 p.c. carbonate of lime. Claystone from south of Sunderland bridge, west shore, 43 p.c. Ca CO_3; surrounding clay, 2 p.c. Brattleboro claystone, 42 p.c. Ca CO_3. Hartford claystone, 47 p.c. Ca CO_3.[1]

The essential difference, therefore, between the clay and claystone, is the almost entire absence in the former of calcium carbonate. These figures show that the composition of concretions is not definite, although it does not vary greatly. We may say that nearly half a claystone is carbonate of lime, and as this is the active agent in the process of formation, we can appreciate Le Conte's appellation of "lime balls" in place of the popular name of "claystones."

The second question is much more difficult to answer. It requires the proof of the existence or non-existence of a nucleus. It has been generally believed that these nuclei exist. Prof. Hall, in the *Geological Report of New York*, speaks of concretions having for a nucleus either a gravel

[1] Prof. Hitchcock gives four analyses thus: 42, 48, 49 p.c. Ca CO_3, and one from Hadley which seems to be the exception to the rule; 56 p.c. Ca CO_3.

stone, a bit of iron pyrites, a shell or a crystal of carbonate of lime. Negative evidence, however, is strong. I think it safe to say, that many concretions have no nucleus of foreign matter. If one exist, it is in the form of such a minute grain of calcium carbonate, it cannot be detected with the eye.

Under the direction of Prof. W. O. Crosby, a concretion was sawed in two and polished. Lines of stratification were distinctly seen, but with this exception the mass was perfectly homogeneous. There was not the slightest evidence of a nucleus or of concentric structure. One half was sawed in two again, giving a sharp angle, which proved the extreme fineness of the material. A quarter was etched in chlorhydric acid, and while this rendered evident a concentric structure, it did not reveal a nucleus. Little spherical cavities were seen, as if the tendency to concretionary structure was so great that the concreting material was not satisfied with forming one large concretion, and so made smaller ones within the larger. I also dissolved one claystone in acid, and examined the insoluble residue upon a filter. It was impalpably fine clay, and no foreign particle of any appreciable size was visible.

Prof. Hitchcock says: "In no case in Massachusetts have I seen an organic relic as a nucleus." In 1859 Mr. Charles Stodder exhibited, at a meeting of the Boston Society of Natural History, two specimens cut open, one showing a nucleus less than 1-16 of an inch in diameter, the other not. At the same meeting ex-President Bouvé remarked while showing some concretions: "These bodies do not always have a nucleus; on the contrary, those from many localities very seldom have any. These seem by no means necessary for their production." I have looked through the Proceedings of the Society since 1859, but find nothing that throws additional light upon the subject.

The third question involves the history of a claystone. We first have the clay arranged in layers by the mechanical action of water. That the formation of the concretions is subsequent to the deposition of the clay is proved by the lines of stratification running with unbroken continuity through them. The plastic clay is charged with water containing carbonate of lime in solution. We may suppose some slight change in the conditions causes a precipitation of a portion of the lime, or that certain foreign bodies attract it. In either case we should have centres towards which other molecules of calcium carbonate would be drawn. By the law which governs the diffusion of liquids new material would be brought, and so the concretion would grow. The process is one of segregation—a flocking together of the molecules. Except in taking on a crystalline form, there is little difference between the building up of a crystal and concretion. The molecules segregate, and in the case of the crystal crowd back the other material, while in that of the concretion a part of this material enters into the new form.

If the concreting material comes from all directions with equal facility, as in a porous rock, the concretions are in the form of spheres, but in clay, which is more or less impervious, it spreads laterally most freely. The tendency is, therefore, to lengthen the horizontal diameter, and shorten the vertical, giving the circular disk which is the normal form of clay concretions. I have never seen a clay sphere larger than a pea, and never found one larger than a pin's head.

When a concretion passes from one layer into another poorer in carbonate of lime, the form is contracted; thus a variation in the amount of calcium carbonate results in a variation in the form of the concretion.

What the exact conditions are which cause one bed to produce animal forms, another lenticular, and a third cylindrical, it would be interesting to know. Many observations must yet be made upon these concretions *in situ.*

Note on Specimens of Fossil Wood from the Erian (Devonian) of New York and Kentucky.

By Sir Wm. Dawson and Prof. D. P. Penhallow.

(Plate I.)

The specimens referred to in this note were sent by Prof. J. M. Clarke, of Albany, to Sir Wm. Dawson, and additional specimens of one of them were subsequently obtained through Prof. Clarke from Mr. C. E. Beecher, of Yale University Museum. The greater number of the specimens proved on examination to be of species previously described by Sir Wm. Dawson, as will appear by the following notes contributed by him. One of the specimens, however, belonging to the genus *Kalymma* of Unger, a form not previously recognized in America, and imperfectly known, was placed in the hands of Prof. Penhallow for more detailed study, and the report thereon is appended.

Dadoxylon (Cordaioxylon) Clarkii,[1] Dawson.

To this species belong a number of slender stems imbedded in the Styliola limestone of the Genessee shale, and one similar specimen from the Naples series, collected by Prof. Clarke. They present the following characters :—

Stem about 1.5 c.m. in diameter, with pith 3 m.m. in diameter, surrounded with woody tissue, but destitute of bark. Woody cylinder in transverse section showing radiating rows of square fibres, converging into distinct wedges toward the pith, which is composed of parenchyma. The terminations of the wedges are about 8 in number.

The radial section shows woody fibres, with two or three rows of bordered pores and medullary rays of various lengths. There are a few scalariform and reticulated vessels in the points of the wedges next the pith.

[1] Report on Erian Plants of Canada, pt. 2, 1882, p. 124. Palæozoic Gymnosperms, Memoirs of Peter Redpath Museum, 1890.

The tangential section shows numerous medullary rays, simple or with one series of cells superimposed, and very variable in length, from one cell to many in each.

This structure is as near to that of *Dadoxylon Clarkii* as could be expected in the more slender stems or branches represented by these specimens. The cortical tissues are absent. The pith does not show Sternbergia structure, except very faintly in parts.

The specimens from the Naples beds are imperfectly presented, but in so far as can be determined, may belong to the same species.

I have already pointed out, in the publications above referred to, that the characters of this species approximate to those of the stems of *Cordaites*, so that it may be referred to *Cordaioxylon* rather than to *Dadoxylon* proper. I may now add that the species is very near to *Araucarites Ungeri*, of Goeppert, from the Cypridina shales of Thuringia. This species appears to be the same with that originally described by Unger as *Aporoxylon primigenium*. The original description and figures of Unger did not permit an exact comparison, but as now figured by Stenzel [1] in his revision of Goeppert's species, it approaches so near to *D. Clarkii* as to suggest the suspicion that it may be the same, or at least a very closely allied species. The state of preservation, however, is so different that it is scarcely possible to be sure as to this.

With reference to the generic names, there has been great misconception among palæobotanists as to the distinction between stems of *Cordaioxylon* and *Dadoxylon*. This does not at all depend on the occurrence of an Artisia or Sternbergia pith, which may be present in Sigillariæ, Cordaites or Conifers, as it is indeed in young shoots of modern firs, as well as in angiospermous exogens of different genera. The real distinction is in the character of the inner vessels or fibres of the wedges, the peculiar nature of the medullary rays, and the thinness of the woody cylinder in *Cordaites*. I have no hesitation on these grounds in referring *D. Clarkii*

[1] Royal Academy of Berlin, 1888.

and probably *D. Ungeri* to *Cordaioxylon*, while I am equally certain that the other Devonian species, *D. Ouangondianum*, *D. Halli* and *D. Newberryi* should be referred to *Dadoxylon*, a name which is properly applied to the woods of Palaeozoic Conifers, as *Walchia, &c.* The name Araucarites, used by Stenzel after Goeppert and Presl, leads to a mistaken view of affinities.

Before leaving this species, it is interesting to observe that the association of this type of gymnospermous wood, with the very different type of plant of the genus *Kalymma* described in Prof. Penhallow's note, applies both to the Cypridina shales of Europe and to the corresponding beds in America.

DADOXYLON NEWBERRYI, Dawson.[1]

With the above specimens of Prof. Clarke's collections from the Styliola beds, are fragments of much larger stems with thicker-walled woody fibres, having three rows of contiguous bordered pores, and long medullary rays, with for the most part, two rows of narrow cells side by side. On comparison with the specimens collected by Dr. Newberry in the Devonian of Ohio, from which my description of 1871 was taken, I find no difference other than what may depend on difference of preservation. I therefore refer Prof. Clarke's specimens to the above species, which is a true *Dadoxylon* and nearly allied to *D. Ouangondianum* of the Devonian of New Brunswick, and to *D. Acadianum* of the Lower coal formation of Nova Scotia. All three species occupy an intermediate position between the species with more composite medullary rays separated by Brongniart to form the genus *Palæoxylon*, and the ordinary species with medullary rays having only one row of cells like *D. materiarium*, of the Upper coal formation.

KALYMMA GRANDIS, Unger.

By D. P. PENHALLOW.

Specimens of a fossil plant from the Genessee or Black Shale (Devonian) of Moreland, Kentucky, collected by Mr.

[1] Report on Erian Plants of Canada, 1871. Page 14. Plate I. Figures 7 and 8.

Charles E. Beecher of the Yale University Museum, and placed in my hands by Sir Wm. Dawson, to whom the specimens were sent in the first instance by Prof. J. M. Clarke of Albany, and by Mr. Beecher, embrace a portion of a stem and several mounted sections. To these there were subsequently added other transverse and longitudinal sections. The derivation of the specimen from the formation referred to is vouched for by Mr. Charles E. Beecher, who collected it. (Plate I, fig. 4.)

The principal specimen, apparently a fragment of a stem, has an elliptical transverse section measuring 2.3x3.8 cm. No cortical structure is represented, although it is evident that certain parts corresponding to a cortex were at one time present. The surface shows numerous closely aggregated bundles traversing the stem longitudinally. With a hand lens of very moderate power each of these bundles presents a distinctly fibrous structure. In the transverse section these bundles are found to be so arranged as to constitute a narrow marginal zone. They are separated by parenchyma tissue, which forms radial bands usually much less in width than the bundles lying on either side.

Internal to this is a somewhat broad zone of parenchyma tissue, followed by an inner vascular zone. In this latter the bundles are somewhat widely separated by parenchyma tissue. They are all small, usually measuring 1.5 mm. in diameter. In transverse section they are round, elliptical, triangular or even crescent shaped, this latter being, in one specimen, somewhat uncommon and apparently resulting from the partial fusion of two bundles. It is also to be observed that all the bundles do not lie strictly within a zone of uniform width, as occasionally a bundle will be found isolated and situated more towards the centre of the stem. This is apparently a normal situation, as no evidence of displacement appears. Central of this inner vascular zone is a large pith composed of large and thick walled cells, in all respects the same as the more external parenchyma tissue.

The entire parenchyma structure of the stem is remarkably well preserved. A very marked peculiarity of the specimen is to be found in the extreme lightness and the porous nature of the greater part of the structure. This latter feature is so conspicuous as to render the coarse cellular tissue readily distinguishable without the aid of a glass. As determined by Sir Wm. Dawson, the infiltrated material is wholly calcite, and it is probable that the deposition was limited, being developed first in the cell walls and later extending to some of the cell cavities which in small tracts are completely filled up.

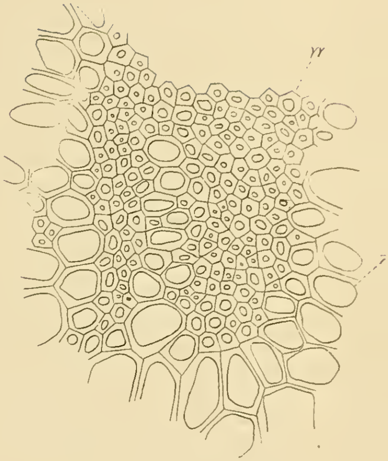
The various sections examined show the entire structure to be in a fine state of preservation. From them we gather the following facts:—

The parenchyma tissue is very coarse and thick walled. It abounds in intercellular spaces which are, for the most part, small. The primary cell is usually well defined, but no structural markings have been observed. (Plate I, fig.3.)

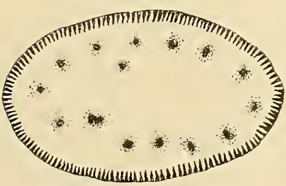
The bundles of the marginal zone are radially elongated, usually two or three times larger than broad and narrower at the inner extremity. Occasionally they are double as shown in fig. 1, from which it will also be seen that the cell walls are very thick, and there is an apparent absence of vessels. The outer face of this figure also shows a portion of the bundle removed. This is a common feature, although in some cases the same space is occupied by cells which appear isolated—separated by somewhat wide structureless areas, a result evidently due to the decay of the primary cell membranes and a wide separation of the liberated parts. We may, therefore, refer the disappearance of the cortical structure and the outer portions of the marginal bundles to the action of decay, rather than to the operation of mechanical action on the stem. Viewed longitudinally these bundles also show a complete absence of vessels, while the cells are found to be very long with tapering extremities, similar in many respects to the cells of bast tissue. No markings have been detected.

The bundles of the inner vascular zone exhibit considerable variety of form, and most of them show interior tracts

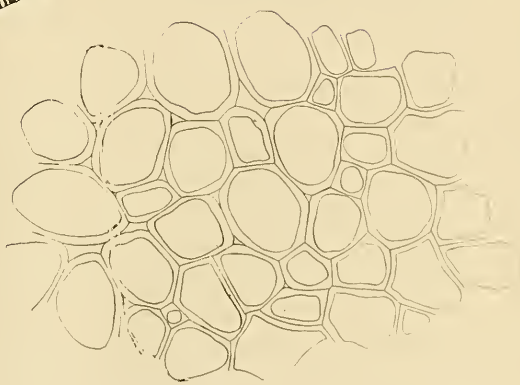
2



1



4



3

KALYMMA GRANDIS, UNG.

devoid of structure, as if a more delicate tissue like combium had been removed. Other and complete bundles, on the other hand, show no such open tracts, nor do they, as appears in figure 2, show more than one kind of tissue, so that we are left somewhat in doubt as to their precise composition. The cross section shows an apparent absence of vessels, and with one exception the same may be said of the longitudinal sections. In one case a single cell shows five transverse bars, possibly the remains of a spiral, annular or scalariform structure. In other respects the cell is the same as the other members of the bundle. Each bundle is surrounded by a layer of sclerenchymatous tissue composed of rather thick walled cells of very unusual dimensions and form.

The specimen is apparently identical with Unger's *Kalymma grandis*,[1] which he considers to be related to the Equisetaceæ—a view correctly based upon the general structure, though the presence of an outer zone of vascular structure must be regarded as exceptional, and, so far as I am aware, it has no parallel in existing types. Uncertainty as to the exact structural characteristics of the vascular bundles renders a more decided opinion as to the affinities of this plant undesirable at the present time.

Additional interest is given to this specimen from the fact that it is the first of the kind from the formation and locality from which it was obtained, and that as already stated by Sir W. Dawson, it aids in connecting the middle Devonian flora of America with that of Europe.

Explanation of Plate I.

Kalymma grandis. Ung.

Fig. 1.—Transverse section of a double vascular bundle from the outer portion of the stem. W.—woodcells; Pr.—parenchyma. The large cells forming a line nearly across the figure, show the parenchyma separating the two bundles. x 40.

[1] Richer and Unger, Devonian of Thuringia, p. 71.

Fig. 2.—Transverse section of vascular bundle from the inner vascular zone. W.—woodcells; Sc.—sclerenchyma cells surrounding the wood tissue. x 40.

Fig. 3.—Transverse section of the parenchyma tissue showing thick walls, intercellular spaces and primary cell-walls. x 40.

Fig. 4.—Transverse section of stem. Natural size.

The Composition of the Ore Used and of the Pig Iron Produced at the Radnor Forges.

By J. T. Donald.

The St. Maurice and the Radnor Forges, situated in the vicinity of Three Rivers, are of interest to those interested in the development of the iron industry in Canada, as well as to the student of the history of the early colonists of the Province of Quebec

These forges are at present the property of the Canada Iron Furnace Company, Ld., and the managing director of this company, Mr. Geo. E. Drummond, has kindly furnished the following historical note: "The value of the Three Rivers ores has been known since a very early period in the history of Canada. Official examinations were made by order of the Government of France as far back as 1668; tests of the ore were made before the year 1700, and finally in 1737 a company was formed to erect a furnace and commence the manufacture of pig iron. The Government of France seems later on to have obtained control of the work, for in 1752 the St. Maurice furnace (erected and operated by the Government) was blown in and the old stone stack bearing date 1752 and the Government insignia, the Fleur de Lis, still remains to dispute with that of Principio in Maryland, the right to be considered the oldest in America. At that early period upwards of 300 men were employed under directors who had obtained their skill in Sweden. According to the reports of Colonial Secretary Tranquet, the works were carried on with much success. In addition to pig iron, wrought iron of high quality was manufactured from the product of the bog ore; shot and shell were cast, and pigs and bars were even exported to France. After the conquest the works were leased to private parties, and since then have passed through many hands."

"Many samples of the articles—notably stoves—manufactured from the pig iron made in those early days, still remain to attest the high quality of the iron."

The furnace at Radnor, though similar in construction to that at St. Maurice, from which it is only four miles distant, was erected at a much later date, and in some respects it may be considered the successor of the old St. Maurice furnace. At present the latter is idle, but that at Radnor is in blast. Recently, the ore used and the pig iron produced in this furnace have been analysed. The ore is a mixture of equal parts of the bog ore of the neighborhood and of the curious "lake ore" from Lac la Tortue. An average sample of each was submitted to analysis, and the results are given below:—No. 1 is the bog ore, No. 2 the lake ore, No. 3 is a lake ore from the same locality, analysed by Mr. W. A. Carlyle, B. A. Sc., some three years ago.[1]

COMPOSITION OF IRON ORE.

	I.	II.	III.
Ferric oxide	60.74	70.04	69.64
Ferrous oxide	....	....	0.72
Manganic oxide	1.18	1.78	2.99
Alumina	2.59	2.20	2.43
Lime	3.47	0.32	....
Magnesia	0.93	0.27	0.60
Phosphoric anhydride	0.69	0.76	0.47
Sulphuric anhydride	0.19	0.23	0.09
Silica	13.94	7.84	8.17
Loss on ignition	16.49	16.84	15.00
	100.22	100.28	100.11
Metallic iron	42.52	49.03	49.31
Phosphorus	0.302	0.331	0.205
Sulphur	0.078	0.093	0.036

[1] Canadian Record of Science, Vol. III., No. I, p. 43.

The close correspondence between Mr. Carlyle's analysis and that of the writer would seem to indicate that this Lac la Tortue ore is of fairly uniform composition over a considerable area.

The Radnor furnace charge consists of 840 lbs. of the mixed ore, 84 lbs. of limestone and 32 bushels of charcoal; the blast used has a pressure of three-fourths of a pound, and ranges in temperature from 300° F. to 450° F. The yield of iron is on an average 42–43 per cent. of the weight of ore used.

The iron sent for analysis consisted of sections of two pigs of different degrees of hardness and produced at different times. Nos. I. and II. are the Radnor irons, No. III. is Dr. T. Sterry Hunt's analysis of a specimen of gray pig made at St. Maurice in 1868.[1]

Composition of Pig Iron.

	I.	II.	III.
Iron	94.375	96.302	Undet'd.
Carbon	.378	.336	1.100
Graphite	1.904	1.796	2.820
Silicon	1.379	.485	.860
Sulphur	.062	.049	.025
Phosphorus	.464	.430	.450
Manganese	1.145	.895	1.240
	90.707	100.293	

Canadian Argol.

By J. T. Donald.

Argol, as is well known, is the commercial name for the crude cream of tartar, which, owing to the diminished solubility of the tartrates, in alcohol is deposited on the vessels in which grape juice is fermented. The principal producers of this material are, of course, the grape-growing

[1] Report Geol. Survey, 1873-74.

countries of Europe. The sample before us however, is the produce of Canada.

In the year 1886, while investigating a process for the separation of tartrate of lime from commercial cream of tartar, the writer desired to obtain argol direct from the fermentation vat. With this end in view he wrote to the Ontario Grape Growing and Wine Manufacturing Company of St. Catharines, Ont., asking if they could supply a quantity. They replied they had none, as they removed all incrustation and sediment from their vats each season and threw it away as refuse. Here the matter dropped at the time.

In June, 1890, the same company wrote informing the writer they had taken a hint from his letter of 1886, had allowed the argol to accumulate, and now had about one ton, represented by a sample sent with the letter. On examination this sample was found to be a good one, containing 79.75 per cent of bitartrate of potash. Later on it was found that whilst a large portion of the quantity mentioned was of this high grade the value of the whole had been lowered considerably by an ignorant workman mixing with it a quantity of muddy sediment which contained only a small portion of tartar.

A fair sample of the whole was submitted to an American refiner of cream of tartar, and he purchased the lot at a price which was satisfactory to the producers. This sample is of interest, not because of any peculiarity of composition, but because it represents, so far as can be learned, the first parcel of Canadian argol that has found its way into commerce.

Aids to the Study of Canadian Coleoptera.

By J. F. Hausen, Montreal.

(Plate II.)

A New Variety of *Elaphrus pallipes*, Horn (Fig. I.)

In looking over some unnamed material in the collection of the Natural History Society of Montreal, my attention was drawn to a small *Elaphrus* I had not seen before, and which I thought at first might possibly be new. On investigation, however, I find it has been described by Dr. Horn [1] and I cannot do better than extract here his excellent description of the typical form:—

"Form rather slender, surface dark bronze as in *ruscarius*. Head densely punctured, eyes large and prominent. Thorax narrower than the head, slightly longer than wide, base narrower than apex, sides moderately arcuate, posteriorly sinuate, hind angles rectangular; disc convex, with apical impression moderately deep, median impression moderate and with a short smooth line more deeply impressed at its middle, within the hind angles a broad impression; surface densely punctured, and with a vague impression on each side of middle; beneath sparsely, but not deeply, punctured. Elytra oboval truncate at base, widest behind the middle, sides slightly sinuate behind the humeri, disc densely and finely punctured with usual three discal and a marginal series of ocellate foveæ and with polished, more elevated spaces between the foveæ of each series, those of the sutural row larger and the outer two quite small. Body beneath bronzed, shining, sparsely punctured at the sides. Legs testaceous, with æneous surface lustre, tips of tibiæ and femora darker. Length, ·24 inch; 6 mm. *Male.*—Anterior tarsi, with three joints dilated.

This species takes its place with *riparius* and *ruscarius*, from which it differs in its generally longer form, narrower and less accurate thorax and its entirely pale legs. The sculpture of the underside of the thorax is somewhat more dense and less deeply impressed, and the interval less shining than in *ruscarius*, and more sparse than in *riparius*, and with intervals distinct, occurs in Oregon and British Columbia."

While of the two individuals before me one is quite of the normal color, the other differs from the typical form by being suffused with beautiful purplish bronze, and by having

[1] Trans. Am. Ent. Soc., vol. VII (1878), p. 51.

the front part of the femora of a dark greenish color. The form is also somewhat more elongate and less compact. If deserving of a distinct name it might appropriately be called *purpurans.*

Both specimens were collected by Mr. Selwyn, of the Geological Survey, in British Columbia.

PTEROSTICHUS (DYSIDIUS) STENOPUS, SP. NOV. (Fig. 2.)

Ater nitidus, angustius elongatus; prochorax latitudine longior, tenuiter marginatus, lateribus modice rotundatus, postice angustatus et punctulatus, dorso canaliculatus, impressionibus basalibus simplicibus et rugose punctatis, elytra vix latiora, striata, tripunctata, interstiis convexis evidenter punctulatis, apice sinuata, stria scutellari longa, marginali simplici, parapleuræ latitudine longiores, punctulatæ; subtus piceo-niger nitidus; trophi, antennæ (articulis tribus basalibus exceptis) pedibusque piceis; abdominis segmenta lateribus subimpressa, basi crebro subtiliter punctulata, tibiæ maris posteriores introrsus villosæ, articulis tribus extus sullcatis. Long. ·46 poll. =11·7 mm.

Simillius P. luctuoso *forma, at notis aliis exceptis prothoracis foveis simplicitus facile distinguendus, ab affinibus forma augustivri sat distinctus.*

In shape not unlike *P. luctuosus*, Dej., but may be at once separated by its single thoracic impressions, which are punctured almost to the dorsal line. The abdominal segments are very shining, with a slight pitchy tint posteriorly, and the femora are darker than the tibiæ.

This species would seem to take its place more properly in the *Dysidius* group than in any other. I have but a single example, a male, collected at St. Rose, P.Q.

The group of which *P. mutus*, Say, may be taken as a sample, and which corresponds, in part, to the sub-genus *Dysidius* of Chaudoir may be defined by the following characters :—

The thorax is finely margined, but little narrower behind, scarcely sinuate on the sides, with the posterior angles generally obtuse, rarely slightly prominent, and the anterior transverse angular impression more or less obliterated; the basilar impressions are single, deep and more or less punctured. The grooves on the outer edge of the hind tarsi are usually well marked; metathoracic espisterna longer than broad, elongate, and the palpi cylindrical truncate, elytra with three dorsal impressions, sinuate at tip and with the scutellar stria long. The species may be separated as follows:—

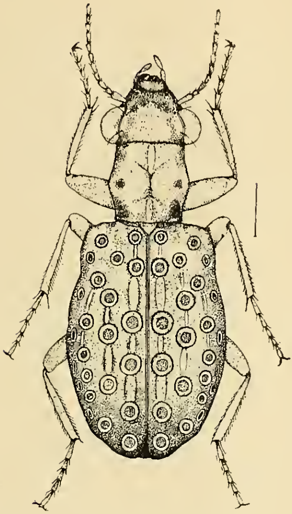
Male, with inner side of hind tibiæ clothed with hair; three points of the tarsi grooved.
  Color purplish.
    Basal prothoracic impressions not punctured; hind angles rather obtuse. 1. *purpuratus.*
  Color black.
    Form stouter, basal impressions more or less punctured.
      Black, with piceous lustre, angles of prothorax small, subrectangular. 2. *mutus.*
      Black, without piceous tint, hind angles slightly more prominent, abdominal segments at base more freely punctured. 3. *pulvinatus*, n. sp.
    Form more slender.
      Prothorax longer and strongly punctured at base. 4. *stenopus*, n. sp.
Male, with hind tibiæ not villose on the inner side; tarsal grooves less deep, not reaching to third joint; prothorax feebly sinuate on sides behind, hind angles rectangular, basal impressions feebly punctured. 5. *lustrans.*

For more detailed descriptions the student may be referred to the following papers and memoirs:—

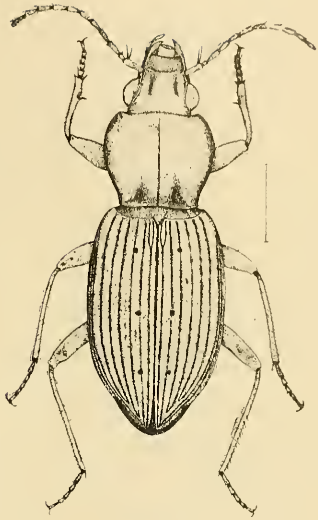
1. *P. purpuratus*, Lec. Jour. Acad. Nat. Sc. Phila., 1853, vol. II, p. 242. Ohio, Ills. Pa. Length 14·3 mm.; ·55 in.

2. *P. mutus*, Say (*Feronia*) Trans. Am. Philos. Soc., v. II, p. 44. *Fer. morosa*, Dej. spec. III, p. 283 (*Omaseus*) *picicornis*, Kirby Faun. Bor. Am. IV, p. 33. Atlantic States and Can. 10–13 mm.; ·47–50 in.

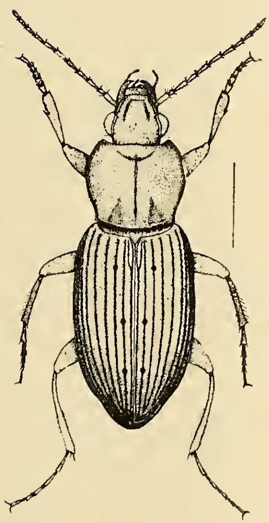
3. *P. pulvinatus*, n. sp. le Naturaliste Canadien, v. XX (1891) No. 2.



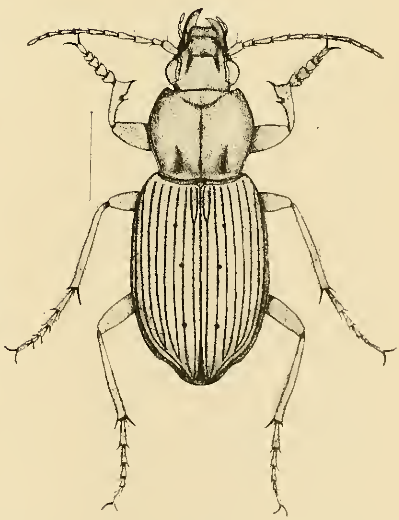
1



2



3



4

HAUSEN ON CANADIAN COLEOPTERA.

5. *P. lustrans*, Lec. Ann. Lyc., v. V, p. 181, Cal. ·12 mm. ·468 in.

EXPLANATION OF PLATE II.

Fig. 1. Elaphrus pallipes, Horn, var. purpurans, n. var. ?
" 2. Pterostichus stenopus, n. sp. ♂
" 3. " pulvinatus, n. sp. "
" 4. " mutus, Say "

ON SOME CAUSES WHICH MAY HAVE INFLUENCED THE SPREAD OF THE CAMBRIAN FAUNAS.

BY G. F. MATTHEW, M.A., F.R.S.C.

The attention given of late years to the succession and the regional variation of the Cambrian faunas, and the discovery of these faunas in different parts of the earth where they were previously unknown, has enabled us to form a judgment, imperfect though it may be, of the causes which have effected the development of these faunas.[1]

Prof. Jules Marcou has given much attention to this subject, and has stated his opinions in a series of articles published in the American Geologist.[2] In these articles he attributes the peculiarities of the Cambrian faunas in various regions of what is now Europe and North America to the peculiar distribution of the land and sea in those early times. He supposes a land connection between the north of Europe and North America as giving the means of transit, along shore lines, for the resembling faunas of Scandinavia and Acadia, and conceives of a land-barrier along the line of the Appalachian ranges as an obstacle to the migration of the Olenellus fauna eastward. A land-barrier such as Barrande has described in his great work on the Silurian system in Bohemia, is supposed by Marcou

[1]The remarks which I make in the following pages are rather suggestions than positive opinions, as to the causes which have produced changes in the Cambrian faunas, or have led to their annihilation.

[2] The lower and middle Taconic of Europe and North America.

to have separated the Welsh-Scandinavian fauna from the Cambrian faunas of the south of Europe.

Such land bridges and barriers, no doubt, had an important influence in assisting or retarding the diffusion of littoral species in former times, as they have at the present day, but in connection with their influence, it may be well to consider what effect ocean currents of different temperatures may have had on the dispersion of marine forms in the Cambrian age.

Marcou is one of the geologists who still upholds the comparatively recent origin of the Olenellus fauna, making it more recent than the Paradoxides fauna; but then he separates from Olenellus the Olenelloid forms found in Sweden and Russia, considering them to be of a more ancient type, and anterior to the Paradoxides genus.

On the other hand, we find Mr. C. D. Walcott, since his visit to Newfoundland, expressing the opinion that the Olenellus fauna is anterior to the Paradoxides fauna. This is on the assumption that all the Olenelloid forms are of nearly the same age, and anterior to the Paradoxidean forms. In this view he has the support of many European palæontologists, and especially of specialists in the Cambrian and Ordovician faunas.

Between these two extremes are several palæontologists, chiefly in America, who are not prepared yet to accept the view that the Olenelloid forms are always and everywhere older than the Paradoxidean. The actual infra-position has been shown, so far as America is concerned, only in Newfoundland.

In Acadia, though the remains of Olenellus and its allies have not been found, those of other species of animals occur, analogous to forms of the Holmia beds in the north of Europe, and so it may be inferred that genera of the Olenellus group will in time be found here. But the entire priority of all the Olenelloid trilobites to the Paradoxides in every part of the globe, may be considered an open question, or, to say the least, not fully established.

A review of the Cambrian faunas of Europe and North

America appears to the writer to show that the cotemporary existence of species of Olenelloid and of Paradoxidean trilobites in contiguous areas is possible, although this is not necessarily an inference from the peculiar distribution of these trilobites.

As a basis for the comparison of faunas, no better standard is available than the indisputable succession of zones in the Paradoxides beds of Scandinavia, where the following succession of Cambrian beds has been shown to exist:—

1. The Holmia (Olenellus Kjerulfi) beds.
2. The Paradoxides beds (proper).
   P. Œlandicus zone.
   P. Tessini zone.
   P. Davidis zone.
   P. Forchammeri zone.
   Agnostus lavigatus zone.
3. Olenus beds.
4. Peltura beds (including the Dictyonema slates.)
5. Ceratopyge (Dicellocephalus) beds.

The last division is considered by the Swedish palæontologists not to be Cambrian but to belong to the next system (Ordovician or Lower Silurian.)

In dealing with the subject from a more general point of view it is necessary to insert another zone of Paradoxides beds which is only imperfectly represented in Scandinavia in the "Exsulens Kalk" at the base of the Tessini zone; this is the group of strata with *P. rugulosus*, which species is well represented in all the Southern faunas, and in the Acadian regions comes between the Œlandicus and Tessini zones.

The complete series of Paradoxides beds proper, would thus stand as follows:—

a. P. Œlandicus (=lamellatus) zone.
b. P. rugulosus (=Eteminicus) zone.
c. P. Tessini (=Abenacus) zone.
d. P. Davidis zone.

e. P. Forchammeri zone.
f. P. Agnostus lævigatus zone.

For comparison I would first refer to the interesting fauna of Cambrian age, described by M. Jules Bergeron, and occurring at the Montaigne Noire, Dept. Herault, in the south of France.

Until of late years the fauna of Sabero in Spain, studied by De Verneuil and Barrande many years ago[1] has been the only one in the south of Europe giving an exact horizon in the Cambrian system. Now, however, that we have Cambrian faunas from other districts in that part of the continent, there is a broader basis on which to build our comparisons. In two of these districts we find varietal forms of species known elsewhere, and in one of them a peculiar combination of types, which it is difficult to parallel in other Cambrian areas, and especially in Scandinavia. To the fauna from the south of France one can easily find a parallel; but that of Sardinia, though in a country so near at hand, is perplexing, and difficult to place, owing to the novel forms which it contains.

M. Jules Bergeron has given a full account of the fauna observed by him in the shales of Montaigne Noire, and illustrated the forms with excellent plates representing the species which occur there. This fauna consists of about ten forms, (seven described species) nine trilobites and one cystidian. It is referred by M. Bergeron to the Menevian, but it is rather to be compared to that part of the Menevian which has been set off by Dr. Hicks as the Solva group. It agrees very closely with the sub-section 1 *c.* 2 of the St. John group, and has species equivalent to those of the "Exsulens Kalk" of Scandinavia.[2]

The talented author of the publication describing this fauna, found it to extend through twelve metres in thick-

[1] Faune primordeale dans la chaine cantabrique.

[2] Etude geologique du Massif ancien situé au sud du plateau central. J. Bergeron, Paris.

ness of slates, and to contain only one species of Paradoxides (*P. rugulosus*, Corda. var.) The species here attains an unusually great size. and, as M. Bergeron remarks, compares for size (being about a foot in length) with the great Paradoxides of other countries. Being so large and occupying the field for so long a period, we may believe that the conditions which surrounded it were highly favourable to its growth and development, and that the south of Europe may have been one of its principal centres of dispersion.[1]

The variety of *P. rugulosus*, found at Montaigne Noire, is remarkable for the prolonged points of the side lobes of the pygidium. In this respect it departs from the type of the species found in Bohemia, and from. *P. Eteminicus* found in Acadia.[2]

That this fauna is parallel to that of Division 1 *c.* 2 of the St. John group is clear from the following comparison of species :—

[1] Although the writer has stated in a previous publication that *P. rugulosus* in Scandinavia was preceded by *P. tessini*, an examination of the characters of one of the forms which Dr. Brogger has referred to this species (as a variety) seems to show that it is a distinct species. Dr. Brogger speaks of two varieties occurring at Krekling, Norway; a large form with smooth shield: and a smaller one with finely granulated shield ; neither variety of surface is that of *P. rugulosus*, and the large form differs also from the type of this species in the shape of the glabella, as well as in the form of the hypostome (to which the doubleur is attached) ; and in these respects also from *P. Eteminicus*, the Acadian representative of this species. The small form approaches much closer to the type *P. rugulosus*, and may be of that species.

[2] It approaches in this respect, as well as in its long eyelobe, the genus *Centropleura* of Angelin, of which genus Angelin made *P. Loveni*, found at a higher horizon, the type, and in which he included *C. decræurus* (Ang.) and *C. serratus* (S. & B.) of a still higher horizon ; but *Centropleura Loveni* has four points to the pygidium, and belongs to the same group of Paradoxidean forms as the Welsh Anopoleni. The two other species of *Centropleura* named above are referred by the latter Swedish geologists to Dicellocephalus.

Paradoxides rugulosus, var......c. f. P. Eteminicus.
Conocoryphe coronata, var......c. f. Ctenocephalus Matthewi.
" Levyi..............c. f. Conocoryphe Baileyi.
" Heberti.... .....c. f. Conocoryphe Walcotti.
" Rouayrouxi........c. f. Solenopleura Robbii.
Agnostus Sallesi..................c. f. Agnostus vir.
Trochocystites Barrandei.......c. f. Eocystites primævus.

Of *Conocoryphe Heberti* it is said that the dorsal suture is not visible, but it probably has a suture similar to the other Conocoryphes, and not to Ctenocephalus as the figures would lead one to suppose.

Conocoryphe Rouayrouxi is a Solenopleura by its dorsal suture, inflated fixed cheek and punctate surface; the eye-lobe is more posterior than in *S. Robbii*, but otherwise it resembles this species.

Agnostus Sallesi is a species of the section "Limbati" of Tullberg. In the Acadian region this section predominates very decidedly over the section "Longifrontes" at this horizon (Div. 1 *c*, 2) there being of this latter section in the St. John group, only the rare *A. partitus.* This seems also to be the case in Sweden, for although Dr. Brogger and others have referred *A. gibbus* to the "Exsulens Kalk" and *A. atavus*[1] (both Longifrontes) to the Holmia beds; they are apparently scarce in these lower beds. *A. Sallesi* differs from all the Scandinavian and Acadian "Limbati" in its pecular first lobe of the pygidium ; but it is Limbatus, and therefore of the section most common at this horizon.

In the preceding table I have compared a Trochocystites found by M. Bergeron with *Eocystites primaevus* of Acadia ; for although we have not yet found examples of the latter species sufficiently complete to determine its genus, the plates which have so far been recovered are of such a form as to make it probable that it will prove to be a Trochocystites.

The shales of Montaigne Noire containing this Paradoxides fauna, are succeeded by a group of sandstones and shales of no great thickness, at the top of which the Arenig

[1] In Lindström's catalogue of the fossil faunas of Sweden the infra position of this species is recorded as doubtful. (See page 2.)

fauna appears. Thus the only Cambrian fauna which this region shows is that of the Acadian sub-section, Div. 1 *c*. 2.

This also is the case in the north of Spain, whence Barrande and DeVerneuil described a primordeal fauna in 1860 of the following genera: Parodoxides, Conocephalites [including the genera Ptychoparia, Conocoryphe and Ctenouphalus] Arionellus [Agraulos], Orthisini [Protorthis, Hall], Orthis, Capulus [Parmophorella], Discina and Trochocystites; an assemblage referable to the Acadian Division 1*c*.

An older fauna than those of France and Spain described above, or, at least, one having types that are more archaic, is that described by Professor G. Meneghini, from the Cambrian beds of Sardinia.[1]

This writer has published a memoir on the Cambrian trilobites of Iglesiente in that island which shows that there are there some novel and peculiar types of trilobites.

The writer of the memoir on these trilobites recognizes two horizons or zones in the Cambrian rocks of this island, each containing its special types. The lower of these he compared to the Menevian group and the Lingula Flags of Britain, and the upper to the Tremadoc slates.

The fauna of the lower horizon is of great interest, partly as combining two faunal facies which are distinct elsewhere, and partly on account of two peculiar types of trilobites which existed there. The most notable of these types is that of the Oleni figured and described in this work. These are remarkable for their stout rachides and for their general olenelloid aspect. They differ from the Oleni of the north of Europe in the fact that their eyes are placed opposite the glabella instead of being nearly in front of that part, as is the case with all the northern forms; and the eyelobes also are unusually long. In one species (*O. Zoppii*) the eyelobes are decidedly drawn in at the posterior end, especially in the young individuals.[2] Now, if we follow the

[1] Palæontologia dell' Iglesiente in Sardegna, Fauna cambriana trilobiti, memoria del Prof. Guiseppe Meneghini, Firenze 1888.

[2] See Tav. I., fig. 10, and for a more mature individual Tav. III., fig. 13.

development of the trilobites of the genera Olenellus and Paradoxides (related genera) it will be observed that a long or continuous eyelobe, and one drawn in at the posterior angle of the dorsal suture, is a character of the early forms, both as larval individuals and as these genera exhibit themselves in successive strata. So well does *O. Zoppii* represent an Olenellus or a Paradoxides that if the glabella were concealed the rest of the body would meet the requirements of a form combining these two genera.[1] Prof. Meneghini also compares his species to *O. micrurus,* one of the oldest species of Olenus of the north of Europe, and the one which there best preserves the Paradoidean type.

In *Olenus armatus*, the second species of this genus described by Meneghini, other primordeal features of the Paradoxides family appear, but chiefly as they show themselves in the genus Olenellus[2]—the glabella strongly lobed and nearly reaching the front of the head shield, and the prominent and large rachis, armed with spines, bring it into relation with Holmia ; but the pygidium is more distinctly, than in *O. Zoppii*, that of an Olenus.

The remains of species of Paradoxides which have been recovered in Sardinia are too defective for comparison, but so far as can be judged they are those of the Lower Paradoxides beds, rather than those of the Upper. It is somewhat strange that no hypostomes of Paradoxides are figured or described by Meneghini.

A remarkable group of trilobites in this fauna is the Conocephalites with a tubercle in front of the glabella. Of these there are three species, or perhaps one might say four, if *C. Bornemanni* be included, in which the tubercle is confluent with the front of the glabella. Prof. Meneghini compares one of these species with *C. typus,* Dames, of the Cam-

[1] In *Holmia* (*Olenellus*) *Kjerulfi* the front of the glabella is small compared with the Paradoxides. See de Undre Paradoxideslagren, Linnarsson, Stockholm, Tafl. III., figs. 12 and 14 ; also Om Skuringsmærker, Kjerulf, Christiania, p. 83, figs. 1, 2, 3.

[2] Compare Tav. II., figs. 6 and 7, with figures referred to in the last foot note.

brian beds of China, but the resemblance is a distant one; the Chinese species is much nearer *C. tucer* of Billings, from the Olenellus beds in Vermont.

The four species of Concephalites found in Sardinia, appear rather to form a special group, distinguished from others by the possession of a frontal tubercle. A parallel case among the Conocoryphinæ is Ctenocephalus which is distinguished from Conocoryphe proper by a tubercle similar to that of these Conocephalites. No Conocoryphes are known in this fauna, though they are so common in the Cambrian rocks of the opposite coast region of France.

A still more remarkable deficiency in this fauna is the absence of the genus Agnostus.[1] We know of no paradoxides fauna and scarcely any Cambrian fauna of trilobites in which this genus does not make its appearance. The tests of this genus are usually found in the greatest abundance in fine dark shales, and especially in the Tessini, Davidis and Forchammeri sub-zones of the North of Europe. The Sardinian deposits are described as of a coarse texture, this would account for the scarcity, but not for the entire absence of the genus.

A fifth species of Conocephalites is described by Prof. Meneghini, (*C. inops*) which is of a different type from those with pre-glabellar tubercle. It is a *Euloma* rather than a Conocephalites, and it is rightly compared to *C. Geinitzi* of the fauna of Hof in Bavaria. But this fauna by its facies is as modern as the Tremadoc slate. Some imperfect examples of *Anomocare* also are figured, a genus which in the North of Europe, appears first in the Upper Paradoxides beds.

This fauna of the lower zone in Sardinia appears to be composed of forms descended from ancestral types of the Parodoxidean family, mingled with precursors of the numerous forms of Conocephalites[2] which showed them-

[1] In these remarks I have assumed that the memoir describes all the trilobites found; and also that the fossils of the lower zone are all of one faunal group, as I see no intimation to the contrary.

[2] The name Conocephalites is here used for such forms as *C. Bavaricus* and *C. Wirthi* of the fauna of Hof.

selves elsewhere mostly in the Upper Cambrian. The Oleni are of a more primitive type than those of the North of Europe, and notwithstanding the presence of so many Upper Cambrian forms the whole assemblage appears to be Lower Cambrian.

It is to be noticed that nowhere in the South of Europe have we recovered the representatives of the later Paradoxides of the north of Europe, or even of *P. Tessini*, except in Bohemia, the Bohemian representative species being *P. Bohemicus.* A similar gradation can be traced on the western side of the Atlantic where the equivalent of the Tessini fauna appears in Acadia, but is not known in Massachusetts; while in Newfoundland the later Davidis subfauna is present in addition to the earlier Paradoxides. Can this deficiency of the later species of Paradoxides in the more southerly district be due to conditions of temperature of the sea, and would a sufficiently high temperature exclude the genus entirely? If so the Paradoxides of the northern seas may have been cotemporary with the Olenelli, Conocephalites and Anomocara of the warmer oceans, and it would be necessary with this landmark gone to reconstruct for the southern areas, the succession of Cambrian faunas from the earliest Olenelloid types to Dicellocephalus and its cotemporaries.

The Utica slate of a later age contains a fauna in many respects analogous to that of the Paradoxides beds of the Atlantic coast of America, but spread over an area on that continent further to the west, and extending to more southern latitudes. It is spread from Labrador to Virginia and as far west as Michigan and Ohio. The *Triarthri* of the Utica slate represented the Paradoxides of the earlier time, and the black bituminous slates of the Utica, the similar alum bearing slates of the Cambrian. The Arctic current which now flows southward along the Atlantic coast has a course corresponding to that of the belt of country along which at the present day the outcrops of the Paradoxides beds and the Utica shale are found.

A diagrammatic view of the distribution and succession of the various phases of the Paradoxides fauna, as at present known, will bring more clearly before the reader the apparent thinning out of the types of this genus in going south from the higher latitudes.

Adopting the symbols for the different phases of this fauna used on a preceding page it may be presented as follows :—

	a	b	c	d	e	f
	P. Œlandicus.	P. rugulosus.	P. Tessini.	P. Davidis.	P. Forchammeri.	P. Lævigatus.
Sardinia (Italy)..........	* ?	* ?				
Montagne Noire (France)..		*				
Bohemia................		*	*			
Wales..................	* ?	*	*	*		
Sweden and Norway......	*	*	*	*	*	*
Newfoundland...........		*	*	*		
Acadia (N. Brunswick)..	*	*	*			
Massachusetts		*				

The genera of the upper horizon or zone in the Cambrian rocks of Sardinia, the trilobites of which are described by Prof. Meneghini, are of no less interest than those of the lower, as they show a mingling of the genera of the Paradoxides Zone with those of the summit of the Cambrian system. Thus we find *Anomocare* which in Sweden is a characteristic genus of the Upper Paradoxides beds, in association in these beds with two Asaphus-like forms which Meneghini compares to *Platypeltis* and *Psilocepalus*, genera which in the North of Europe belong to the upper part of the Upper Cambrian.

If we give Anomocare the full range accorded to it by Angelin, Dames and Meneghini, it will include, beside the forms of the Upper Parodoxides, many species found in different countries in the lower part of the Upper Cambrian. It is in this way that Dr. Dames has treated the genus in describing the fauna of Liau-tung in China, and Prof. Meneghini has followed his example. Anomocare is a genus full of interest in connection with the question of the point at which the limit of the Cambrian system shall be drawn. It is a genus which foreshadows the swarm of Asaphoid trilobites which appeared in the Ordovician seas. This is apparent when (taking *A. nomocare limbatum* as the type) we observe in the head shield the narrow cylindrical glabella, the sinuous suture, and the sharp posterior angles of the checks; in the thorax the few compact segments; in the pygidium the prominent narrow many-jointed rachis and the flattened border.[1] Many trilobites of the Upper Cambrian beds have been referred to Anomocare, mostly from the head shields, so that it is at present difficult to draw the line between it and Ptychoparia when only these imperfect remains are to be had. Still the presence of these numerous species with flattened borders is a distinctive mark of the Upper Cambrian.

Neither of the two asaphoid forms of Sardinia, described by Meneghini, agree altogether with the definition of the genera (*Platypeltis* and *Psilocephalus*) to which they are provisionally referred. In the possession of extended genal points to the movable cheeks they differ from the types of the genera above named and approach more closely to Asaphus, proper.[2] *Asaphus* (*Platypeltis ?*) *Meneghinii* also has a pygidium with several distinct lateral costa and with three marginal points, thus differing from the type. These

[1] It may be thought by some that the presence in Anomocare of a long eyelobe, is an objection to a comparison of this genus with Asaphus-like trilobites, all of which have short eyelobes; but there is as great variety between the species of Paradoxides in this respect as between the two genera named above. In Paradoxides the shortening of the eyelobe is progressive with age both as regards the individuals of a species, and as the species appeared successively in time, and the same may hold good for Anomocare and Asaphus.

[2] Meneghini refers these cheeks doubtfully to the heads of the species described, but the reference to *Platypeltis Meneghinii* is probably correct.

differences if they mean anything, are more primitive features than those of the types of Platypeltis and Psylocephalus.

Prof. Meneghini compares the species of these two Asaphus-like genera described by him, to species of the fauna of Hof in Bavaria, of the Lower Tremadoc (Dolgelly) beds in Wales and of the Upper Cambrian (Dictyonema) shales of Shropshire.

A type of Cambrian trilobites which one might expect to find in Sardinia in association with genera of Dolgelly and Tremadoc age, and which is represented in Wales and Sweden, as well as in the western part of America, is *Dicellocephalus.* This genus, which by the large size of some of its species, by its general form, and its mobile pleura, represented at the close of the Cambrian age the genus Paradoxides of its earlier time, is apparently unknown in the Sardinian rocks.

But Dicellocephalus had its precursor in a species of the Paradoxides beds (Tessini sub-zone) in *Conocephalites ornatus* described by Dr. Brogger from Krekling in Norway.

So many of the Tremadoc genera have their roots far down in the Cambrian zones, that it seems impossible to separate them from their relatives in the older beds. Whether we look to the north of Europe, to Sardinia or to the western United States of America, these links in the chain of life seem too strong to be severed, and the Tremadoc group should therefore be included in the Cambrian system.

If we desire a well defined line to separate the Cambrian system from its successor this is afforded by the beds in which the typical Arenig or Levis graptolites make their appearance.

One phase of the upper Cambrian fauna which we find notably absent from the more southerly regions where Cambrian rocks are found, is the *Peltura* fauna. In Sweden and Norway this presents quite a variety of small and smooth or spinose forms related to Olenus, as it does also in Wales, and to a lesser degree in Acadia, but from other regions it seems to be absent. Its geographical distribution is in fact to a great extent parallel with that of the middle and upper Paradoxides zone; and if these latter owe their presence to cold arctic waters, we may attribute to the same cause the distribution of the Peltura fauna along the coast of America in Cambrian times. The Cambrian fauna of the Liau-tung has not a sufficiently wide range to make it certain that Peltura sub-fauna may not overlay it. But if the succession of Cambrian trilobites, as established in Europe, is to be relied upon for other countries, this fauna is absent from Minnesota, and probably from the Rocky Mountain region of the United States. Neither in Bohemia, nor at any point in the south of Europe has this phase of the Upper Cambrian fauna been met with.

In the absence of the Peltura fauna the lines dividing the different parts of the Upper Cambrian are but obscurely defined, and for the southern countries we have not yet discerned the land marks by which this division may be effected. Only in the western United States is there known a full representation of the southern types of the Upper Cambrian faunas, and here we may hope that these dividing lines will soon be drawn. Prof. Jas. Hall many years ago, described the Cambrian trilobites of the Mississippi Valley. He divided them into three faunal groups of which the upper by its facies, appears to be equivalent to the Tremadoc fauna. Various considerations render it probable that the middle fauna, which Prof. Hall intimates might hereafter be subdivided, includes all the lower part of the Upper Cambrian, so that the Peltura fauna would be excluded. In the middle fauna of the Mississippi Valley a peculiar type of Agnostus which in Sweden is represented by *A. cyclopyge* of the Olenus beds, is here present in *A. Josepha*, and in China by *A. Chinensis.* These Agnosti are associated with species of other genera which are particularly prevalent at the horizons of the Olenus and Dolgelly beds, and thus carry the series of forms down to the Lower Cambrian division without the presence of Peltura.

As a result of the comparisons attempted in this paper it may be said that the hypothesis of the circulation of ocean currents between the poles and the equator will explain some of the peculiar features, which may be observed in the distribution and succession of the faunas of the Cambrian age. There are three Northern faunas of Cambrian and Ordovician times, which successively extended themselves to the southward—these are the *Paradoxides fauna*, the *Peltura fauna*, of which the Olenus fauna was an earlier phase, and the fauna of the *Utica Slate*. To these as intermediate between the two latter, might be added the Arenig fauna; but this I have not attempted to discuss.

The Australasian Association for the Advancement of Science.

The Australasian Association for the Advancement of Science held its annual meeting at Christchurch, New Zealand, on January 15, 1891. It will be remembered that this Association was organized only a few years since, taking the British Association as its model. Like this and the American Association, it has no permanent place of meeting, but moves from place to place each year. The last session was held at Canterbury College, Christchurch, New Zealand, with the retiring president Baron Ferd. von Mueller, the distinguished Australian naturalist, in the chair.

The holding of this session of the Association in New Zealand, originated in an invitation given by Sir James Hector in 1888, when in Melbourne representing New Zealand at the Exhibition. The request to hold the meeting in New Zealand was agreed to, and subsequently Christchurch was selected as the *locale* of the session. Immediately upon this being settled, Professor Hutton, the local Secretary, took steps to get together a local committee, and at once proceeded to work out the programme for the session. How successfully this was achieved may be gathered from the high expressions of approval which have proceeded from several of the professors, and the President, Baron von Mueller, and Christchurch is to be congratulated on having been selected as the city in which the meeting of the Association was held.

The various sections were organized under their respective vice-presidents, who addressed them on the subjects given below:

Section A.—Professor Lyle.

Section B.—Professor O. Masson.

Section C.—Mr. R. A. Murray, "The Past and Future of Mining in Victoria."

Section D.—Professor Haswell, "Recent Biological Theories."

Section E.—Mr. G. S. Griffiths, "Antarctic Exploration."

Section F.—Hon. G. W. Cotten, "A State Bank of Issue."

Section G.—Mr. A. W. Hewitt, "Ceremonies of Initiation in the Australian Tribes."

Section H.—Hon. Dr. Campbell, "The Advancement of Sanitation among the People."

Section I.—Mr. R. H. Roe, "Literature in Education."

Section J.—Mr. John Sulman, "The Architecture of Towns."

A presidential reception in the afternoon of the second day, by Sir James and Lady Hector, was very largely attended. In the evening the president-elect, Sir James Hector, was installed. The retiring president, Baron von Mueller, in addressing the meeting said that:

"We owe to the British Association that great advance of science, and especially of applied knowledge, which has been made throughout the world.

* * * * * * * * * * *

In introducing the president to you, let me say that he is one who took part in the expedition to the Rocky Mountains. Some thirty years ago he was selected for the position he now holds under the Government, which he has so worthily filled to this time, and during this period he has exercised a great, an enormous influence upon the development of his adopted country. Sir James Hector stands high in the scientific world by the universality of his knowledge. It is remarkable in how many directions he has been useful, and of the application of his knowledge there are many testimonies existing. If any testimony were wanting, it is to be found in the series of volumes of the Institute of New Zealand. They show in a remarkable manner the power of his administrative abilities and the great amount of his own research, which resulted in this long series of volumes, for although in all the colonies there has been an honorable and noble competition in science, New Zealand carries the palm by ths long series of publications through the Institute. I beg with pleasure to induct Sir James Hector into the presidential chair, and I trust, Sir, that your term will be, as I feel sure it will be, a glorious success."

Upon the President-elect taking the chair, His Excellency the Governor of New Zealand addressed the Association at some length, congratulating the members upon the occasion of their meeting, and passing in review the important work which lay before them in Australasia.

Among the guests of the meeting was Dr. G. L. Goodale, of Harvard University, who was on a tour of the world in search of botanical specimens and information. The President called upon him as representing the American Association for the Advancement of Science, of which he is the President. As his remarks are of some interest as showing the common bonds between the three kindred Associations, we reproduce them in full. He said :—" My first duty this this evening is to thank you very heartily Sir James, and you, my dear Baron, for the very warm welcome you have extended to me. Be assured that these cordial expressions are most sincerely appreciated. My second duty is to bring to you greetings from the American Association for the Advancement of Science. When, a few years ago, we learned that one of your most energetic professors had taken in hand the formation of an Australasian Association, somewhat on the lines of the British Association and our own, we took the deepest interest in the plans, for we hoped that you would realize what we have secured. In these days of extreme specialism there is need of a broad general association, so that specialists might confer together; that they can widen the outlook and that those who are cultivating small portions of the field can see that the ground near to the fence is not neglected. Now, under a general association like this, specialists can meet and confer together, and they can preserve that which they certainly hope to preserve. Then again we have found, and I have no doubt you will find, that general meetings of associations like this diminish, if they do not fully prevent or remove, personal misunderstandings. Sometimes these misunderstandings are allowed to grow until at last they become intensified. In associations like the British Association and our own we find the tendency to anything like personal differences to diminish and disappear, and I hope you will find the same. We have found that the British Association and our own have always done good, by their visits, to the community where the meetings were held. A good many have criticised unfavorably this migratory tendency, holding that it is better to have the meetings in some central place. But it seems that in this the old fable comes back, that 'strength seems to be restored every time we touch new ground.' This migratory tendency is the survival of the migratory tendency inherited from our ancestors. I feel very sure if you were to put it to the vote in the British Association you would not receive a single positive vote in favor of subtituting for these missions, as we may call them, one resident place. Now, when we heard that an Australasian Association was to be formed in this manner, our hopes and best wishes went out to you, and when the opportunity came to present felicitations on your success it was most eagerly accepted; so that I have now great pleasure in presenting, on behalf of the Association I represent, our congratulations upon the pronounced success of the Association. The American Association is not limited to the United States.

As his Excellency the Governor has told you, the British Association met on Canadian soil. Some of our meetings are also held in the large centres of the Dominion of Canada, and the meeting of the British Association was really a joint meeting of the two Associations. We sometimes read disturbing cablegrams, but I love to think that blood is thicker than water. Now, my honored colleagues, through me, extend to you an invitation to visit our Association. Do not regard it as one of those general invitations which means just drop in as you pass by; but if you find you can be present at any of our meetings just inform our General Secretary, and when you did meet, then the general invitation, you would find, would be converted into a most specific one. I again thank you for your cordial welcome, and congratulating the Association upon its past and present success, I have only now to express on behalf of our Association, and on my own behalf, our best wishes for Australasia and the Australasian Association."

The address of the President, Sir James Hector, presented a valuable review of the advance of Scientific knowledge and research in New Zealand. It possesses so much of general interest that we venture to reproduce the greater part of it.

Presidential Address.

"* * * * Presidents of similar Associations in the Old World, who are in constant contact with actual progress in scientific thought, feel that a mere recital of the achievements during their previous term is sufficient to command interest; but in the colonies most of us are cut off from personal converse with the leading minds by whom the scientific afflatus is communicated; and in our suspense for tardy arrival of the official publications of the societies, we have to feed our minds with science from periodical literature. But even in this respect my own current education is very defective, as I reside in the capital city of New Zealand, which has no college with professional staff, whose duty, pleasure and interest it is to maintain themselves on a level with the different branches of knowledge they represent. I therefore decided that instead of endeavouring to review what had been done in the way of scientific progress, even in Australasia, it would be better to confine my remarks to New Zealand—the more so that this is the first occasion that there has been a gathering of what must, to some extent, be considered to be an outside audience for the colony.

To endeavour to describe, even briefly, the progress made in the science of a new country is, however, almost like writing its minute history. Every step in its reclamation from a wild state of nature has depended on the application of scientific knowledge, and the reason for the rapid advance made in these colonies is chiefly to be attributed to their having had the advantage of all modern resources ready at hand. As in most other matters in New Zealand there is a sharp line dividing the progress into two distinct periods, the first before and the second after the formation of the colony in 1840. With reference to the former period it is not requisite that much should be said on this occasion. From the time of Captain Cook's voyages, owing to his attractive narrative, New Zealand acquired intense interest for naturalists. His descriptions of the country and its productions, seeing that he only gathered them from a few places where he landed on the coast, are singularly accurate. But I think rather too much is sometimes endeavored to be proved from the negative evidence of his not having observed certain objects. As an instance, it has been asserted that if any of the many forms of the moa still survived, Captain Cook must have been informed of the fact. Yet we find that he lay for weeks in Queen Charlotte Sound and in Dusky Sound, where all night long the cry of the kiwi must have been heard just as now, and that he also obtained and took home mats and other articles of native manufacture, trimmed with kiwis' skins; and that most likely the mouse-colored quadruped which was seen at Dusky Sound by his men when clearing the bush was only a gray kiwi; and yet the discovery of this interesting bird was not made till forty years after Cook's visit. As a scientific geographer Captain Cook stands unrivalled, considering the appliances at his disposal. His longitudes of New Zealand are wonderfully accurate, especially those computed from what he called his "rated watches," the first type of the modern marine chronometer, which he was almost the first navigator to use. The result of a recent measurement of the meridian difference from Greenwich by magnetic signals is only two geographical miles east of Captain Cook's longitude. He also observed the variation and dip of the magnetic needle, and from his record it would appear that during the hundred years which elapsed up to the time of the Challenger's visit, the south-seeking end of the needle has changed its position $2\frac{1}{2}$ deg. westward, and inclines $1\frac{1}{2}$ deg. more towards the south magnetic pole. Captain Cook also recorded an interesting fact, which, so far as I am aware, has not been since repeated or verified in New Zealand. He found that the pendulum of his astronomical clock, the length of which had been adjusted to swing true seconds at Greenwich, lost at the rate of 40 sec. daily at Ship Cove in Queen Charlotte Sound. This is, I believe, an indication of a greater loss of the attraction of gravity than would occur in a corresponding North latitude.

The additions to our scientific knowledge of New Zealand, acquired through the visits of the other exploring ships of early navigators, the settlement of sealers and whalers on the coast, and of pakeha Maoris in the interior were all useful, but of too slight a character to require special mention. The greatest additions to science were made by the missionaries, who in the work of spreading Christianity among the natives, had the services of able and zealous men, who mastered the native dialects, reduced them to written language, collected and placed on record the traditional knowledge of the interesting Maori, and had among their numbers some industrious naturalists who never lost an opportunity of collecting natural objects. The history of how the country, under the mixed influence for good and for evil which prevailed almost without Government control until 1840, gradually was ripened for the colonist, is familiar to all. The new era may be said to have begun with Dieffenbach, a naturalist, who was employed by the New Zealand Company. He travelled and obtained much information, but did not collect to any great extent, and, in fact, appears not to have anticipated that much remained to be discovered. For his conclusion is that the smallness of the number of the species of animals and plants then known—about one-tenth of our present lists—was not due to want of acquaintance with the country, but to paucity of life forms. The chief scientific value of his published work is in the appendix, giving the first systematic list of the fauna and flora of the country, the former being compiled by the late Dr. Gray, of the British Museum.

The next great scientific work done for New Zealand was the Admiralty survey of the coast line, which is a perfect marvel of accurate topography, and one of the greatest boons the colony has received from the Mother Country. The enormous labor and expense which was incurred on this survey at an early date in the history of the colony is a substantial evidence of the confidence in its future development and commercial requirements which animated the Home Government. On the visit of the Austrian exploring ship Novara to Auckland in 1859, Von Hochstetter was left behind, at the request of the Government, to make a prolonged excursion to the North Island and in Nelson; and he it was who laid the foundation of our knowledge of the stratigraphical geology of New Zealand. Since then the work of scientific research has been chiefly the result of State surveys, aided materially by the zeal of members of the New Zealand Institute, and of late years by an increasing band of young students, who are fast coming to the front under the careful science training that is afforded by our University Colleges.

In the epoch of their development the Australasian colonies have been singularly fortunate. The period that applies to New Zealand is contemporaneous with the reign of Her

Majesty, which has been signalized by enormous strides in Science. It has been a period of gathering into working form immense stores of previously-acquired observation and experiment and of an escape of the scientific mind from the trammels of superstition and hazy speculation regarding what may be termed common things. Laborious work had been done and many grand generalizations had been formerly arrived at in physical science; but still, in the work of bringing things to the test of actual experience, investigators were still bound by imperfect and feeble hypotheses and supposed natural barriers among the sciences. But science is one and indivisible, and its sub-divisions, such as physics, chemistry, biology, are only matters of convenience for study. The methods are the same in all, and their common object is the discovery of the great laws of order under which this universe has been evoked by the great Supreme Power.

The great fundamental advance during the last fifty years has been the achievement of far reaching generalizations, which have provided the scientific worker with powerful weapons of research. Thus the modern "atomic theory," with its new and clearer conceptions of the intimate nature of the elements and their compounds that constitute the earth and all that it supports, has given rise to a new chemistry, in which the synthetical or building-up method of proof is already working marvels in its application to manufactures. It is, moreover, creating a growing belief that all matter is one, and reviving the old idea that the inorganic elementary units are merely centres of motion specialized in a homogeneous medium, and that these units have been continued on through time, but with such individual variations as give rise to derivative groups, just as we find has been the case in the field of organic creations. The idea embodied in this speculation likens the molecule to the vortex rings which Helmholtz found must continue to exist for ever, if in a perfect fluid free from all friction they are once generated, as a result of impacting motion. There is something very attractive in the simplicity of this theory of the constitution of matter which has been advocated by Sir William Thomson. He illustrates it by likening the form of atoms to smoke rings in the atmosphere, which were they only formed under circumstances such as above described, such vortex atoms must continue to move without changing form, distinguished only from the surrounding medium by their motion. As long as the original conditions of the liquid exist they must continue to revolve. Nothing can separate, divide or destroy them, and no new units can be formed in the liquid without a fresh application of creative impact. The doctrine of the conservation of energy is a second powerful instrument of research that has developed within our own times. How it has cleared away all the old cobwebs that formerly encrusted our ideas about the simplest agencies that are at work around us. How it has so simplified the teaching of the laws that order the conversion of internal motions of bodies into phases which represent light, heat, electricity, is abundantly proved by the facility with which the mechanicians are every day snatching the protean forms of energy for the service of man with increasing economy.

These great strides which have been made in physical science have not as yet incited much original work in this colony. But now that physical laboratories are established in some degree at the various college centres, we will be expected, ere long, to contribute our mite to the vast store. In practical works of physical research we miss in New Zealand the stimulus the sister colonies receive from their first-class observatories, supplied with all the most modern instruments of research, wielded by such distinguished astronomers as Ellery, Russell and Todd, whose discoveries secure renown for their separate colonies. I am quite prepared to admit that the reduplication of observatories in about the same latitude, merely for the study of the heavenly bodies, would be rather a matter of scientific luxury. The few degrees of additional elevation of the South Polar region which would be gained by an observatory situated even in the extreme South of New Zealand could hardly be expected to disclose phenomena that would escape the vigilance of the Melbourne observatory. But star gazing is only one branch of the routine work of an observatory. It is true that we have a moderate but efficient observatory establishment in New Zealand sufficient for distributing correct mean time, and that our meridian distance from Greenwich has been satisfactorily determined by telegraph, also thanks to the energy and skill of the Survey Department, despite most formidable natural obstructions, the major triangulation and meridian circuits have established the basis of our land survey maps on a satisfactory footing, so that sub-divisions of the land for settlement and the adoption and blending of the excellent work done by the Provincial Governments of the colony is being rapidly overtaken.

Further, I have already recalled how much the colony is indebted to the Mother Country for the completeness and detail of the coastal and harbor charts. But there is much work that should be controlled by a physical observatory that is really urgently required. I may give a few illustrations. The tidal movements round the coast are still imperfectly ascertained, and the cause of their irregular variations can never be understood until we have a synchronous system of tide meters, and a more widely extended series of deep-sea soundings. Excepting the Challenger soundings on the line of the Sydney cable, and a few casts taken by the United States ship Enterprise, the depth of the ocean surrounding New Zealand has not been ascertained with that accuracy which many interesting problems in physical geography and geology demand. It is supposed to be the culmination of a great submarine plateau; but how far that plateau extends, connecting the southern islands towards the great Antarctic land, and how far to the eastward, is still an unsolved question. Then, again, the direction and intensity of the magnetic currents in and around New Zealand require further close investigation, which can only be controlled from an observatory.

Even in the matter of secular changes in the variation of the compass we find that the marine charts instruct that an allowance of increased easterly variation of 2min. per annum must be made, and as this has now accumulated since 1850 it involves a very sensible correction to be adopted by a shipmaster in making the land or standing along the coast; but we find from the recently published work of the Challenger that this tendency to change has for some time back ceased to affect the New Zealand area, and as the deduction appears only to have been founded on a single triplet observation of the dip taken at Wellington and one azimuth observation taken off Cape Palliser, it would be well to have this fact verified. With regard to the local variation in the magnetic currents on land and close in shore, the requirement for exact survey is even more imperative. Captain Creak, in his splendid essay, quotes the observations made by the late Surveyor-General, Mr. J. T. Thomson, at the Bluff Hill, which indicate that a compass on the north side was deflected more than 9deg to the west, while on the east side of the hill the deflection is 46deg. to the east of the average deviation in Foveaux Strait. He adds that if a similar island-like hill happened to occur on the coast, but submerged beneath the sea to a sufficient depth for navigation, serious accidents might take place, and he instances a case near Cossack, on the north coast of Australia, when H.M.S. Medea, sailing on a straight course in eight fathoms of water, experienced a compass deflection of 30deg. for the distance of a mile. A glance at the variation entered on the meridian circuit maps of New Zealand shows that on land we have extraordinary differences between different trig. stations at short distances apart. For instance, in our close vicinity, at Mount Pleasant, behind Godley Head lighthouse, at the entrance to Lyttelton harbor, the variation is only 9deg. 3min. east, or 6deg. less than the normal; while at Rolleston it is 15deg. 33min., and at Lake Coleridge 14deg. 2min. In Otago we have still greater differences recorded, for we find on Flagstaff Hill, which is an igneous formation, 14deg. 34min., while at Nenthorn, thirty miles to the North, in a schist formation, we find an entry of 35deg. 41min. In view of the fact that attention has been recently directed to the marked effects on the direction and intensity of the terrestrial magnetic currents of great lines of fault along which movements have taken place, such as those which bring widely different geological formations into discordant contact, with the probable production of mineral veins, this subject of special magnetic surveys is deserving of being undertaken in New Zealand. In Japan and in the United States of America the results have already proved highly suggestive. A comparison between this country and Japan by such observations, especially if combined with systematic and synchronous records by modern seismographic instruments, would be of great service to the physical geologist. There are many features in common, and many quite reversed in the orographic and other physical features of these two countries. Both are formed by the crests of great earth waves lying north-east and south-west, and parallel to, but distant from, continental areas, and both are traversed by great longitudinal faults and fissures, and each by one great transverse fault. Dr. Nauman, in a recent paper, alludes to this in Japan as the *Fossa Magna*, and it corresponds in position in relation to Japan with Cook Strait in relation to New Zealand. But the *Fossa Magna* of Japan has been filled up with volcanic products, and is the seat of the loftiest active volcano in Japan. In Cook Strait and its vicinity, as you are aware, there are no volcanic rocks, but there and southward, through the Kaikouras, evidence of fault movements on a larger scale is apparent, and it would be most interesting to ascertain if the remarkable deviation from the normal in direction and force of the magnetic currents, which are experienced in Japan, are also found in New Zealand. For it is evident that if they are in any way related to the strain of cross fractures in the earth's crust, the observation would tend to eliminate the local influence of the volcanic rocks which are present in one case and absent in the other. With reference to earthquakes also, few, if any, but very local shocks experienced in New Zealand have originated from any volcanic focus we are acquainted with, while a westerly propagation of the ordinary vibrations rarely passes the great fault that marks the line of active disturbance. In Japan, also, out of about 480 shocks which are felt each year in that country, each of which, on an average, shakes about one thousand square miles, there are many that cannot be ascribed to volcanic origin. There are many other problems of practical importance that can only be studied from the base line of a properly equipped observatory. These will readily occur to physical students, who are better acquainted with the subject than I am. I can only express the hope that the improved circumstances of the colony will permit some steps to be taken. Already in this city, I understand, some funds have been subscribed. As an educational institution, to give practical application to our students in physical science, geodesy and navigation, it would clearly have a specific value that would greatly benefit the colony. Another great branch of physical science, chemistry, should be of intense interest to colonists in a new country. Much useful work has been done, though not by many workers. The chief application of this science has been naturally to promote the development of mineral wealth, to assist agriculture, and for the regulation of mercantile contracts. I cannot refrain from mentioning the name of William Skey, analyist to the Geological Survey, as the chemist whose researches during the last twenty-eight years have far surpassed any other in New Zealand. Outside his laborious official duties he has found time to make about sixty original contributions to chemical science, such as into the electrical properties of metallic sulphides—the discovery of the ferro-nickel alloy *awaruite* in the ultra-basi rocks of West Otago, which is highly interesting, as it is the first recognition of this meteoric-like iron as native to our planet—the discovery that the hydrocarbon in torbasic and the gas shales is chemically and not merely mechanically combined with the clay base—of a remarkable color test for the presence of magnesia and the isolation of the poisonous principle in many of our native shrubs. His recent discovery, that the fatty oils treated with analine form alkaloids, also hints at an important new departure in organic chemistry. His suggestion of the hot-air blow pipe, and of the application of cyanide of potassium to the saving of gold, and many other practical applications of his chemical knowledge, are distinguished services to science, of which New Zealand should be proud. In connection with the subject of chemistry, there is a point of vast importance to the future of the pastoral and agricultural interests of New Zealand, to which attention was directed some years ago by Mr. Pond, of Auckland. That is the rapid deterioration which the soil must be undergoing by the steady export of the constituents on which plant and animal life must depend for nourishment. He calculated that in 1883 the intrinsic value of the fixed nitrogen and phosphoric acid and potash sent out annually was £592,000, taking into account the wool and wheat alone.

Now that we have to add to that the exported carcases of beef and mutton, bones and all, the annual loss must be immensely greater. The proper cure would, of course, be to bring back return cargoes of artificial manure, but even then its application to most of our pastoral lands would be out of the question. I sincerely hope that the problem will be taken in hand by the Agricultural College at Lincoln as a matter deserving of practical study and investigation. I have already referred to several great generalisations which have exercised a powerful influence in advancing science during the period I marked out for review, but so far as influencing the general current of thought, and almost entirely revolutionising the prevalent notions of scientific workers in every department of knowledge, the most potent factor of the period has been termed the doctrine of evolution. The simple conception of the relation of all created things by the bond of continuous inheritance has given life to the dead bones of an accumulated mass of observed facts, each valuable in itself, but, as a whole, breaking down by its own weight. Before this master-key was provided by the lucid instruction of Darwin and Wallace, it was beyond the power of the human mind to grasp and use as biological research the great wealth of minute anatomical and physiological details. The previous idea of the independent creation of each species of animal and plant to a little Garden of Eden of its own must appear puerile and absurd to the young naturalists of the present day; but in my own College days to have expressed any doubt on the subject, would have involved a sure and certain pluck from the examiner. I remember well that I first obtained a copy of Darwin's "Origin of Species" in San Francisco when on my way home from a three years' sojourn among the red Indians in the Rocky Mountains. Having heard nothing of the controversies, I received the teaching with enthusiasm, and felt very much surprised on returning to my *alma mater* to find that I was treated as a heretic and a backslider. Nowadays it is difficult to realise what all the fuss and fierce controversy was about, and the rising school of naturalists have much cause for congratulation that they can start fair on a well assured logical basis of thought, and steer clear of the many complicated and purely ideal systems which were formerly in vogue for explaining the intentions of the Creator and for torturing the unfortunate students. The doctrine of evolution was the simple-minded acceptance of the invariability of cause and effect in the organic world as in the inorganic; and to understand his subject in any branch of natural science, the learner has now only to apply himself to trace in minutest detail the successive steps in the development of the phenomena he desires to study. With energetic leaders educated in such views, and who, after their arrival in the colony, felt less controversial restraint, it is not wonderful that natural history, and especially biology, should have attracted so many ardent workers, and that the results should have been so good. A rough test may be applied by comparing the number of species of animals and plants which had been described before the foundation of the colony and those up to the present time. In 1840, Dr. Gray's list in Deiffenbach's work gives the number of described species of animals as 5498. The number of mammalia has been doubled through the more accurate study of our seals, whales and dolphins. Then the list of birds has been increased from eighty-four to one hundred and ninety-five, chiefly through the exertions of Sir Walter Buller, whose great standard work on our avifauna has gained credit and renown for the whole colony. The number of fishes and moluzca has been more than trebled, almost wholly by the indefatigable work of our Secretary, Professor Hutton. But the greatest increase is in the group which Dr. Gray placed as annulosa, which, chiefly through the discovery of new forms of insect life, has risen from 156 in 1840 to 4,295, of which over 2,000 are new beetles described by Captain Broun, of Auckland.

When we turn to botany we find that Deiffenbach, who appears to have carefully collected all the references to date in 1840, states the flora to comprise 632 plants of all kinds, and, as I have already mentioned, did not expect that many more would be found. But by the time of the publication of Hooker's "Flora of New Zealand" (1863), a work which has been of inestimable value to our colonists, we find the number of indigenous plants described had been increased to 2,451. Armed with the invaluable guidance afforded by Hooker's "Handbook," our colonial botanists have renewed the search, and have since then discovered 1,460 new species, so that our plant census at the present date gives a total of 3,355 species. It would be impossible to make mention of all who have contributed to this result as collectors, and hardly even to indicate more than a few of those to whom science is indebted for the description of the plants. The literature of our post Hookerian botany is scattered about in scientific periodical literature, and as Hooker's "Handbook" is now quite out of print, it is obvious that, as the new discoveries constitute more than one third of the total flora, it is most important that our young botanists should be fully equipped with all that has been ascertained by those who have preceded them. I am glad to be able to announce that such a work in the form of new edition of the "Handbook of the Flora of New Zealand," approved by Sir Joseph Hooker, is now in an advanced state of preparation by Professor Thomas Kirk, who has already distinguished himself as the author of "Forest Flora." Mr. Kirk's long experience as a systematic botanist, and his personal knowledge of the flora of every part of the colony, acquired during the exercise of his duties at Conservator of Forests, point to him as the fitting man to undertake the task. But quite apart from the work of increasing the local collections which bear on biological studies, New Zealand stands out prominently in all discussions on the subject of geographical biology. It stands as a lone zoological area, minute in area, but on equal terms as far as regards the antiquity and peculiar features of its fauna, with nearly all the larger continents in the aggregate. In consequence of this, many philosophical essays —such, for instance, as Hooker's introductory essay to the early folio edition of the "Flora," the essays by Hutton, Travers and others, and also the New Zealand references in Wallace's works, have all contributed essentially to the vital question of the causes which have brought about the distribution and geographical affinities of plants and animals, and have thus been of use in hastening the adoption of the doctrine of evolution. But much still remains to be done. Both as regards its fauna and its flora, New Zealand has always been treated too much as a whole quantity, and in consequence percentage schedules prepared for comparing with the fauna and flora of other areas fail from this cause. It is absolutely necessary to discriminate not only localities, but also to study more carefully the relative abundance of individuals as well as of species before instituting comparisons. The facility and rapidity with which change is effected at the present time should put us against rashly accepting species which may have been accidental intruders, though wafted by natural causes, as belonging to the original endemic fauna. Further close and extended study, especially of our marine fauna, is urgently required. We have little knowledge beyond the littoral zone, except when a great storm heaves up a gathering of nondescript or rare treasure from the deep. Of dredging we have had but little done, and only in shallow waters, with the exception of a few casts of the deep sea trawl from the Challenger. When funds permit a zoological station for the study of the habits of our sea fishes and for the propagation of such introductions as the lobster and crab would be advantageous. I observe that lately such an establishment has been placed on the Island of Mull, Scotland, at a cost of £400, and that it is expected to be nearly self-supporting. With respect to food fishes, and still more with respect to some terrestrial forms of life, we, in common with all the Australasian Colonies, require a more scientific and a less casual system of acclimatization than we have had in the past. One must talk with bated breath of the injuries that have been inflicted on these colonies by the rash disturbance of the balance of nature. Had our enthusiasm been properly controlled by foresight, our settlers would probably not have to grieve over the losses they now suffer through many insect pests, through small birds and rabbits, and which they will in the future suffer through the vermin that are now being spread in all directions.

BOOK NOTICES.

Elements of Crystallography.[1]—This admirable little book will, it is believed, fill a want which has long been felt by teachers and students of mineralogy and chemistry, and for the first time affords to the English-speaking student a clear and readable statement of the elementary principles of crystallography. Hitherto, chemists have too frequently ignored the subject, and failed to recognize its very important bearing upon their work. For this no doubt the crystallographer has been largely to blame ; for as a rule he has presented the subject in such a way as to terrify rather than attract the student. Prof. Williams' book is not of this kind, and while he only claims for it a place among elementery works, we are sure that any one who studies it with care will have learned a great deal of crystallography.

Questions relating to the mode of molecular arrangement in

[1] The elements of Crystallography for students of Chemistry, Physics and Mineralogy. By G. H. Williams, Ph.D., Associate Professor in the Johns Hopkins University. Pp. viii + 250, with 383 Figs. New York : Henry Holt & Co., 1890.

crystals and the general principles of crystallography are first taken up, and then follows a detailed discussion of the crystallographic systems based mainly upon the symmetry of crystal forms. A chapter is devoted to crystal aggregates, another to imperfections of crystals, and an appendix to the discussion of zones, projection, and the construction of crystal figures. Ths symbols of Weiss are taken as a starting point, those of Naumann, however, being generally employed, and the index symbols of Miller written beside them. A somewhat fuller explanation and illustration of Miller's index system than that found on pages 30 and 31, would probably add to the usefulness of the volume.

The book is well printed and well illustrated, and evidently the proofs have been read with great care.

B. J. H.

Proceedings of the Society.

The first regular meeting of the Society was held on Monday, Oct. 27th, the President Dr. Harrington in the chair.

The Curator presented a report from Mr. H. T. Martin on the mammals, and from Mr. F. B. Caulfield on the ornithological collections in the Society's Museum. He also referred to the rearrangement of the other specimens.

On motion of Hon. Senator Murphy, seconded by Mr. J. A. U. Beaudry, the thanks of the Society were tendered to Mr. Brown, Mr. Martin and Mr. Caulfield for their efforts in the rearrangement of the collections.

The Curator reported the following donations, received since the last monthly meeting:—

Fossils from the Trenton Formation, Mr. E. T. Chambers.

Bobolink, Mr. Tedford.

One pair American Pipits.

Olive-back Thrush.

Varied Woodpecker.

Cedar Waxwing, Mr. G. Dunlop.

Semipalmated Plover.

Buff breasted Sandpiper.

Rose breasted Grosbeak (young).

Cedar Waxwing.

Varied Woodpecker, Mr. F. B. Caulfield.

Cape May Warbler, Mr. E. D. Wintle.

Lake Trout, Mr. J. S. Brown,

Concretions from the Connecticut River, Miss C. Alice Baker.

Apatite from Renfrew, Ont.

" " Templeton, P. Q.

Titanite " Renfrew, Ont.

Phlogopite " Templeton, P.Q.

Dawsonite " " " Dr. Harrington.

Copper ore and boulder from the conglomerate vein of the Calumet and Hecla Mines, Lake Superior, Michigan.

Nickel ore and nickel matte from the Blizzard Mines, Sudbury, Ont.

Specular ore from the Republic Mine, Michigan,

Magnetic specular ore from the Champion Mine, Michigan, Mr. Geo. Sumner.

The usual vote of thanks was tendered the donors for the above.

Notice of motion was given by Mr. Shearer to open the Museum to the public, free, on one day of each week.

On motion of Mr. Brown, seconded by Hon. Senator Murphy, it was decided to leave the question of lending the Elephantine remains to Mr. Whiteaves of the Geological Survey, in the hands of Sir Wm. Dawson.

On motion of Mr. Shearer, seconded by Mr. Chambers, it was decided to invite the British Iron & Steel Institute to visit the museum during their visit to the city.

On suspension of the rules, the following members were elected.

Miss Laing, Dr. Arch. Campbell, Mrs. Lewis, Harry McLaren and F. W. Radford.

Sir Wm. Dawson then presented a paper from Miss Arms of Deerfield, Massachusetts, on "The Clay Concretions of the Connecticut River," to which he added many valuable observations. In the subsequent discussion it was shown that similar concretions occur abundantly in some Canadian localities, notably at Green's Creek, Ottawa, where each nodule is found to contain a fossil, either of fish, plant or other organic remains, while those from the Connecticut River often show no distinguishable nucleus, or if present, it consists of a shell or small pebble.

Prof. Penhallow then followed with some notes on "A Peculiar Growth in a Black Walnut."

After the usual vote of thanks to the authors of papers the meeting adjourned.

The regular monthly meeting of the Society was held on Monday. Nov. 24th. the President, Dr. Harrington presiding.

The Librarian reported the usual exchanges. The following donations of the museum were also reported.

Antlers of Virginian Deer, Mr. Alfred Griffin.

Virginian Horned Owl, Mr. F. B. Caulfield.

The usual vote of thanks was tendered the donors.

On motion of Mr. Shearer, seconded by Mr. Brown, it was decided to open the museum to the public, free, one day in each week.

Prof. Penhallow then presented a very interesting description of a caterpillar fungus (*Sphaeria Robertsii*) from New Zealand. He showed its relation to other fungus pests in various parts of the world, and also pointed out the fact that insects of various kinds are infested by related species. The discussion was an animated and important one, and developed many interesting laws relative to the parasitic action of plants and their relation to disease. He presented one of the specimens to the museum.

Prof. Penhallow also gave the results of observation on soil temperatures carried on by a committee of the Society, under a grant from the Elizabeth Thompson Science Fund. His remarks were illustrated by instruments and drawings. He pointed out the various changes of temperature effected in the soil by atmospheric temperature and solar radiation, and showed that the present line of enquiry has an important bearing upon the growth of vegetation.

The usual vote of thanks was tendered for these papers, and also to Prof. Penhallow and his associates for their work on soil temperatures.

It was decided not to hold the usual monthly meeting in December.

The regular monthly meeting was held on Monday, Jan. 26th, Dr. Harrington presiding.

In the absence of the Secretary, Mr. J. A. U. Beaudry was requested to act.

The Curator reported the following donations :—

Three cases exotic insects, Mr. J. H. Tiffin.

Geological specimens, Miss Laing.

Surf Duck, shot on Lake St. Louis, Mr. Wm. Byrd.

Woven wire tray from Tokyo, Mr. Alfred Griffin.

A vote of thanks was tendered to donors.

The Librarian reported the usual exchanges. Prof. J. T. Donald then presented a paper on "Canadian Argol" and also one on "The Composition of the Ore used, and of the Pig Iron Produced at the Radnor Forges." In the subsequent discussion the President referred to the good quality of the Three Rivers iron and mentioned a stove cast from it which has been in use for the last twenty years.

Sir William Dawson in his remarks stated that in Sweden, the iron contained a quantity of organic matter, and asked if there was any in the Three Rivers iron.

Dr. Harrington exhibited a specimen "bear" blasted from the smelting furnace in Londonderry, N. S., showing a deposit of titanium nitrocyanide.

The meeting adjourned after the usual vote of thanks to the authors of papers.

Proceedings of the Montreal Microscopical Society.

This Society has been holding its regular monthly meetings during the winter, in the library of the Natural History Society.

The first meeting in October was devoted entirely to receiving the statements of the Secretary-Treasurer and the election of officers for the coming year.

The President J. Stevenson Brown was re-elected and Leslie J. Skelton was elected Hon. Secretary-Treasurer.

Papers on the following subjects have been read.

Nov. 10th, Illumination as Applied to the Microscope. J. Stevenson Brown.

Dec. 8th, Facts Connectəd with Keeping an Aquarium, Very Rev. Dean Carmichael.

Jan. 12th, Practical Hints about Microtomes, Wyatt G. Johnson M.D.

There has been a large attendance at the meetings, a considerable influx of new members and a very general interest shown in extending the usefulness and objects of the society.

Papers have been promised for the remainder of the season by

J. W. Stirling, M.D.

G. P. Girdwood, M.D.

Wyatt G. Johnson, M.D.

At the last meeting His Excellency Lord Stanley, was elected an honorary member.

A committee has been appointed on infusoria,and members or others interested in this branch of microscopical study can have their specimens classified by sending drawings and descriptions to the secretary before any of the monthly meetings.

ER, 1890.

87 feet. C. H. McLEOD, *Superintendent.*

D	Clouded Tenths. Max.	Min.	Per cent of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	10	0	76	....	....	....	1
	10	0	85	...	....	...	2
	10	1	69	0.07	.. .	0 07	3
	10	4	00	0.08	....	0.08	4
SUNDAY	..	..	70	....	....	....	5 ....SUNDAY
	10	0	51	.....	....	...	6
	10	0	00	0.13	....	0.13	7
	10	10	00	0.29	....	0.29	8
	10	0	06	....	...	...	9
	10	5	00	0.23	....	0.23	10
	10	0	16	Inapp.	....	0.00	11
SUNDAY	..	..	77	....	.. .	....	12 ....SUNDAY
	10	0	91	....	....	....	13
	10	0	00	0.80	..	0.80	14
	10	0	89	....	....	....	15
	10	0	76	...	....	....	16
	10	10	00	0.79	....	0.79	17
	10	10	00	0.02	....	0.02	18
SUNDAY	..	..	00	0.03	....	0.03	19 ....SUNDAY
	10	0	01	....	....	....	20
	9	0	88	......	....	....	21
	10	0	80	....	....	....	22
	10	0	58	....	....	....	23
	10	10	00	....	....	....	24
	10	10	02	....	....	....	25
SUNDAY	..	..	37	....	....	....	26 .... .SUNDAY
	10	10	00	Inapp.	....	0.00	27
	10	10	07	Inapp.	....	0.00	28
	10	0	25	0.08	....	0.08	29
	10	0	00	0.07	....	0.07	30
	10	0	43	0.10	....	0.10	31
..... .	..	..	33.8	2.69	....	2.69	Sums ....
16 yrs. includi	..	..	¶40.4	3.38	1.57	3.54	16 yrs. means for and including this month.

level and giving a range of 1.049 inches. Maximum relative humidity was 100 on the 14th. Minimum relative humidity was 47 on the 23rd.

Rain fell on 15 days.

A few flakes of snow fell on the 28th, and soft hail on the 31st.

Auroras were observed on 4 nights.

Hoar frost on 6 days.

Lunar halos on 3 nights.

Fog on 4 days.

Directi
ury.
Miles. 100.
Durati
nd ; the
Mean giving a
Warmest
Grea the 31st.
Resu 3 on the
Resu the 28th,

ABSTRACT FOR THE MONTH OF OCTOBER, 1890.

Meteorological Observations McGill College Observatory, Montreal. Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	§Max.	§Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	59.52	69.9	48.3	21.6	30.2375	30.284	30.202	.082	.4100	81.0	53.5	S.W.	4.8	4.3	10	0	76	....	....	....	1
2	61 72	71.7	51.6	20.1	30.1858	30.247	30.123	.124	.4185	77.3	54.0	S.W.	7.2	5.0	10	0	85	...	....	...	2
3	59.63	63.6	56.7	6 9	29 9985	30.120	29.888	.232	.4535	88.5	56.2	S.E.	9.0	7.7	10	1	69	0.07	.. .	0 07	3
4	58.92	64 2	55.2	9.0	29.7553	29.874	29.654	.220	.4632	92.8	56.8	S.W.	11.1	10.0	10	4	00	0.08	....	0.08	4
SUNDAY....... 5	......	59.2	41.6	17.6	....	......	......	....	....	....	....	N.W.	13.4	...	..	..	70	....	....	....	5 ....SUNDAY
6	41 45	47.4	36 0	11.4	29.8845	29.906	29.845	.061	.1860	71.2	32.3	N.	7.6	4.0	10	0	51	....	....	...	6
7	40.37	46.3	33.6	12.7	29.8693	29.910	29.822	.088	.2168	85.2	36.2	E,	12.4	8.3	10	0	00	0.13	.. .	0.13	7
8	43.75	46.0	42.1	3.9	30.0450	30.226	29.848	.378	.2680	94.0	42.3	W.	5.5	10.0	10	10	00	0.29	....	0.29	8
9	45 00	50.9	41.0	9.9	30.2882	30.337	30.237	.100	.2617	88.0	41.5	S.W.	2.4	7.2	10	0	06	....	...	...	9
10	46.90	53.6	40.5	13.1	30.0008	30.218	29.873	.345	.2948	91.3	44.3	S.	7.2	9.2	10	5	00	0.23	....	0.23	10
11	46.98	53.8	42.0	11.8	29.9025	29.936	29.868	.068	.2528	78.2	40.2	W.	15.6	6.7	10	0	16	Inapp.	....	0.00	11
SUNDAY. 12	......	49.9	36.5	13.4	....	......	......	....	......	....	... .	N.W.	7.2	....	..	..	77	....	.. .	....	12 ....SUNDAY
13	44 17	52.0	36 2	15.8	30.0248	30.114	29.912	.202	.2265	78.5	37.5	N.E.	7.5	1.2	10	0	91	....	....	....	13
14	44.78	49.2	36.7	12.5	29.6847	29.820	29.593	.227	.2805	93.3	42.8	S.E.	10.7	8.3	10	0	00	0.80	..	0.80	14
15	48 63	54.2	41.3	12.9	29.8198	29.943	29.680	.263	.2555	75 5	40.5	S.W.	15.2	3.0	10	0	89	....	....	....	15
16	54.18	60.5	48.3	12.2	29.9080	30.008	29.783	.225	.2825	67.7	43.5	S.W.	9 1	8.3	10	0	76	...	....	....	16
17	49 37	54.0	44.1	9.9	29.6152	29.725	29.527	.198	.3297	93.3	47.5	S.E.	7.5	10.0	10	10	00	0.79	....	0.79	17
18	44.73	47.8	41.9	5.9	29.8703	29.891	29.837	.054	.2892	97.3	43.8	N.	1.5	10.0	10	10	00	0.02	....	0.02	18
SUNDAY........19	......	50.0	43.6	6.4	....	......	......	....	......	....	....	N.E.	14.8	....	..	..	00	0.03	....	0.03	19 ....SUNDAY
20	45.03	49 9	38 0	11.9	29.8473	29.982	29.732	.250	.2413	80.7	39.0	N E.	19.4	8.3	10	0	01	....	....	....	20
21	40.03	46.7	34.0	12.7	30.1623	30.261	30.050	.211	.1835	75.2	32.3	N.E.	3.5	1.5	9	0	88	.....	....	....	21
22	40 83	49.0	32.2	16 8	30.3357	30.396	30 303	.093	.1867	74.5	32.5	E.	2.2	2.2	10	0	80	....	....	....	22
23	42.68	52.8	33.1	19.7	30.2303	30.343	30.123	.220	.1935	72.2	33 7	S.E.	5.3	7.0	10	0	58	....	....	....	23
24	42.83	46.4	39.7	6.7	29.9983	30.083	29 918	.165	.1948	70.8	33.8	N.E.	7.3	10.0	10	10	00	....	....	....	24
25	43.17	48.0	37.6	10.4	29.8287	29.916	29.730	.186	1753	63.7	31.3	N.E.	14 6	10.0	10	10	02	....	....	....	25
SUNDAY........26	....	49.8	37.6	12.2	....	......	......	......	.....	....	....	N.E.	12 7	....	..	..	37	....	....	....	26 .... .SUNDAY
27	40.03	44.3	37.6	6.7	29.5718	29.679	29.451	.228	.1745	70.5	31 0	N.	16.6	10.0	10	10	00	Inapp.	....	0.00	27
28	38.80	43.9	36.0	7.9	29.3873	29.414	29.347	.067	.1585	67.2	28.7	W.	16 9	10.0	10	10	07	Inapp.	....	0.00	28
29	38.15	46.0	30.7	15.3	29.4275	29.467	29 378	.089	.1952	84 3	33.7	E.	6.3	8.3	10	0	25	0.08	....	0.08	29
30	38.65	42.5	35.6	6.9	29.5642	29.759	29.381	.378	.1940	83.0	33.7	N.W.	10.2	8.3	10	0	00	0.07	....	0.07	30
31	37.68	43.7	33.7	10.0	29.8657	29.889	29.814	.075	.1868	82.8	32.7	S.W.	9 2	6.7	10	0	43	0.10	....	0.10	31
....Means.	45.85	51.84	40.10	11.75	29.9003	......	......	.179	.2583	80.7	39.8	....	18.85	7.25	..	..	33.8	2.69	....	2.69	Sums . ...
16 yrs. means for & including this mo.	45.06	52.00	38.36	13.65	30.0023	... ..	......	.210	.2411	76.3	....	....	....	6.50	..	..	¶40.4	3.38	1.57	3.54	16 yrs. means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles..	888	1817	166	745	333	1200	1376	525	....
Duration in hrs..	89	160	31	92	47	122	111	55	37
Mean velocity...	10.0	11.4	5.4	8.1	7.1	9.8	12.4	9.5	

Greatest mileage in one hour was 30 on the 20th.
Resultant mileage, 1038.
Resultant direction, N. 36°.5 W.

Total mileage, 7,050
Average mileage, 9.5.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 71.7 on the 2nd; the greatest cold was 30.7 on the 29th, giving a range of temperature of 41.0 degrees. Warmest day was the 2nd. Coldest day was the 31st. Highest barometer reading was 30.396 on the 22nd; lowest barometer was 29.347 on the 28th, giving a range of 1.049 inches. Maximum relative humidity was 100 on the 14th. Minimum relative humidity was 47 on the 23rd.

Rain fell on 15 days.

A few flakes of snow fell on the 28th, and soft hail on the 31st.

Auroras were observed on 4 nights.

Hoar frost on 6 days.

Lunar halos on 3 nights.

Fog on 4 days.

BER, 1890.

187 feet. C. H. McLEOD, *Superintendent.*

	Clouded in Tenths. Max.	Min.	Per cent of Possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
o	10	10	30	0.05	....	0 05	1
Su	..	..	01	0.42	....	0.42	2 ....SUNDAY
o	10	10	06	....	Inapp.	0.00	3
3	10	0	27	....	...	....	4
o	10	0	88	....	..	....	5
5	10	1	00	....	....	....	6
o	10	3	41	0.05	....	0.05	7
o	10	0	61	0.31	....	0.31	8
Su	..	..	00	0.99	0.1?	1.00	9 ....SUNDAY
3	10	0	94	.....	....	....	10
5	10	0	50	....	...	....	11
3	10	0	02	....	....	....	12
8	10	9	06	Inapp.	....	0.00	13
5	10	0	98	Inapp.	....	0.00	14
3	10	0	00	....	1.0	0.16	15
Su	..	..	50	....	...	...	16 ....SUNDAY
3	10	0	00	0.37	....	0.37	17
o	10	10	03	0.05	5.0	0.55	18
7	10	6	20	0.05	Inapp.	0.05	19
7	10	0	32	....	....	....	20
8	10	0	83	...	....	....	21
o	10	0	40	Inapp.	....	0.00	22
Su	..	..	91	....	0.5	0.05	23 .... SUNDAY
3	10	6	00	....	Inapp.	0.00	24
o	10	10	00	0.07	Inapp.	0.07	25
2	10	0	96	....	....	....	26
2	5	0	90	....	...	....	27
8	10	0	87	....	0.3	0.02	28
o	10	10	00	....	1.9	0 12	29
Su	....	....	00	0.10	....	0.10	30.......... SUNDAY
..4	..	..	36.5	2.46	8.8	3.32	Sums ....
16 6 inc	..	..	¶29.8	2.41	13.3	3.76	16 yrs. means for and including this month.

ı-level and
Di
cury.
M 100.
Di
7th ; the
M giving a
Warmest
the 27th.
n the 8th
th and 30th.

giving a range of 0.927 inches. Maximum relative humidity was 100 on the 9th. Minimum relative humidity was 44 on the 14th.

Rain fell on 13 days.

Snow fell on 10 days.

Rain or snow fell on 19 days.

Rain and snow fell on 4 days.

Aurora was observed on 1 night.

Hoar frost on 2 days.

Lunar halo on 1 night.

Fog on 2 days.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1890.

Meteorological Observations McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				*BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent of Possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	Max.	Min.	Range.				General direction.	Mean velocity in miles perhour	Mean.	Max.	Min.					
1	37.48	42.0	33.8	8.2	29.8580	29.903	29.805	.098	.1722	76.8	30.8	S.W.	11.4	10.0	10	10	30	0.05	....	0 05	1
SUNDAY...... 2	......	47.7	36.0	11.7	....	......	......	....	... .	....	....	S.	9.5	....	..	..	01	0.42	....	0.42	2 ....SUNDAY
3	32.40	40.8	29.0	11.8	29.6947	29 779	29.528	.251	.1487	80.5	27.2	W.	16 3	10.0	10	10	06	....	Inapp.	0.00	3
4	30.32	35 0	25.7	9.3	29.8527	29.980	29.784	.196	.1240	73.5	23.2	S.W.	9.0	5.3	10	0	27	. ..	.	....	4
5	39.72	48.9	29.1	19.8	29.9528	30.016	29.864	.152.	.1678	68.7	30.0	S.W.	21.0	2.0	10	0	88	....	..	....	5
6	36.82	43.4	30.7	12.7	30.2000	30.292	30.023	.269	.1585	71.3	28.2	N.E.	23.2	8.5	10	1	00	....	....	....	6
7	45.90	55.0	29.7	25.3	29.9850	30.201	29.793	.408	.2457	77.2	38.7	S.	18.3	8.0	10	3	41	0.05	....	0.05	7
8	38.60	55.0	24.5	30.5	30.1272	30.443	29.752	.691	1687	65.2	27.7	W.	23 5	4.0	10	0	61	0.31	....	0.31	8
SUNDAY 9	......	48.7	22.9	25.8	.. ....	......	......	....	.....	....	....	E.	20.1	...	..	..	00	0.99	0.1?	1.00	9 ....SUNDAY
10	30.52	47.0	25.4	21.6	30.2733	30.423	29.929	.494	.1255	71.7	22.5	N.	11.1	2.3	10	0	94	.....	....	....	10
11	26.27	30.7	21.9	8.8	30.3887	30.401	30.371	.030	.1147	81.2	21.3	N.E.	4.2	3.5	10	0	50	....	...	....	11
12	31.07	35.7	21.8	13.9	30.2745	30.399	30.141	.258	.1345	77.7	24.8	S.W.	9.2	8.3	10	0	02	....	....	....	12
13	39.63	44.8	34.2	10.6	29.9652	30.122	29.810	.312	.1808	74.0	32.6	S.W.	14.2	9.8	10	9	06	Inapp.	....	0.00	13
14	40.98	47.7	32.5	15.2	30.0788	30.292	29.851	.441	.1588	61.7	28.7	S.W.	19.2	3.5	10	0	98	Inapp.	....	0.00	14
15	30.82	33.9	28.5	5.4	30.2327	30.346	30.119	.227	.1410	82.2	25.8	N.E.	10.0	8.3	10	0	00	....	1.0	0.16	15
SUNDAY 16	......	35.7	28.7	7.0	....	......	......	....	.....	....	.. .	S.W.	14.7	....	..	..	50	....	...	...	16 ....SUNDAY
17	34.60	37.5	30.7	6.8	29.8195	30.137	29.439	.698	.1853	92.0	32.5	S.	10.0	8.3	10	0	00	0.37	....	0.37	17
18	34.58	37.3	31.8	5.5	29.6885	29.776	29.528	.248	.1797	90.0	31.7	S.W.	14.1	10.0	10	10	03	0.05	5.0	0.55	18
19	37.20	43.7	30.5	13.2	29.5362	29.647	29.515	.132	.1878	84.2	32.7	S.W.	22.0	8.7	10	6	20	0.05	Inapp.	0.05	19
20	27.52	31 6	23.5	8.1	29.8450	30.034	29.686	.348	.1122	75.0	20.8	W.	22.5	6.7	10	0	32	....	....	....	20
21	27.23	33.5	18.8	14.7	29.9665	30.131	29.746	.385	.1182	79.0	21.7	S W.	13.4	3.8	10	0	83	...	....	....	21
22	30.80	35.4	26.0	9.4	29.7928	29.832	29.708	.124	.1232	71.2	22.7	W.	16.4	7.0	10	0	40	Inapp.	....	0.00	22
SUNDAY.......23	......	27.1	16.8	10.3	....	......	......	....	.....	....	....	W.	17.2	....	..	..	91	....	0.5	0.05	23 .... .SUNDAY
24	21.98	32.0	13.9	18.1	29.9522	30.116	29.672	.444	.0927	76.2	15.8	S.W.	12.5	9.3	10	6	00	....	Inapp.	0.00	24
25	36.08	40.0	30.7	9.3	29.6487	29.836	29.580	.256	.1798	84 0	31.7	S.W.	19.2	10.0	10	10	00	0.07	Inapp.	0.07	25
26	21.90	31.3	16.8	14 5	30.1320	30.210	30.003	.207	.0865	73.0	15.0	W.	16 6	4.2	10	0	96	....	....	....	26
27	15.42	18.8	10.3	8.5	30.1703	30.225	30.132	.093	.0648	74.3	8.7	N	8.5	2.2	5	0	90	....	.. .	....	27
28	16.48	21.0	9.0	12.0	30.0762	30.158	29.923	.235	.0703	75.2	10.2	W.	9.7	4.8	10	0	87	....	0.3	0.02	28
29	28.50	33.6	20.0	13.6	29.7957	29.843	29.758	.085	.1332	85.2	24.5	W.	12.4	10.0	10	10	00	....	1.9	0 12	29
SUNDAY........30	....	37.0	13.8	23.2	....	.....	......	......	.....	....	....	S.W.	18.6	....	....	....	00	0.10	....	0.10	30.......... SUNDAY
....Means.	31.71	38.39	24.90	13.49	29.9734	......	......	.283	.1430	76.8	25.2	....	14.92	6.74	..	..	36.5	2.46	8.8	3.32	Sums ....
16 yrs. means for & including this mo.	32.05	38.10	25.97	12.12	30.0093	... ..	.....	.262	.1543	79.7	....	....	....	7.36	..	..	¶29.8	2.41	13.3	3.76	16 yrs. means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	
Miles............	301	964	267	240	1887	3289	3271	533	
Duration in hrs..	36	61	21	25	127	213	186	44	7
Mean velocity...	8.4	15.8	12.7	9.6	14.9	15.4	17.6	12.1	

Greatest mileage in one hour was 39 on the 8th. Greatest velocity in gusts, 44 miles per hour on the 7th.

Resultant mileage, 5,720.
Resultant direction, S. 58° W.
Total mileage, 10,752.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 55.0 on the 7th; the greatest cold was 9.0 on the 28th, giving a range of temperature of 46.0 degrees. Warmest day was the 7th. Coldest day was the 27th. Highest barometer reading was 30.443 on the 8th; lowest barometer was 29.516 on the 15th and 30th, giving a range of 0.927 inches. Maximum relative humidity was 100 on the 9th. Minimum relative humidity was 44 on the 14th.

Rain fell on 13 days.
Snow fell on 10 days.
Rain or snow fell on 19 days.
Rain and snow fell on 4 days.
Aurora was observed on 1 night.
Hoar frost on 2 days.
Lunar halo on 1 night.
Fog on 2 days.

BER, 1890.

1, 187 feet. C. H. McLEOD, *Superintendent.*

Y Clouded In Tenths. Mean.	Max.	Min.	Per cent of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
.8	10	0	94	....	....	....	1
.0	5	0	94	..	....	....	2
.3	10	0	00	....	10.8	0.90	3
.7	10	0	80	....	2.4	0.24	4
.7	10	0	53	....	Inapp.	0.00	5
.0	10	0	00	....	1.8	0.16	6
...	..	..	92	....	.	....	7 ....Sunday
Sun .5	10	0	49	....	Inapp.	0.00	8
.0	10	10	00	....	1.2	0.05	9
.8	10	9	00	....	2.5	0.25	10
.8	10	9	00	....	0.1	0.00	11
5	10	0	60	...	0.7	0.05	12
.3	10	0	41	....	0.1	0.01	13
..	..	..	00	....	3.2	0.27	14 ....Sunday
Sun .3	10	0	00	....	0.1	0.01	15
5.8	10	1	05	....	..	....	16
9.5	10	1	00	....	Inapp.	0.00	17
5.5	10	0	49	....	....	....	18
.7	4	0	85	....	....	....	19
.7	10	0	84	....	....	...	20
...	..	..	00	0.05	1.3	0.29	21 ....Sunday
Sun 7.8	10	1	84	.....		....	22
7.7	10	1	39	......	2.6	0.14	23
0.8	7	0	93	....	....	....	24
0.2	1	0	95	....	....	....	25
8.3	10	0	00	....	1.6	0.15	26
0.0	10	10	00	....	1.8	0.17	27
...	..	..	95	....	0.1	0.01	28 .... .Sunday
Su 8.5	10	2	00	....	2.0	0.09	29
7.7	10	0	15	......	....	....	30
2.7	10	0	91	.	..	.. .	31
3.7	..	..	41.9	0.05	32.3	2.79	Sums ....
.11	..	..	¶28.4	1.34	24.5	3.75	16 yrs. means for and including this month.

16
inc

sea-level and

Dir mercury.

Mil ng 100.

Du le 22nd ; the

Me on the 31st,

50.4 degrees.

day was the

as 30.677 on

con

G6 on the10th,

the

giving a range of 1.351 inches. Maximum relative humidity was 100 on 4 days. Minimum relative humidity was 54 on the 24th.

Rain fell on 1 day.

Snow fell on 19 days.

Rain or snow fell on 19 days.

Rain and snow fell on 1 day.

Hoar frost on 2 days.

Fog on 8 days.

ABSTRACT FOR THE MONTH OF DECEMBER, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	0.00	14.3	—8.6	22.9	29.8803	29.962	29.805	.157	.0307	68.7	—8.0	W.	15.1	1.8	10	0	94	....	....	....	1
2	—10.45	—6.2	—14.6	8.4	30.2240	30.450	30.077	.373	.0185	72.3	—17.5	W.	14.3	1.0	5	0	94	..	....	....	2
3	—1.68	9.4	—11.8	21.2	30.0982	30.492	29.531	.961	.0353	83.2	—5.7	W.	14.6	8.3	10	0	00	....	10.8	0 90	3
4	10.03	12.2	7.5	4.7	29.7835	30.106	29.471	.635	.0562	82.3	5.7	W.	30.2	3.7	10	0	80	....	2.4	0.24	4
5	9.35	14.0	1.6	12.4	30.3407	30.437	30.272	.165	.0497	75.3	2.8	W.	4.1	3.7	10	0	53	....	Inapp.	0.00	5
6	4.20	14.9	—5.8	20.7	30.1392	30.437	29.902	.535	.0482	89.7	1.7	W.	9.9	9.0	10	0	00	....	1.8	0.16	6
SUNDAY........ 7	......	16.5	9.9	6.6	....	......	......	....	....	....	....	W.	21.9	....	..	..	92	....	.	....	7 ....SUNDAY
8	5 02	10.5	0.8	9 7	30.2710	30.409	30.076	.333	.0465	85.7	1.7	W.	5.0	3.5	10	0	49	....	Inapp.	0.00	8
9	12.78	25.0	—0.2	25.2	29.7788	30.032	29.642	.390	.0768	91.5	10.7	W.	10.8	10.0	10	10	00	....	1.2	0.05	9
10	27.22	29.6	24.5	5.1	29.4425	29.622	29.326	.296	.1407	94.8	26.0	S.	12.3	9.8	10	9	00	....	2.5	0.25	10
11	25.73	29.6	22.8	6.8	29 5897	29.634	29.533	.101	.1167	84 2	21.7	W.	8.2	9.8	10	9	00	....	0.1	0.00	11
12	5.28	24.0	—3.5	27.5	29.9123	30.129	29.653	.476	.0457	73.8	—1.5	W.	20.4	4 5	10	0	60	...	0.7	0.05	12
13	1.95	7.8	—4.4	12 2	30.1355	30.205	30.018	.187	.0368	77.5	—3.8	W.	16 5	8.3	10	0	41	....	0.1	0.01	13
SUNDAY 14	......	30.0	5 0	25.0	......	......	......	....	.....	...	....	S.W.	14.7	..	..	..	00	....	3.2	0.27	14 ....SUNDAY
15	18.38	30.6	7.6	23.0	30.3017	30.524	29.955	.569	.0895	85.5	14.5	S.W.	8.1	8.3	10	0	00	....	0.1	0.01	15
16	2.27	9.0	—5.9	14.9	30.4992	30.602	30.404	.198	.0438	90.5	—0.2	N.E.	9.9	5.8	10	1	05	....	..	....	16
17	15.15	21.8	5 5	16.3	30.2455	30.395	29.993	.402	.0763	85 8	11.7	N.E.	15.6	9.5	10	1	00	....	Inapp.	0.00	17
18	22.08	27 9	11.7	16 2	29.7733	29.926	29 676	.250	.0903	74 3	15.3	W.	26.3	5.5	10	0	49	....	....	....	18
19	2.58	12.0	—1 5	13.5	30.3262	30.523	30.141	.382	.0300	61.0	—8.0	W.	27.4	0.7	4	0	85	....	....	....	19
20	5.22	14.0	—5.9	19.9	30.3832	30.573	30.144	.429	.0370	65.3	—4.2	S.	11.9	1.7	10	0	84	....	....	...	20
SUNDAY.. 21	......	35 1	13.2	21.9	.. ....	......	......	....	.....	....	. .	S.	21.0	....	..	..	00	0.05	1.3	0.29	21 ....SUNDAY
22	17.70	35.4	12.9	22.5	29.9478	30.072	29.775	.297	.0793	78.3	11.5	W.	24.2	7.8	10	1	84	.....		....	22
23	23.40	33 1	12.8	20.3	29.5765	29.666	29.503	.163	.1073	83.7	19.0	S.W.	21 7	7.7	10	1	39	......	2.6	0.14	23
24	6.03	21.1	2.8	18.3	30 0682	30.270	29.839	.431	.0358	62.2	—4.3	W.	24 0	0.8	7	0	93	....	....	....	24
25	—2.93	3.9	—5.5	9.4	30 5742	30.677	30.425	.252	.0270	72.3	—10 2	W.	18.0	0.2	1	0	95	....	....	....	25
26	—4.55	4.7	—13.0	17.7	30.3682	30.672	29.925	.747	.0315	88.5	—7.3	N.E.	12.8	8.3	10	0	00	....	1.6	0.15	26
27	13.22	17.5	4.2	13.3	29.4890	29 712	29.368	.344	.0675	85.0	9.7	W.	21.7	10.0	10	10	00	....	1.8	0 17	27
SUNDAY.... ...28	.....	15.6	—7.9	23.5	....	......	......	....	.....	....	....	W.	26.9	....	..	.	95	....	0.1	0.01	28 .... .SUNDAY
29	3.27	10.8	—4.6	15.4	29.8855	30.250	29.657	.593	.0385	75.2	—3.2	S.	14.5	8.5	10	2	00	....	2.0	0.09	29
30	—9.47	—4.6	—14 0	9.4	30 4930	30.526	30.419	.107	0213	77.8	—14.7	N.E.	7 8	7.7	10	0	15	......	....	....	30
31	—9.02	—5.8	—15.0	9.2	30.4103	30.518	30.251	.267	.0213	77.0	—14.8	N.E.	17.1	2.7	10	0	91	.	..	.. .	31
....Means	7.14	16.57	0.66	15.91	30.0718	......	......	.372	.0555	79.3	1.80	....	16.35	58.7	..	..	41.9	0.05	32.3	2.79	Sums ....
16 yrs. means for & including this mo.	18.29	25.35	10.92	14.42	30.0195	......	......	.293	.0963	82.3	....	... .	.. .	7.11	..	..	¶28.4	1.34	24.5	3.75	16 yrs. means for and including this month.

ANALYSIS OF WIND RECORD.

Direction......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles...........	451	1441	119	272	1122	1581	6861	317	
Duration in hrs..	26	95	15	28	76	80	374	19	31
Mean velocity...	17.3	15.2	7.9	9.7	14.8	19.8	18.3	16.7	

Greatest mileage in one hour was 44 for four consecutive hours on the 4th.
Greatest velocity in gusts, 52 miles per hour on the 4th.

Resultant mileage, 6,915.
Resultant direction, S. 84° W.
Total mileage, 12,164.

* Barometer readings reduced to sea-level and temperature of 32° Fahr.
§ Observed.
† Pressure of vapour in inches of mercury.
‡ Humidity relative, saturation being 100.
¶ Nine years only.

The greatest heat was 35.4 on the 22nd; the greatest cold was 15.0 below zero on the 31st, giving a range of temperature of 50.4 degrees. Warmest day was the 10th. Coldest day was the 2nd. Highest barometer reading was 30.677 on the 25th; lowest barometer was 29.326 on the 10th, giving a range of 1.351 inches. Maximum relative humidity was 100 on 4 days. Minimum relative humidity was 54 on the 24th.

Rain fell on 1 day.
Snow fell on 19 days.
Rain or snow fell on 19 days.
Rain and snow fell on 1 day.
Hoar frost on 2 days.
Fog on 8 days.

YEAR 1890.

Observade N. 45° 30′ 17″. Longitude $4^h\ 54^m\ 18^s.55$ W.

C. H. McLEOD, *Superintendent.*

Month.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.	Month.
January	7	31.3	21	4.40	4	24	January
February	10	27.4	12	4.45	2	20	February
March	5	11.7	12	1.53	2	15	March
April	12	3.0	5	2.11	2	15	April
May	18	..	..	4.85	..	18	May
June	14	..	..	2.72	..	14	June
July	17	..	..	2.78	..	17	July
August	20	..	..	8.08	..	20	August
September	11	..	..	3.57	.	11	September
October	15	..	..	2.69	..	15	October
November	13	8.8	10	3.32	4	19	November
December	1	32.3	19	2.79	1	19	December
Sums for 1890	143	114.5	79	43 29	15	207	Sums for 1890
Means for 1890	....	....	....	3.61	..	17	Means for 1890
Means for 16 years ending Dec. 31, 1890.	134	124.6	84	40.25	15	202	Means for 16 years ending Dec. 31, 1890.

* Baromet ndicates that the temperature has been *higher;* "—" that it has been *lower* than the a andard time. The anemometer and wind vane are on the summit of Mount Royal,

The greate st range of the thermometer in one day was 41.8 on Jan. 13th; least range was 3.7 on ture was 15.73 below zero. The highest barometer reading was 30.717 on January 28th t mileage of wind recorded in one hour was 67 on January 13th, and the greatest velo W., and the resultant mileage 50,720, Auroras were observed on 18 nights. Fogs on s and contact are on one day. The sleighing of the winter closed, in the city, on Apri s a slight earthquake on September 26th, at 3 h. 3 m.

The yearly

METEOROLOGICAL ABSTRACT FOR THE YEAR 1890.

Observations made at McGill College Observatory, Montreal, Canada. — Height above sea level 187 ft. Latitude N. 45° 30′ 17″. Longitude 4^h 54^m $18^s.55$ W.

C. H. McLEOD, *Superintendent.*

Month.	Thermometer.					* Barometer.								Wind.												Month.
	Mean.	¶ Deviation from 16 year means.	Max.	Min.	Mean daily range.	Mean.	Max.	Min.	Mean daily range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Mean dew point.	Resultant direction.	Mean velocity in miles per hour.	Sky clouded per cent.	Per cent. possible bright sunshine	Inches of rain.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.			
January	14 86	+ 3.07	52.3	− 21.6	17.34	30.1399	30.717	29 201	.400	.0824	79.6	9.5	N. 75° W.	19.6	64.6	33.8	1.64	7	31.3	21	4.40	4	24			January
February	19.08	+ 3.60	45.0	− 9.1	16.95	30 0184	30.702	29.092	.400	.1025	80.4	13.8	S. 52° W.	18 6	63 5	44.9	2.85	10	27.4	12	4 45	2	20			February
March	26.5t	+ 2.64	43.0	− 4.0	13.67	29.9363	30.561	29.329	243	.1158	71.9	18.5	S. 55° W.	16.9	62 8	45.9	0.48	5	11.7	12	1.53	2	15			March
April	40.01	+ 0.41	66.9	21.1	16.66	30 0415	30.456	29.220	.236	.1534	60.1	26.5	S. 61° W.	17.9	49.8	56.8	1.80	12	3.0	5	2.11	2	15			April
May	51.59	− 2.99	74.1	28.3	16.81	29.899t	30.311	29.558	.195	.2664	68.7	40.7	S. 38° W.	14 0	65 4	42.3	4.85	18	..	..	4.85	..	18			May
June	64.45	− 0.01	85 3	40.8	17.25	29.9106	30.270	29.632	.160	.4252	69 7	53.4	S. 8[illegible]° W.	12.2	60.7	57.2	2.72	14	..	..	2.72	..	14			June
July	68.57	− 0.42	88 6	49.4	17.52	29.9253	30.259	29.501	.143	.4915	69 9	57.7	S. 39° W.	12.6	59.4	58 4	2.78	17	..	..	2.78	..	17			July
August	64.82	− 2.14	68.8	47.4	16 11	29.9595	30.261	29.533	.178	.4409	70.8	54.5	S. 83° W.	11.3	50.8	58.1	8.08	20	..	..	8.08	..	20			August
September	57 79	− 0.72	80.0	38.1	14.79	30.0786	30.450	29.666	.160	.3846	77.9	50.5	S. 49° W.	11.3	57.5	51.6	3.57	11	..	..	3.57	.	11			September
October	45.85	+ 0.79	71.7	30.7	11.75	29.9003	30.396	29.347	.179	.2583	80.7	39.8	N. 36° W.	9.5	72.5	33.8	2.69	15	..		2.69	..	15			October
November	31.7t	− 0.34	55.0	9.0	13.49	29.9734	30.443	29.515	.283	.1430	76.8	25.2	S. 58° W.	14.9	67.4	36.5	2 46	13	8.8	10	3.32	4	19			November
December	7.14	−11.15	35.4	− 15.0	15 91	30.0718	30.677	29.326	.372	.0555	79.3	1.8	S. 84° W.	16.4	58.9	41.9	0.05	1	32.3	19	2.79	1	19			December
Sums for 1890	...	...	....	....	....	....	....	....	....	....		....		....	....	....	33.97	143	114.5	79	43 29	15	207			Sums for 1890
Means for 1890	41.03	− 0.60	....	....	15.69	29.9904	....	....	.246	.2433	73.8	32.7	S. 66° W.	14.60	61.1	46.8	....	....	....	....	3.6t	..	17			Means for 1890
Means for 16 years ending Dec. 31, 1890.	41.63	....	....	....	...	29.9765	....	....	....	.2493	74.4	....	....	* 15 34	61.4	§ 46.1	28.13	134	124.6	84	40.25	15	202			Means for 16 years ending Dec. 31, 1890.

* Barometer readings reduced to 32° Fah., and to sea level. † Inches of mercury. ‡ Saturation, 100. § For 9 years only. * For 4 years only. ¶ "+" indicates that the temperature has been *higher;* "−" that it has been *lower* than the average for 16 years, inclusive of 1890. The monthly means are derived from readings taken every 4th hour, beginning with 3h. 0m, Eastern Standard time. The anemometer and wind vane are on the summit of Mount Royal, 57 feet above the ground, and 810 feet above sea level.

The greatest heat was 88.8 on August 4th; greatest cold 21.6 below zero on January 10th; extreme range of temperature was therefore 110°.4. Greatest range of the thermometer in one day was 41.8 on Jan. 13th; least range was 3.7 on Feb. 27th. The warmest day was July 1st, when the mean temperature was 76.45. The coldest day was Jan. 10th, when the mean temperature was 15.73 below zero. The highest barometer reading was 30.717 on January 28th the lowest was 29.092 on February 5th, giving a range of 1.625 for the year. The lowest relative humidity was 15 on April 15th. The greatest mileage of wind recorded in one hour was 67 on January 13th, and the greatest velocity in gusts was at the rate of 104 m. p. h. The total mileage of wind was 127,618. The resultant direction of the wind for the year was S. 66° W., and the resultant mileage 50,720, Auroras were observed on 18 nights. Fogs on 42 days. Hoar-frost on 23 days. Thunder storms on 20 days. Lunar halos on 13 nights. Lunar coronas on 1 night. Solar halos on 4 days and contact arc on one day. The sleighing of the winter closed, in the city, on April 1st. The first appreciable snowfall of the autumn was on November 9th. The first sleighing of the winter was on December 3rd. There was a slight earthquake on September 26th, at 3 h. 3 m.

The yearly means above, are the averages of the monthly means, except for the velocity of the wind.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. IV. APRIL, 1891. NO. 6.

Descriptions of Four New Species of Fossils From the Silurian Rocks of The South Eastern Portion of the District of Saskatchewan.[1]

By J. F. Whiteaves.

(*With Plate III.*)

While engaged in explorations on behalf of the Geological Survey of Canada in 1889 and 1890, Mr. J. B. Tyrrell discovered an area of Silurian (Upper Silurian) rocks on the north east side of Lake Winnipegosis, on Cedar Lake, and on the Saskatchewan River below Cedar Lake. From these rocks an interesting series of fossils was obtained, some of which are apparently new to science, and of these latter, four of the most characteristic or important species will be described and illustrated in the present paper. On stratigraphical and other grounds, Mr. Tyrrell has found it desirable to divide the Silurian of this district into two local subdivisions. The fossils here described will be considered in the order of their geological relations, but it may be well to state that the *Pentamerus* and *Gomphoceras* are from the

[1] Communicated by permission of the Director of the Geological Survey of Canada.

lower of these two subdivisions, and the *Strophomena* and *Acidaspis* from the upper.

Brachiopoda.

Strophomena acanthoptera. (Sp. nov.)

Plate iii, figs. 1 and 2.

Shell varying in outline from broadly semicircular or semioval and regularly rounded in front, to subtrigonal with the front margin produced and somewhat pointed in the centre,—but always broadest at the cardinal margin, which is produced on each side into a long, very slender, and slightly curved spine; length of each cardinal spine a little more than one half of the greatest breadth of either valve without the spines. Ventral valve regularly convex from beak to front, though the nasute forms are most prominent anteriorly along the median line; umbonal region compressed; beak small and raised very little above the general level of the hinge line; area transversely elongated and very narrow in the direction of its height, with a small equilateral foramen in the centre. Dorsal valve concave, with a perfectly straight cardinal margin, an extremely minute beak and a hinge area much narrower than that of the ventral.

Surface marked by numerous, but comparatively distant and, for the most part simple, radiating raised lines, which increase by intercalation and alternate at unequal distances with from one to five (or perhaps more) shorter and much smaller ones, the whole being crossed by extremely minute and close set concentric striations, and by a few more or less distant lines of growth. Characters of the interior unknown.

Collected at several localities on the northern portion of the east shore of Lake Winnipegosis, in the district of Saskatchewan and in the adjacent part of the Province of Manitoba by Mr. J. B. Tyrrell in 1889, (but previously found loose in this vicinity by Mr. D. B. Dowling in 1888,) also on the shores and islands of Cedar Lake and on the Saskatchewan below Cedar Lake by Mr. J. B. Tyrrell in 1890. At each of these localities it is apparently abundant and often associated with *Isochilina grandis*, Jones.

The specimens consist either of natural moulds of the exterior of the shell or of casts of the interior, in a compact fine grained dolomite, and in no case is there any vestige of the actual test remaining. In several of these natural moulds, however, the minutest details of the surface ornamentation are well preserved, and it is from wax impressions made from two of these moulds that the figures on Plate III. were drawn.

The species is apparently most nearly related to the *Strophomena Leda* of Billings,[1] from division 3 of the Anticosti group of the Island of Anticosti, (which Mr. Billings correlates with the Llandovery of England and with the Clinton of the State of New York), but seems to differ therefrom in its much larger size, and in the greater proportionate length of its cardinal spines. Both it and *S. Leda* are evidently what Professor H. L. Williams[2] would call "geological mutations" of the "race which began in *Strophomena alternata* in the Trenton stage," but they form a marked exception to his statement that in the American race of the *S. alternata* type the slender mucronate points at the terminations of the hinge line "first appear in the Tully limestone."

Pentamerus decussatus. (Sp. nov.)

Plate iii, figs. 3 and 4.

Shell large, usually longitudinally and rather narrowly subovate, about one third longer than broad, and broadest a little in advance of the midlength, but sometimes nearly

[1] Geol. Surv. Can., Palæoz. Foss., vol. 1, 1865, p. 120, figs. 98 and 99.

[2] See his paper on "The Cuboides Zone and its Fauna," in Bull. Geol. Soc. America, published May, 1890.

as broad as long ; front margin regularly rounded in most specimens, but somewhat pointed in the centre in others. Ventral valve strongly convex, very tumid, prominent, and rounded or obtusely angulated along the median line, and narrowing rapidly to the margin on both sides, but devoid of a distinctly defined mesial fold, its umbo prominent and rather broad, and its beak so strongly recurved as almost to touch that of the opposite valve. Fissure rather large, triangular, a little higher than broad, completely covered by the recurved beak and visible only when the beak is broken off. Dorsal valve much flatter than the ventral, gently and uniformly convex, or flattened with a faint longitudinal depression in the centre, its beak small, rather narrow and slightly incurved.

Surface marked by very numerous, closely disposed, rounded and but slightly elevated radiating raised lines, which are crossed by smaller, more close set and irregularly disposed concentric raised lines, as well as by a few distant and more or less imbricating lines of growth. The radiating raised lines, which are rather irregular in their arrangement and unequal in size, increase so rapidly by division that as many as from sixty to one hundred or more of them can be counted around the front margin of an adult specimen, though, on account of its greater convexity, there is always a larger number on the ventral valve than on the dorsal.

Septum of the ventral valve well developed, comparatively thick but very short, occupying less than one fourth of the entire length in some specimens, but a little longer in others, though rarely or never exceeding one third of the total length. Septa of the dorsal valve thin, feebly developed and almost rudimentary, very slightly divergent and much shorter than the ventral septum. Muscular and vascular impressions unknown. Interior of the valves rather minutely papillose.

Dimensions of the specimen figured ; maximum length, eighty seven millimetres, greatest breadth, fifty nine mm. ; maximum height or depth through the closed valves, fifty two mm.; amount of recurvature of beak of ventral valve, sixteen mm.

The only locality at which this species is known to the writer to have been certainly found *in place*, is in a light brownish yellow dolomitic limestone at the foot of the Grand Rapids of the Saskatchewan, where a number of fine specimens were collected by Mr. Tyrrell in 1890. Boulders containing it have been found at several localities in Manitoba and elsewhere in the central portion of the Dominion. It is almost certainly the shell referred to by Sir John Richardson as a "*Pentamerus*, very like *P. Knightii*," which was gathered by Dr. Bigsby "in 1823" on the Lake of the Woods and presented by him to the British Museum,[1] as specimens of the shell which I here call *P. decussatus* have since been collected from boulders on the south west shores of that lake by Dr. G. M. Dawson in 1873 and by Dr. A. C. Lawson in 1884. Other localities at which the species has been obtained from boulders are as follows:—Nelson River, about sixty miles above its mouth, Dr. R. Bell, 1879; Lower Fort Garry, Dr. R. Bell, 1880; Kenogami River, six miles above the mouth of the Bagutchewan, Dr. R. Bell, 1886. Mouth of the Fairford River and Steep Rock Island, Lake Manitoba, J. F. Whiteaves, 1888. North east side of Lake Winnipegosis and Red Deer River near its mouth, J. B. Tyrrell, 1889; Virden, Manitoba, C. N. Bell, 1889.

In Appendix No. 1 to Franklin's "Narrative of a Second Expedition to the Shores of the Polar Sea, in the years 1825, 1826 and 1827," Sir John Richardson says that "Mr. Sowerby determined a shell, occurring in great abundance in the strata at Cumberland House" . . . "to be the *Pentamerus Aylesfordii*," which is regarded by Dr. Davidson as a synonym of *P. Knightii*. Although Cumberland House is 135 miles farther up the Saskatchewan than the locality at which Mr. Tyrrell obtained *P. decussatus* in place, it is by no means improbable that the specimens which Mr.

[1] Journal of a Boat Voyage through Rupert's Land and the Arctic Sea, vol. 1, foot note to page 62. See also Ib., vol. ii, p. 197.

Sowerby determined as *P. Knightii* are really referable to the present species. However this may be, it seems to the writer that *P. decussatus* differs materially from the true *P. Knightii*, especially in the following particulars. The umbo of the ventral valve of the former is narrower and less prominent, while its beak is much less strongly curved; the coarser surface markings of both valves do not consist of comparatively distant and regular radiating ribs, as in *P. Knightii*, but of close set, irregularly disposed, unequal and not much elevated radiating raised lines; and the mesial septa of both valves of *P. decussatus* are not more than half the comparative length of those of *P. Knightii*.

Cephalopoda.

Gomphoceras parvulum. (Sp. nov.)

Plate iii, figs. 5, 5 a, b.

Shell small, straight, slender, rather more than three times as long as broad, and broadest a little in advance of the midlength: sides slightly compressed, the outline of a transverse section near and at the commencement of the body chamber being ovate: venter narrower than the dorsum and especially so at both ends: lateral outline conical, with the ventral border not much more convex than the dorsal. Septate portion occupying a little more than one-half the entire length, narrowly conical in lateral aspect, pointed posteriorly and about twice as long as it is broad anteriorly. Body chamber crenulated around the base, its outer margins at first nearly straight and almost parallel on both sides as viewed laterally, its anterior termination rounded but much more broadly so on the ventral side than on the dorsal: ventral region at the summit laterally compressed on each side of the aperture. Aperture, as viewed from above, extremely contracted, Y shaped, with the stem about twice as long as either of the two branches, which diverge from it at an angle of about 115°. The stem is a narrow slit which expands at its outer termination into a narrow and longitudinally elliptical orifice, exactly in a line with the siphuncle, and the branches are similarly narrow divergent slits, each of which widens into a smaller and circular orifice externally.

Surface markings consisting only, so far as known, of extremely fine transverse striations, which are too minute to be shewn in the figure.

Sutures slightly concave at the sides, closely approximated but rather nearer together posteriorly than anteriorly: siphuncle exogastric, marginal and placed in the median line of the venter.

Approximate dimensions of an average specimen (the one figured): entire length, thirty eight millimetres; length of the septate portion, twenty one mm.; greatest breadth, twelve mm.

Grand Rapids of the Saskatchewan below Old Portage, J. B. Tyrrell, 1890: a number of casts of the interior of the shell, in a pale brownish yellow or nearly white dolomitic limestone.

A singular little species, apparently well characterized by its diminutive size, ovately conical, slender and nearly equilateral contour, as viewed laterally, and by its narrowly contracted and widely divergent Y shaped aperture. It is not at all likely to be mistaken for any American species, and is perhaps most nearly related to the *G. clava* of Barrande,[1] young specimens of which have a very similar marginal outline. The aperture of *G. clava*, however, is regularly T shaped at all stages of growth, and in the adult stage it seems to differ very widely from the present species, both in its dimensions and in its general contour.

[1] Systême Silurièn du Centre de la Bohême, Prague and Paris, vol. ii, 1865 pl. 77, figs. 6-22, and pl. 92, figs. 10-13.

G. clava is from Etage E of Bohemia, which is said to be the equivalent of the Lower Ludlow of England.

TRILOBITA.

Acidaspis perarmata. (Sp. nov.)

Plate iii, fig. 6.

Body depressed, very slightly convex, its general outline, apart from the marginal spines, longitudinally subelliptical and a little longer than broad.

Head about twice as broad as long, occupying one third of the total length, exclusive of the spines on the pygidium: its front margin broadly subtruncate, nearly straight but faintly sinuous and very obscurely three lobed, with a slight indentation on each side of the glabella immediately in front of the anterior termination of each of the ocular ridges: its posterior margin much more distinctly flexuous and curved backward in the centre with a moderately convex curve, and forward with a shallowly concave curve, on each side. Eyes small, placed very near the posterior margin of the head and opposite the most contracted portion of each of the free cheeks: ocular ridges moderately prominent, slightly curved and converging obliquely forward from the eyes to their terminations near the frontal margin, where they are about twice as close together as at their commencement anteriorly. Characters of the glabella unknown. Outer margin of each of the free cheeks somewhat expanded anteriorly and forming a not very prominent rounded lobe, which is armed with eight very short pointed spines—slightly contracted behind the midlength and terminating posteriorly in a straight and pointed genal spine, which is a little shorter than that of the pleura of the first abdominal segment, and diverges outward and backward at an angle of 40° to a line drawn at a right angle to the longitudinal axis.

Thorax arched upon the axis, depressed and flattened on the pleuræ: composed of nine segments: axis occupying more than one third of the entire breadth without the spines, and narrowing very gradually to the posterior end:

its annulations horizontal, subparallel and nearly straight, but faintly sinuous at their margins, both in front and behind. Pleuræ also decreasing very gradually in breadth to the posterior end of the thorax, nearly straight and terminating externally on each side in a long and very slender spine, which is bent backward and outward at an angle of about 57°. The spines increase gradually in length posteriorly, the two spines on the anterior thoracic segment being shorter than the pleuræ from which they proceed, and nearly equal in length to the genal spines immediately in front of them, whereas in the posterior thoracic segment the pleural spines are nearly three times as long as the pleuræ and as the spines on the pleuræ of the anterior thoracic segment.

Pygidium broad and short, its outer margin broadly rounded and fringed with spines, its inner or anterior margin almost straight and nearly three times as broad as the length of the non spinose portion along the median line; its axis moderately convex and its pleuræ flat. Axis narrowly rounded posteriorly and terminating just within the margin of the pygidium, apparently bearing two transverse annulations, the posterior unarmed and the anterior bearing a long and very slender primary spine on each of its rounded postero-lateral angles. These primary spines, whose length considerably exceeds that of the united pygidium and thorax, diverge for the greater part of their length at an angle of about 48°, but curve slightly inward at their outer ends. Outer margin of the pygidium armed with four secondary internal spines between the two primaries and with five secondary external spines on each side of the latter. The four secondary internal spines are moderately close together, nearly equal in length and about one fourth as long as the primaries. The five outer secondary spines on each side are much closer together than the four inner ones and not more than one half as long.

Surface markings unknown.

Long Point, at the northeast angle of Lake Winnipegosis, just outside of the northern boundary of Manitoba, J. B. Tyrrell, 1890 ; a single and not very well preserved cast of the interior of the dorsal or upper side, in a compact and slightly vesicular dolomite. Although the surface markings are not even faintly indicated, and the characters of the glabella and some of those of the central portion of the thorax are unknown, the whole of the marginal outline of the specimen can be ascertained with considerable accuracy.

In the elucidation of its characters the writer has been materially assisted by Mr. L. M. Lambe.

The species appears to be of the type of the *A. Prévostii* of Barrande,[1] from the Upper Silurian Rocks (Etage E.) of Bohemia, but it has a smaller number of short spines on the lateral margins of the two free cheeks, a proportionately broader axis to the thorax, much longer primary spines on the pygidium, and differs from that species in several other particulars.

EXPLANATION OF PLATE III.

Strophomena acanthoptera.

Fig. 1.—Dorsal view of a specimen, showing the whole of the dorsal valve and the cardinal areas of both valves.

Fig. 2.—Ventral view of another specimen.

Pentamerus decussatus.

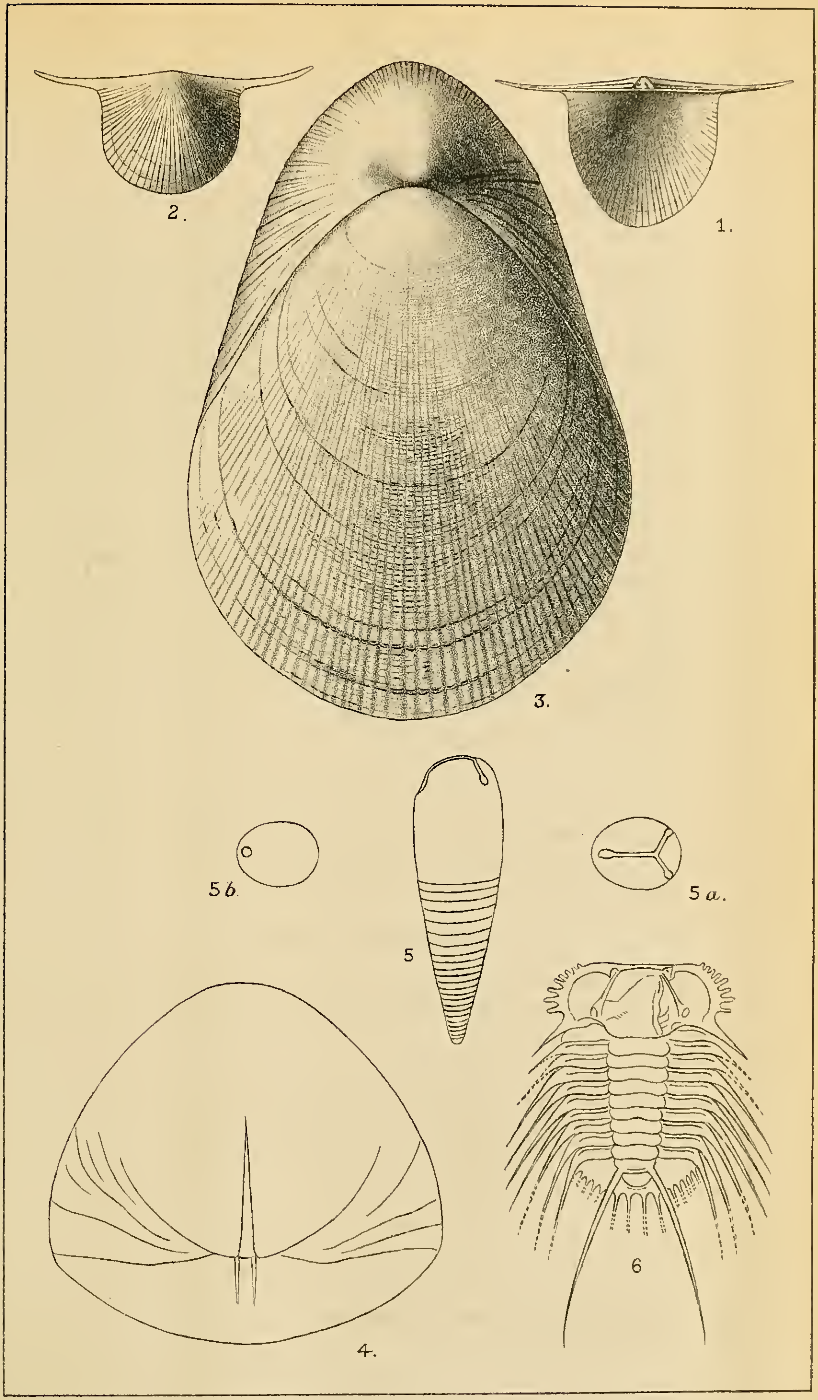
Fig. 3.—Dorsal view of a specimen, showing the whole of the dorsal valve and the prominent umbo and recurved beak of the ventral.

Fig. 4.—Outline of the posterior end of a cast of the interior of the shell of this species, to show the relative convexity of the two valves, the length and other characters of the mesial septum of the ventral valve and the nature of the two short septa in the dorsal.

Gomphoceras parvulum.

Fig. 5.—Lateral outline of a cast of the interior of the shell.

[1] Système Silurien du Centre de la Bohème, Prague and Paris, vol. i, 1852, p. 739, pl. 39, figs. 33-41.



L.M Lambe, Del. Mortimer Lith

SILURIAN FOSSILS FROM SASKATCHEWAN.

Fig. 5a.—Outline of anterior end of another specimen, to show the shape of the aperture.

Fig. 5b.—Outline of one of the septa near the body chamber, to show the relative position of the siphuncle.

ACIDASPIS PERARMATA.

Fig. 6.—Outline of the only specimen collected, slightly restored.

(All the figures are of the natural size.)

NOTE ON A SHARK AND RAY OBTAINED AT LITTLE METIS, ON THE LOWER ST. LAWRENCE.

By SIR WILLIAM DAWSON, F.R.S.

(With Plate IV.)

Some of the summer resorts on the Lower St. Lawrence are not destitute of supplies of fish. In addition to the delicious trout of the lakes and streams, the sea affords, at certain seasons, an abundant harvest of various kinds. At Little Metis, for example, salmon are taken in the St. Lawrence in early summer. A little later, mackerel, herring, and the delicate sardine make their appearance, and flounders, loche or tom-cod, and smelts are taken by juvenile anglers. Now and then the brush wears erected on the shore capture a specimen of the great Albecore or horse mackerel, an excellent fish, and the striped bass is sometimes taken in the same way. Formerly the cod was taken in considerable quantity, but it seems to have deserted the locality, except that a few "rock cod" and young cod, scarcely larger than the loche, are sometimes caught. Of late years, however, the halibut has appeared in sufficient numbers to make a profitable fishery for local use, and it is in connection with the halibut fishery that the animal to which this note refers has made its appearance.

The halibut fishers, using herring or sardine for bait, occasionally hook a large shark, and find little difficulty in capturing it. Five or six specimens, some of them ten feet in length, were thus taken and towed ashore last summer. They are not valued for food, but the liver yields a considerable quantity of oil, and the skin is used as a rasp for dressing wood. I examined and measured one specimen about ten feet in length, and secured, with the aid of Mr. Sim, of Lighthouse Point, the skin of another, which is now admirably mounted by Bailly in the Peter Redpath Museum. I also obtained the jaws and teeth of a third specimen, now in the same museum.

The creature is known to the fishermen at Little Metis as the "Dog Fish," a name not altogether inappropriate, since it belongs to the same family of sharks with the ordinary dog-fish, though much larger than they, and destitute of the bony spines with which they are armed. It seems to haunt the bottom rather than the surface of the sea, and to feed on all sorts of smaller fish and crustaceans. It is apparently sluggish, though muscular and powerful, and is said, when hooked, to make little resistance.

It belongs to a species or group of closely-allied species haunting all the northern seas, and known by a great variety of names. Gunther appears to think that the fishes designated by all the following names belong to one widely distributed species, to which he assigns the name

LAEMARGUS BOREALIS,

With the following synonyms:—

Squalus carcharias, Linnæus, Muller and Otho Fabricius.
Squalus microcephalus, Bl. Sehn.
Somniosus brevipinna, Leseur and Storer, Fishes of Massachusetts.
Scymnus brevipinna, Dekay, Fishes of New York.
Squalus borealis, Scoresby.
Scymnus borealis, Fleming.
Laemargus borealis, Muller and Henle.
Somniosus microcephalus, Goode, Fish Commission, United States.

In England it is usually known as the Greenland Shark, and on the American coast bears the names "Nurse," "Sleeper," "Ground Shark," and "Dog Fish."

Its distinctive characters are thus given by Gunther and Day:—

All the fins small and spineless; two dorsal and a pair of ventral fins; skin uniformly covered with minute tubercles; nostrils near the extremity of the snout; no nictitating membrane to the eye; mouth with a deep oblique groove at the angle; the upper teeth small, narrow, conical, and in several rows (44 to 52 in a row); the lower teeth more numerous, also in several rows, flat, and each tooth having its front so much turned aside, that the inner margin forms the cutting edge, which is not serrated; spiracles of moderate width. The skeleton is wholly cartilaginous.

The colour is either very variable or changes easily under different circumstances. It is usually represented as gray or dusky above and lighter below; and Calderwood states that of two recent specimens which he examined, one, a young individual, was of a dull, slate colour, with a number of small white spots distributed irregularly over the surface of the skin. The other, of larger size, was of a more bluish tint and without white spots. One specimen which I saw at Metis seemed of a general gray or dull brown colour above, with slightly lighter bands on the sides. Another, which had been some time dead, was of a rich deep brownish colour above, with distinct zebra-like stripes of brown on the sides, and creamy white below. The colours probably differ under different circumstances, even during life; and preserved and dried skins usually fade into a uniform gray hue.

The measurements of my Little Metis specimen are as follows:—

	Feet.	Inches.
Total length	9	6
Girth behind pectorals	4	5
Nostrils behind point of snout	0	2
Snout to centre of eye	4	5
Do. to first gill opening	1	5
Width of mouth	0	8
Length of series of five gill openings	0	7

Last gill opening to base of pectoral.......	0	2
Length of pectoral........................	0	11
Breadth of do.	0	6¼
Snout to base of pectoral..................	2	4
Do. to first dorsal	4	0
Breadth of first dorsal....................	0	9
First to second dorsal......................	2	1
Length of second dorsal	0	5½
Second dorsal to origin of caudal..........	0	11
Length of caudal..........................	1	7
Depth of do. about	2	0
Pectorals to origin of ventrals........	3	6
Breadth base of ventral	0	6
Base to points of ventrals................	0	10½
Ventral to caudal	1	6

The Greenland shark seems to have its headquarters in the seas of that country and Spitzbergen, in which considerable numbers are taken annually for their oil. It ranges southward to Newfoundland and the New England coast, is found also on the west coast of America, and occasionally strays to the coast of Europe. Though a powerful creature, and said sometimes to attain to the length of 25 feet, it seems slow and sluggish in its habits, and haunts the bottom rather than the surface of the water. In addition to feeding on small fish and crabs, it is said to have the habit of devouring cod and other fish when caught in set lines, and is therefore not loved by the fishermen. In the arctic seas it is often seen to feed on the floating carcases of dead whales, around which these sharks are said to collect in great numbers. Scoresby states[1] that they are able to bite out large pieces of the flesh with their sharp cutting teeth. On the coast of the United States, it is said by the American naturalists cited above, to devour fish offal at the fisheries, and on this account has acquired locally the name of "gurry shark." Its flesh is not eaten on our coasts, but is said to be used as food by the Esquimaux. The liver of a

[1] Arctic Voyages.

large individual will yield as much as five or six gallons of oil.

It does not appear to be dreaded by man on our coasts, but in Greenland and on the Labrador coast the larger individuals seem sometimes to attack boats and canoes. Fabricius [1] states it is much dreaded by the Greenlanders, as it can bite through the skin bottoms of their kayaks and seize the legs of the occupants. Hence, when a solitary Greenlander in his kayak sees one of these animals, he generally takes to flight. They are believed to be attracted by the smell of putrid carcases, and also by any sound or noise; and as their presence scares away the fish, the fishermen keep silence in order not to bring them near. He remarks that it shows little fear of man, and states that when the Greenlanders are flensing the floating carcase of a whale. the sharks are often as diligently employed in feeding on it below the water. The Greenlanders occasionally take it with hook and line or with the harpoon.

Ballantyne, in his work on Hudson's Bay, tells a frightful story of an Indian who, when voyaging with his family in a canoe, was pursued by a large shark which attempted to upset the canoe, and failing in this, to break it up. The canoe beginning to give way, the terrified Indian seized his youngest child and threw it to the ferocious monster to secure his own safety. It is not, however, quite certain that this story refers to the present species; but if so, it would confirm the impression of the Greenlanders that large individuals impelled by hunger and, perhaps, accustomed to feed on the carcases of whales, may become dangerous to man. It is not likely, however, that they ever venture so near the shore as to attack bathers.

Calderwood thus describes two specimens taken on the Coast of Scotland and studied by him [2]:—

" The Greenland shark is described by the various ichthy-

[1] Fauna Greenlandica.

[2] Appendix to Fourth Annual Report of the Fishery Board for Scotland.

ologists as a fish rarely straying to the British shores. Its natural home is doubtless in the colder waters of the Arctic Circle, where it is said to occur in considerable abundance; but when its occurrence is compared with that of the more truly British sharks, it would appear to be at least as common in our waters as any other. Since 1803 there are records of its capture which go to prove that scarcely a year passes without one or more specimens being obtained, and it is worthy of note that nearly all these specimens were captured on the East Coast. The most southerly point from which this shark is recorded is the Seine, where one was taken in 1832. Three were caught off the Bell Rock in 1873, and two at Scarborough in 1878. Three specimens are recorded from Aberdeen, and two from the Dogger Bank, besides a number of single ones from different parts of the coast.

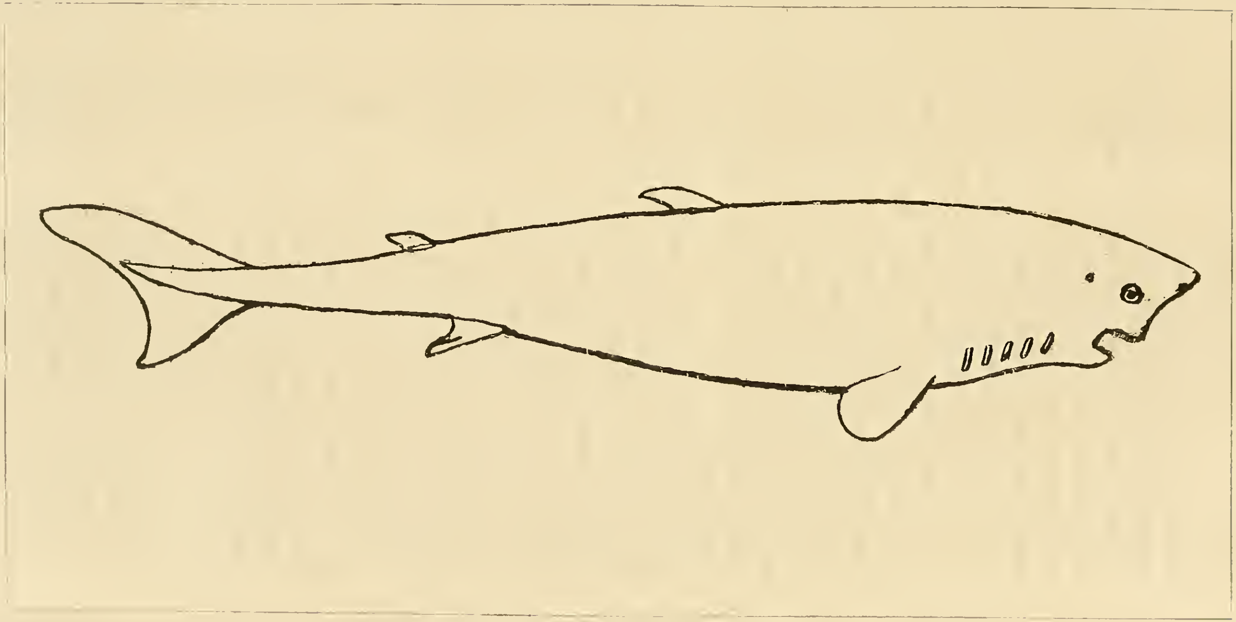
"The two which I dissected were caught, within a few days of each other, in January of this year. The first was a fine specimen 11 feet long, which was brought up by one of the trawlers of the General Steam Fishing Company 8 miles S.E. of the May Island. When it was slung up clear of the water, a cod and three baited hooks with snoods attached fell out of its mouth, and I afterwards found a large cod hook fixed in the gullet. Its stomach contained one herring, five cod, one conger eel, and a considerable quantity of partly digested fish.

"The second shark was only 5 feet long, and was caught by line fishermen. The stomach of this one contained three herrings and about a score of cuttle fish beaks."

The figure (Plate IV.) is an accurate outline of the specimen now in the Peter Redpath Museum.

Raiaerinacea, Mitchell.

Along with the shark above described, I obtained a specimen of a ray, or skate, which appears to be the species above named. Mitchell's species is referred by Gunther to *R. eglanteria* of Lacepede. My specimen is, however, so



LAEMARGUS BOREALIS. GUNTH.

different from the typical *R. eglanteria* that I am inclined to think it may be distinct. It is found at Little Metis, and is sometimes taken in the wears, or in fishing for halibut.

Specimens of British Wild Flowers in July and August.

By Rev. Robert Campbell, M.A., D.D.

My holiday in 1890 was spent in Great Britain. I was accompanied by two lady members of my family, to whom I was to act as guide to the most noteworthy scenes of the mother country, with which I was already familiar from having gone over the ground thoroughly on two previous occasions. It occurred to me that it would impart new interest to even old scenes if I should note the flora of the several districts visited; and I provided the simple apparatus which is sufficient to equip the botanist for field work, having first learned that the best book for general use, as applicable to the entire island, was Bentham & Hooker's British Flora. On subsequently visiting the herbarium of the Botanic Gardens of Edinburgh, under the guidance of Prof. Balfour, I found that the specimens in that fine collection are determined by this authority, and in arranging the collection which I present to the Society, I have numbered the specimens as they are named in Bentham & Hooker, so as to facilitate a reference to that text-book. This hint I obtained from Prof. Balfour.

During my eleven weeks' tour in England, Wales and Scotland I succeeded in collecting 481 of the 1,310 British species recognized by the best authorities, more than one-third of the whole. Of course, my botanical pursuits were subordinated to sight-seeing and visiting friends. Except an afternoon spent in Epping Forest, I may say that I never went out of my way to look for specimens. Making a collection was only an indirect object of my movements, so that I have no idea of claiming completeness for this one, for which my friend, Mr. Brown, has promised to find a place in the Society's Museum. But the considerable number of plants on which I stumbled shows how rich the grand old island is in flowers, as well as in men, money and merchandise, and how one may make his ordinary holiday serviceable in enhancing his knowledge, especially of this department of natural history, by keeping his eyes open. It may entail some inconvenience on the collector's companions if they are not animated with his enthusiasm, and large demands have to be made upon the forbearance of the friends whom he may chance to be visiting, as he spreads about his room each evening the spoils of the day's pursuit of specimens. But with all the drawbacks involved, and the labour and perseverance required in prosecuting the work successfully, it adds immensely to the enjoyment of a tour in Great Britain to pick up every new flower which one comes across and to which one can get legitimate access. You may excite the suspicion of foresters and gamekeepers, and you will certainly draw down upon you the wonder and pity of people everywhere that you should consider it worth while to be carrying away armsfull of what they call weeds; but all these little incidents will be gladly met, and whatever risks are run are more than repaid by the delight that is experienced in finding new specimens. There is no earthly joy comparable to that which flows from discovering at last some new plant for which you may have been on the lookout. Even an amateur botanist can in some measure enter into the feelings which are said to have moved the great Linnæus when he at last found a specimen of furze, *Ulex Europæus*, and kneeled down and thanked God for giving him this favour. On my former visits to Great Britain I paid no particular attention to its flora. Of course, no one could spend nearly two years tramping through that country without taking notice of the more showy of its plants. The foxglove, the broom, the whin, the heather, the harebell, the daisy, could not fail to attract the attention of the most unpractised eye, especially of a Canadian, to whom they were not familiar objects. But those plants which have to be looked for in the quiet recesses of the woods, or which modestly hide themselves by the brooksides, I knew nothing about practically. Great Britain was, therefore, to me an unexplored territory so far as its botany was concerned. Nine out of every ten species were new to me. You can; therefore, see what splendid field practice I had in gathering and determining this collection; as you can conceive, the elevation of spirits I felt when first I set my eyes on flower after flower of which I had often read, and which have entered so largely into the poetry and song of the mother country.

Landing at Liverpool on July 4th, that afternoon our company proceeded to Chester, and in walking round the walls of that venerable episcopal city I first broke ground, and succeeded in capturing a number of specimens: *Epilobium parviflorum* and *Sagina procumbens*, growing in large numbers out of the old wall; *Rubus fruticosus*, *Heracleum sphondylium*, *Ranunculus acris*, *Urtica urens* and *Bellis perennis*, that modest crimson-tipped flower which is the glory of every grass plot in Britain from March to November, and well earns its title *perenne* by lasting right through the year in well-sheltered nooks—these being among the rest. During the fortnight of our stay in London I succeeded in finding a number of plants in the neighbourhood of Crouch Hill; *Salvia pratensis*, *Tragopogon pratensis*, *Stellaria media*, *Erysimum cheiranthoides* and *Myosorus minimus* among them. I gathered a few plants in the park at Richmond, on the banks of the river at Hampton and Kew—the alluvial basin of the Thames, formed in the course of ages, being rich in vegetable productions. But the first really important addition made to my growing stock of British wild flowers was obtained in that part of Epping Forest which is nearest the metropolis, where I spent an afternoon. The heavy London clay soil yielded a large crop of *Cruciferæ*, *Ranunculaceæ* and *Caryophyllaceæ* in particular. Epping Forest is credited with twenty of these specimens.

My next stopping place was at Bridport, Dorsetshire, on the English Channel, where I spent a delightful week. This is a very paradise for the botanist. Had I been in search of one of the best hunting grounds in England for wild flowers, I could not have found a more fruitful county than Dorsetshire. From the lias of the coast, up through the green-sand and tertiaries, the geological formation gave promise of abundance of vegetable life. The sands, the chalks and the clays amply fulfilled this promise. Within a few miles a very great variety of specimens was found in profusion. So remarkably mild is the air on the coast, that in some of the sunnier spots even tropical plants are found to flourish in the open air. I made incursions into the neighbouring parishes of Allington, Charmouth and Whitchurch Canonicorum, and to the top of Golden Cap and Hardown Hill, crowned with terraces of flint. A lad belonging to the parish of Whitchurch has just succeeded in carrying off the Bishop of Salisbury's prize for the best collection of wild flowers made by the youth of his diocese. His Lordship suggested, a couple of years ago, that a varied and useful recreation might be found for the youth connected with the Church Sunday-schools in collecting and arranging under their several orders, and giving the local nomenclature of the immense variety of wild flowers with which the diocese abounds. The successful collection embraced 611 species, and I suppose I may congratulate myself upon gathering 75 new species in the same district in the course of four or five days.

A day's journey brought us next to the old Manor House of Tregwynt, Parish of St Nicholas, Pembrokeshire, South Wales, situated near the west coast, about half way between St. David's and Fishguard. This coast is swept by the Atlantic storms and is thus denuded of forests, but it is rich in botanical specimens. The soil prevailing is a dark grey loam, resting on carboniferous limestone and old red sandstone, with a buttress of Igneous rocks around St. David's Head. Here were *Senecios*, *Scabiosas*, *Hypericums*, *Scillas*, *Saponarias*, *Lychnises* and *Epilobiums* in great profusion. It was a difficult matter harvesting the fruits of the field here and at Bridport. It was *embarras de richesse.* Old newspapers were at a premium in both places, and it generally took the late evening hours and the early hours of morning to arrange the specimens and change the drying papers. Altogether, sixty-five new species of plants were gathered in this district.

The Braes o' Gleniffer, rendered classic ground by the sweet music of Tannahill, the glen lying at its base, made famous by the wit of its late laird, and the clay loam of the adjoining country of Ayr have also contributed their quota to this collection. Seamill is a small watering place on the Ayrshire coast, and the banks of the little stream that drives its "mill" I found one of my richest hunting grounds. Here and at Prestwick, Mauchline, and Mossgiel, where Burns ploughed down the daisies, sixty-two specimens were obtained. But the field that yielded the largest amount of results with the least toil and trouble was the island of Arran, or rather the district of Corrie on that island. The geology of Arran is an epitome of that of the whole of Scotland. From the granite on the top of Goatfell, flanked by micaceous and argillaceous slates, and on their edges red sandstones, with conglomerate and limestone intercalated, every variety of soil may be looked for within a radius of three or four miles, and as the coast is never visited by frost, *Laurinæ* and other tropical species grow luxuriantly at the highland village of Corrie. In this quarter I was able to add fifty-six new species to my collection.

Of course, the finding of new plants was now becoming more difficult. All those most frequently met with I had already secured. The flowers "born to blush unseen," had to be wooed and won from their retirement, or further progress was to be slow. Besides, July in England corresponds with August in Scotland, and so I was only coming in contact with the same general plants which I had previously seen in the south. When I visited the north a month later, I had no thought at first of touching either grasses or ferns, as I concluded I should have more than enough to do in harvesting the phanerogamous plants; but before I left Seamill and Corrie, I concluded that I had better divide my attention for the remainder of my holiday between the flowering plants and the *Gramineæ* and *Filices*.

This was a fortunate conclusion, because the banks of Loch Etive, a frith of the sea running far into the heart of Argyllshire, founded on igneous rocks, are very rich in grasses, while flowering plants are comparatively rare; and Glen Etive, with Inverliver and Glennoe, rich glens leading down to Loch Etive from the south, are credited with twenty-nine specimens.

The band of limestone bounding the north side of Loch Tay, in Perthshire, plunging under Ben Lawers, and rising in Glenlyon, with the granite and porphyry of the Ben, the King of Perthshire Hills, with its top 4,000 feet high, usually in the clouds, gave a few new specimens, as did also Balyukan near Pitlochrie. But my work was virtually done now. My search afterwards in the neighborhood of Eskbank, Dryburgh, Abbotsford and Melrose, added indeed a few more to my now somewhat unwieldy bundle of plants; but the summer flowers were over, and the autumn ones had not yet to any considerable extent begun to bloom. The season was in the main a favourable one for my undertaking. The spring and early summer were cold and wet, and this retarded the progress of vegetation, so that I got a good chance to make myself acquainted with some of the later spring flowers as well as the whole of the summer ones, and they were very fine. I was disappointed, however, with the September bloom; for it was the 19th of that month before I sailed from Liverpool. So far, nothing had appeared that would vie with our golden-rods and asters, the glory of our early Canadian autumn.

I could have wished to be able to compare my British collection with Canadian catalogues and note what species are common to both countries; but time did not allow of my doing this; but a few came under my notice. One general observation, however, I make, that the species is modified by the climatic and other conditions of the two countries, in Canada the same plant being usually sturdier than in Britain. This is true, for instance, of *Solidago virgo aurea* of the *Silene inflata*, called the *Silene cucubalus* in England, of the *Verbascum thapsus*, of the *Arctium lappa*, and of the *Epilobium Angustifolium*, among others that occur to me.

I have made a catalogue of the collection, but I wish to copy it for the duplicate specimens which I have retained for my private Herbarium. As soon as I have a little leisure to do this piece of clerical work, I shall have great pleasure in putting the catalogue in the hands of the curator of the museum.

On the Geology of Quebec City, Canada.

By Henry M. Ami, M.A., F.G.S.

(Of the Geological Survey of Canada.)

The researches of Sir William Logan, Mr. Billings, Dr. Sterry Hunt, Dr. Selwyn, Sir William Dawson, Prof. James Hall, Prof. Emmons, Prof. Walcott, Prof. Marcou, Dr. Ells, Prof. Lapworth, and many others on the geology of Quebec and its environs have made that region classic ground to the student of North American Geology. The famous Quebec group controversy, as well as its closely related friend, the Taconic question in geology, and the Lorraine-Hudson River problem, are all involved in the geologic history of Quebec. Much diversity of opinion has existed as to the exact geological position of some of the terranes at and about Quebec City, as also along the whole line of the great Appalachian or St. Lawrence-Champlain. Nor is this at all astonishing, seeing that profound dislocations exist, intricate foldings of strata occur, and several terranes are met within very narrow belts, faulted and folded together in anything but a simple manner, which requires exceedingly detailed and careful examination before satisfactory conclusions are arrived at.

The rocks forming the Citadel Hill or promontory of Quebec (Cape Diamond) have been assigned to different positions in the geological scale by different writers at different times. An elaborate review of these views is given in Dr. Ells' last report to Dr. Selwyn (1888) published by the Geological Survey of Canada, which includes from Dr. Bigsby's paper published in 1827, down to Prof. Lapworth's Report, etc., published in the Transactions of the Royal Society of Canada for 1887.

The rocks of Quebec have been referred by some of the geologists above named to the age of the Quebec Group (Levis Division) whilst others, and the majority at present regard them as newer than the Trenton limestone, viz.: being of "Trenton-Utica," "Utica-Hudson," or "Lorraine" age. But before assigning a definite position to the rocks of Quebec City in the scale of terranes in America, it is necessary for the writer to state that, so far, he has been unable to find any evidence in the field, either stratigraphical or palæontological, whereby the "Hudson River" rocks and "Lorraine" shales, as originally understood by Emmons, could be correlated, or referred to the same or immediately following geologic terrane.

The fauna of the Norman's Kiln shales, that of the Marsouin, of the Tartigo River, Griffin Cove and Gagnon's Beach Rocks, as well as that from Crane Island, N. W. or False Point of the Island of Orleans, Quebec City, Etchemin River, between St. Henry and St. Anselme, Drummondville, and other localities in Maine, Vermont, and New York States constitutes one large assemblage of forms peculiar to one terrane.

The fauna of the Lorraine shales, (Cincinnati era in part) on the other hand, as it is characterized at Montmorency Falls, Côte Sauvageau, in the St. Charles Valley near Quebec, at Charlesbourg (near the Church), two miles above St. Nicholas, Yamaska River, Rivière des Hurons, and in the undisturbed regions in Ontario at Ottawa, Toronto, Weston, Oakville, Collingwood, etc., intermediate between the Utica terrane and the base of the Silurian Epoch marks another terrane.

These two faunas, I hold, are very distinct both in their palæontological and stratigraphical relations. The Lorraine terrane, according to Dr. Selwyn's classification of formations ("Index to the Colours and Signs used by the Geological Survey of Canada,") has a definite position, viz., at the summit of the Cambro-Silurian or Ordovician system, The strata at Quebec, either on physical or palæontological grounds, cannot be referred to the Lorraine nor to the Utica, nor yet to the Trenton nor to the Black River formation.

Sir William Logan referred the Quebec city rocks to the Levis division of Quebec group. From examinations recently made, the fauna which Mr. Weston, Mr. Giroux, l'Abbé Laflamme and the writer have been able to obtain from the rocks of that locality, presents some fifty species of fossils, including graptolites, brachiopods, ostracods and trilobites, different from Levis forms and yet capable of being correlated with forms from a portion of the Quebec group of Logan, as described in his Newfoundland section, as also with Cambro-Silurian strata in the Beccaguimic valley of New Brunswick.

To state the precise geological horizon to which the strata at Quebec city belong, I hold, is perhaps premature. These rocks appear, however, to occupy a position in the Ordovician system higher than the Levis formation being akin to it, but lower than the Trenton, and probably an upward extension of that peculiar series of sedimentary strata occurring along the present valley of the St. Lawrence, which, owing to the peculiar conditions of deposition of the specialized fauna entombed. Sir William Logan advisedly classed under the term "Quebec Group." This would make the rocks at Quebec about equivalent to the Chazy formation of the New York and Ontario divisions.

As to the propriety of retaining the term "Hudson River" group, or terrane in geologic nomenclature, at present, there may be some doubt. Much confusion exists as to its use. It would very naturally follow, however, that some such designation as the "Quebec terrane" or "Quebec formation" would be most acceptable at this particular juncture in order to designate the horizon of the Quebec city rocks, and include those which constitute the citadel and main portion of Quebec city and other synchronous strata.

The term "Hudson River" is very extensively used throughout North American geological nomenclature to designate the highest series of strata in the Ordovician or Cambro-Silurian epoch. Its use is far more general than the equivalent term, "Lorraine," as defined and very carefully used by Emmons. One of the two terms requires to be dropped, and whilst neither term is objectionable and both have been used by various authors at different times to designate precisely the same horizon, it appears most practical now to retain the term which has been most extensively used and adopted in North American geology, viz., the term Hudson River or Hudson Terrane, whilst it is decidedly regrettable te drop Emmons' well-defined and clearly marked Lorraine. The adoption of the term Hudson River, in preference to the term Lorraine, would entail much less confusion, and would thus serve the ends of geological science more effectively.

Amongt the most characteristic and better known species of graptolites peculiar to the Quebec terrane may be mentioned the following:—*Cænograptus gracilis*, Hall; *Dicellograptus sextans*, Hall; *D. divaricatus*, Hall; *Dicranograptus ramosus*, Hall; *Diplograptus foliaceus*, Murchison; *D. Whitfieldi*, Hall; *D. marcidus*, Hall; *Climacograptus bicornis*, Hall; *C. bicornis*, var. *tricornis*, Lapworth; *Corynoides calycularis*, Nicholson.

In a paper which the writer is now preparing for the Royal Society of Canada, the various forms characterizing the Sillery, Levis and Quebec divisions of the Quebec Group in Canada as now understood, and constituting the natural series of sedimentary strata to which Sir William Logan had given that very appropriate term, will be tabulated and the palæontological grounds for the separation of these will then be very apparent and evident.

Aids to the Study of the Coleoptera of Canada.—No. 2.

On Some Little Known Canadian Coleoptera, with Descriptions of Two New Species.

By J. F. Hausen.

(With Plate V.)

Zilora, Muls.

The genus *Zilora* may be distinguished from the other genera of the melandryini of our fauna by the following characters :—

The antennæ are slender, not suddenly enlarged; frontal suture indistinct; maxillary palpi have the last joint wider than the preceding joints and securiform. The front coxæ, which are contiguous, are without trochantin, and the acetabula have on the outer side a distinct fissure ; the middle coxæ are separated, and the body clothed with erect hairs.

Only two species are known to me as occurring in the northern parts of America, one of which has been described from Canada. They appear to be rare.

Z. canadensis, n. sp. (Plate v, figs. 1 and 2).—*Fusco-castanea, elongata, sub-convexa, undique breviter haud dense pube suberecta vestita et punctulata ; subtus, antennis trophis pedibusque dilutioribus ; elytris haud striatis sulculo suturam versus a medio ad apicem extendente excepto ; prothorace latitudine breviore, antice angustato, lateribus rotundatis et subtiliter marginatis, anguils posticis subrectis, basi utrinque foveolato, medio sublobato et late rotundato. Long.* ·23 *unc. ;* 6 *mm.*

The head and thorax are somewhat darker and more densely and finely punctured than the wing-covers. The elytra are not very finely punctured, and with no trace of striæ except an impressed line along the suture extending from before the middle backwards, but interrupted before reaching the apex.

The pygidium extends slightly beyond the elytra, and in my specimen, which seems to be a male, the penis is protruded and bilobed at the extremity. The eyes are disengaged from the thorax, prominent and scarcely transverse. The front is indistinctly impressed between the eyes. Posterior tibiæ are slightly longer than their tarsi, of which the first joint is about equal to the three following. Taken at Montreal.

I have not had an opportunity of comparing this with the species described from New Hampshire by Leconte[1] as *hispida*, which is said to havo the foreæ of the thorax "*profunde et late impresso*," and the elytra "*obsolete sulcatis*."

It also seems to come near the European *ferruginea* figured by Duval,[2] but specimens will have to be carefully compared before they can be pronounced identical.

It is evidently distinct from *nuda* described from our territory by Abbé Provancher,[3] which is stated to be black, the thorax with a transverse impression at the base, which does not reach the angles, and the elytra without pubescence, while no mention is made of their being grooved at all.

I owe the privilege of describing this interesting little species to my friend, Mr. A. F. Winn, who has kindly placed the only specimen in his collection in my hands for this purpose.

---

[1] New Species of Coleoptera, pt. i, p. 148.

[2] Gen. Coleopt., Europe, iii, pl. 87, f. 432.

[3] Additions et Corrections à la Faune Coléoptérologique Province Québec, 1877.

PHILONTHUS STICTUS, n. sp. (Plate V, fig. 3.)

Crassiusculus subdepressus, subnitens piceo-niger, antennis pedibusque concoloribus ; capite subovato, basi subtruncato angulis posticis rotundatis, pubescenti et punctato, spatio medio lævi ; thorace vix latiore convexo, latitudine longiore, basi late rotundato, lateribus paullum rotundatis atque antice convergentibus, disco creberrime punctato linea dorsali lævi ; elytris thorace longioribus, postice paullo latioribus, convexiusculis, confertim non subtellissime punctulatis pubescentibus, stria suturali conspicua, sutura subimbricata ; abdomine thoracem elytra que conjuncta æquanti, valde marginato, confertim punctulato pubescenti. Long. ·31 *unc.* ; 7·9 *mm.*

Head a little longer than broad, parallel behind the eyes, with the hind angles rounded, punctured and pubescent, and furnished in addition with a few longer hairs. Antennæ rather stout, reaching the base of the thorax, first joint equalling joints two and three taken together, fourth to seventh subequal, remainder obconical, a little longer than broad, the last obliquely emarginate at the end, subacuminate. Thorax with the surface closely and rather coarsely uniformly punctured, except a smooth medean line, which has, however, a longitudinal impression before the base; somewhat pubescent, shining, with a few longer hairs, two of which (one on each side), a little before the middle, are conspicuous by their length. There are also one or two shorter ones at the front angles, which are rectangular. The elytra are somewhat wider behind, densely, confluently, but not finely punctured; the striæ of the left wing is more remote from the junction than the other, so that the suture appears imbricated, abdomen strongly margined, slightly iridescent, margins of fourth and fifth (apparent) dorsal segments piceous, pubescent, villose at the sides and behind; abdominal segments gradually increasing in length behind, convex, not finely punctured, fourth and fifth segments truncate at apex. Hind tarsi scarcely shorter than their tibiæ, first joint about equalling the three following joints.

This species, which is remarkable for the close punctuation of the thorax, bears considerable superficial resemblance to *Philonthus viridanus*, but differs from it in several important particulars.

It is broader and stouter, the sides of the thorax slightly rounded and converging in front, not almost parallel as in the latter species, and the punctuation of the thorax is also different. In *viridanus* the legs are also more or less testaceous. It is, perhaps, more of the form of *P. confertus*, but quite different in color.

Described from a single specimen (♀ ?) in my collection, captured at Lachine, Montreal Island.

HYDNOBIUS LONGULUS, Lec. (Plate V, figs. 4 and 5.)

Picco-castaneous, elongate, convex, elytra finely and rather inconspicuously striate, the sutural stria deeper, interspaces flat, somewhat densely punctulate. Thorax transverse, much less deeply and densely punctured than the wingcases and more shining, finely margined at the sides, apex truncate and with rounded hind angles. Labrum deeply emarginate and villose. Male femora provided near the end with a large tooth, which is obliquely truncate at the apex Length ·12 in.; 3·5 mm.

Collected by Dr. A. R. C. Selwyn, Director of the Geological Survey, in British Columbia, and by him presented, with other coleoptera from the same locality, to the Society.

LIMONIUS STIGMA, Herbst. (Plate V, fig. 6.)

Elater stigma, Herbst, 10, 86, tab. 166, f. 1.

Elater armus, Say, Trans. Am. Phil. Soc., 6, p. 171.

Gambrinus armus, Lec., Revision Elateridæ U. S., Trans. Am. Phil. Soc., 1853, p. 435.

Black, shining, tinted with æneous, more especially the thorax, with short grey pubescence, rather convex, punctured. Prothorax convex; the surface rather distantly punctured, slightly channelled at the middle behind; the sides behind the middle are parallel, then at the middle somewhat suddenly obliquely narrowed to the front. The sides are obtusely angulated before the anterior angles, which are dentiform. Elytra with rather strongly punctured furrows, the intervals also densely punctured, the sides parallel and obtusely rounded at the tip, third and fourth striæ confluent before reaching the extremity. The humeri are covered with a conspicuous red spot; tarsi piceous. Variable in size, ·25-·37 in.

CORYMBITES HAMATUS, Say. (Plate V, fig. 7.)

Elater hamatus, Say, Tr. Am. Phil. Soc., 6, 170.
Corymbites hamatus, Lec., *loc. cit.*

Robust, head and thorax black, rather finely densely punctured, the punctures almost concealed by the short yellow pubescence. Thorax convex, with the sides rounded, the hind angles moderately divergent, disk channelled at the middle near the base; sides, hind angles and inflexed portion of the thorax, as well as the anterior lobe of the prosternum rufo-testaceous. Elytra pale yellow, with a brownish curved spot near the extremity, and the suture also infuscate behind. The elytral striæ are well marked, with the intervals convex and densely punctured; antennæ brown, second and third joints nearly equal; legs brown testaceous.

Length ·43; 11 mm.

New Jersey (Geux), Ontario, Montreal.

GNORIMUS MACULOSUS, Kn. (Plate V, fig. 8.)

Cetonia maculosa, Knoch.
Trichius maculosus, Schönherr.
Trichius bigsbii, Kirby, Zool. Journ., iii, 155, t. v., f. 7; Fauna Bor. Am., Pt. IV, p. 136.
Gnorimus dissimilis, Gory.

Black, ovate, variously spotted and villose with yellowish hairs; head quadrangular, front margin reflexed and emarginate, antennæ and legs black, sometimes more or less luteous, vertex occasionally with a yellow-white longitudinal spot. Thorax narrowed in front, sub-angulated at the sides, broadly lobed at the base, which is sinuate on each side of the middle, densely but not finely punctured, and villose with yellow hairs, the surface not or variably maculate with numerous yellow spots. Elytra luteous, with a slight bloom, and usually with nine black spots arranged transversely, two in front, three at the middle and two behind the middle, the humerus and apical gibbosity also black and shining. Tarsi piceous. The pygidium is often covered with dense yellow-white scales. Very variable in color, another individual in my collection being almost entirely black, the elytra alone having four rufous spots in the middle and two indistinct ones near the scutel.

Length ·53 in.; 13·5 mm.

Lake St. Clair (Bigsby), Ontario (Kilman), Montreal (Cushing).

Mr. Cushing tells me he took it on thorn blossoms in spring. Uncommon.

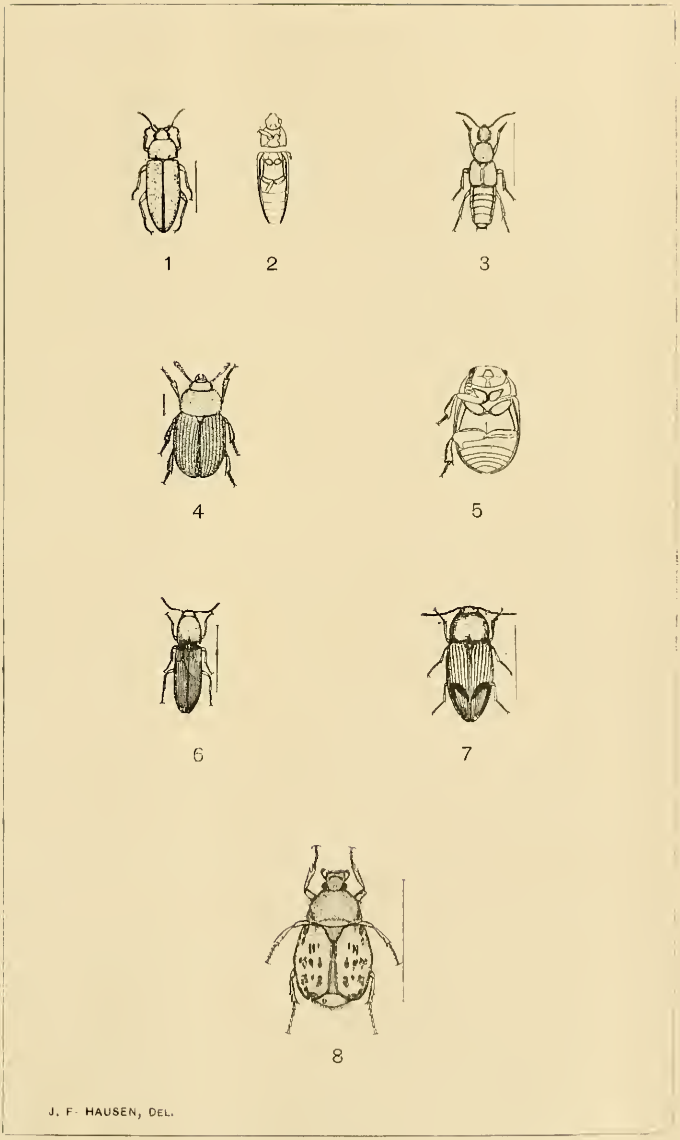
EXPLANATION OF PLATE V.

Fig. 1. Zilora canadensis, n. sp.
" 2. " " seen from beneath to show details.
" 3. Philonthus stictus, n. sp.
" 4. Hydnobius longulus, Lec., ♂.
" 5. The underside of the same to show structure.
" 6. Limonius stigma, Herbst.
" 7. Corymbites hamatus, Say.
" 8. Gnorimus maculosus, Knoch.

Errata.

The following errors, partly clerical, partly typographical, occur in my paper in the last number of this magazine:—

Page 252, l. 17 from top, instead of *stenopus* read stenops.
" 252, l. 28 " " " *sullcatis* read sulcatis.
" 252, l. 31 " " " *simplictus* read simplicibus.
" 253, l. 20 " " " *points* read joints.
" 253, l. 31 " " " *freely* read feebly.
" 253, l. 34 " " " *stenopus* read stenops.
" 254, l. 15 " " " *stenopus* read stenops.



HAUSEN ON CANADIAN COLEOPTERA.

The Royal Society of Canada.

By John Reade, A.M.

The Royal Society of Canada owes its existence to the thoughtful interest of Lord Lorne in the intellectual progress of Canada. The movement out of which its organization arose was inaugurated in 1881. Already its enlightened founder had established a Canadian Academy of Arts, for the encouragement of design as applied to painting, sculpture, architecture, engraving and the industrial arts, and the promotion and support of art education. The success which had attended the formation and early proceedings of the institution led his Lordship to believe that a national organization which would be to science and literature what the Academy was to art would be of real service to the cause of the higher intellectual culture in the Dominion. After consulting with the leading men of science and letters, both French and English, his Lordship invited the gentlemen whom he had designated as provisional officers of the proposed organization to meet in Montreal. The meeting accordingly took place on the 29th and 30th of December, 1881, and thereat a memorandum from Lord Lorne on the subject was read and considered.

A provisional basis was then agreed upon for the constitution of the new society, the first meeting of which took place at Ottawa on the 25th of May, 1882. The Governor General (Lord Lorne) had invited the members of the provisional council to Government House for the settlement of the procedure, and the arrangements proved entirely satisfactory. The Council consisted of Principal (now Sir) J. W. Dawson, C.M.G., LL.D., F.R.S., President; the Hon. P. J. O. Chauveau, LL.D., Docteur des Lettres, Vice-President; and the Presidents and Vice-Presidents of sections: J. M. LeMoine, Esq., and Faucher de St. Maurice, Esq., first section; Dr. (now Sir) Daniel Wilson, F.R.S.E., and Goldwin Smith, Esq., D.C.L., second section; Dr. T. Sterry

Hunt, F.R.S., and Charles Carpmael, Esq., third section, and Dr. A. R. C. Selwyn, F.R.S , and Dr. George Lawson, Ph.D., fourth section; J. G. Bourinot, Esq., F.S.S., Honorary Secretary. All these members of Council were present except Dr. Goldwin Smith, then absent in England.

At the general business meeting, held in the railway committee room, Parliament Building, Ottawa, on the morning of the 25th of May, the Honorary Secretary read the Council report, the recommendations of which were afterwards embodied in the charter and constitution of the Society. The formal public inauguration of the Society took place in the Senate Chamber, at 4 o'clock in the afternoon. Members of the Society having been presented to the noble Founder, His Excellency set forth the aims of the Society, and expressed the hope that its formation would promote the intellectual development of the Dominion in the higher ranges of thought, letters and research. "Imperfections," said his Lordship, " there must necessarily be at first in its constitution—omissions in its membership and organization there may be. Such faults may be hereafter avoided. Our countrymen will recognize that in a body of gentlemen drawn from all our provinces and conspicuous for their ability there will be a centre around which to rally. They will see that the welfare and strength of growth of this association shall be impeded by no small jealousies, no carping spirit of detraction, but shall be nourished by a noble motive common to the citizens of the republic of letters and to the students of the free world of nature, namely, the desire to prove that their land is not insensible to the glory which springs from numbering among its sons those whose success will become the heritage of mankind.

The President, in his address, mentioned some of the reasons which, in his opinion, justified the institution of such a body in Canada. If the idea had been broached in the past, it had been abandoned owing to obvious difficulties. But it had at last presented itself under happier conditions which gave fair hopes of success. It was fitting that the representative of a Sovereign, whose rule had been so favorable to culture and research in the United Kingdom, would show himself the patron of letters and science in the new world. The time, moreover, was auspicious. Political consolidation had been drawing nearer to each other the once scattered and isolated scientific workers of the North American provinces. Such a society would be to them a bond of union and sympathy, and by the interchange of ideas would supply a needed stimulus to men of kindred pursuits. It would, by the publication of its Transactions, be of incalculable benefit to Canadian naturalists, hitherto so largely dependent on foreign aid for placing the results of their labors, in a worthy form, before the world. As a centre of literary and scientific effort, it would, without interfering with the claims of older local societies, be of very real help to them. Comparing Canada with other countries, the President thought it was rather matter for surprise that so many persons amongst us had won distinction in the paths of research and of letters than that there were not more. Finally he spoke of the great responsibility of the members, and he hoped that by earnest and united effort they would prove themselves deserving of the name to which they aspired. The Vice-President set forth in French, with his customary grace of style, the intellectual progress that Canada had already achieved, dwelling especially on its literary, as Dr. Dawson had dwelt on its scientific aspects. He trusted that the Royal Society would prove a common meeting ground not only for scientific and literary workers, but also for the culture of the two great races whose lot was cast together in this broad Dominion.

The Society then separated into sections. Fifty-six papers, embracing nearly all the departments of research, were either read or presented at the first meeting, and of these thirty-three were published in the Transactions. Referring a year later to the general results of the meeting Sir William Dawson was able to express a high degree of satisfaction at what had so far been accomplished. "We have occasion," he said, "to congratulate ourselves on the reception which our inaugural meeting met with at the hands of the public and the newspaper press. Everywhere the institution of the Society was recognized as wise and beneficial, and if any doubts were expressed with reference to it, they were based not on hostility to the Society, but on a very natural diffidence as to the capacity of Canada, in its present state of development, to sustain a body comparable with the great national societies of other countries. The amount of original work produced at our first meeting was evidently an agreeable surprise to many; and while there was some friendly criticism by which we may hope to profit, on the whole our debut was regarded with that feeling at once kindly, considerate and patriotic which becomes all true Canadians in witnessing any effort, however feeble, to sustain and exalt the greatness of our country."

Meanwhile the Society had obtained the recognition of the Queen and of the Canadian Parliament. A letter from Lord Kimberley, Secretary of State for the Colonies, dated the 22nd of August, 1882, to the Marquis of Lorne, gave the pleasing information that Her Majesty had graciously permitted the Society to be styled "The Royal Society of Canada." On the 1st of March, 1883, a Bill to incorporate the Society was introduced in the House of Commons by Mr. Tassé. It was read a second time on the 19th of the same month, and on the 6th of April it was considered in committee, read a third time and passed. It received the royal assent on the 25th of May.

Rule 11, regarding the affiliation of local literary and scientific societies throughout the Dominion, has proved most fruitful in concentrating and developing the intellectual efforts of all the provinces of the Dominion. In

1883 twelve societies responded to the Hon. Secretary's invitation by sending delegates. This number has increased from year to year, until now there are altogether twenty-four literary, scientific, philosophical and historical societies represented in the Transactions. The full reports of their proceedings submitted by these organizations of kindred aim are extremely valuable, as indicating the work that Canada is doing in the various fields of scientific research, historical investigation and literary creation or criticism. Some of the delegates have contributed records covering the whole period of their society's existence—records of undoubted interest and value to the future historian of our intellectual progress. The following is a list, in the order of their seniority, of these

AFFILIATED SOCIETIES.

Literary and Historical Society of Quebec	1824
Natural History Society of Montreal (Incorporated, 1832.)	1827
Institut Canadien, Quebec	1846
Canadian Institute, Toronto	1851
Institut Canadien, Ottawa	1852
Hamilton Association, Hamilton	1856
Société Historique, Montreal	1858
Nova Scotia Inst. Natural Science	1862
Natural History Society, New Brunswick	1862
Numismatic and Antiquarian Society, Montreal	1862
Entomological Society of Ontario	1863
Ottawa Literary and Scientific Society	1869
Murchison Scientific Society, Belleville	1873
Nova Scotia Historical Society	1878
Ottawa Field and Naturalists' Club	1879
Geographical Society of Quebec	1879
Historical and Scientific Society of Manitoba	1879
Society for Historical Studies, Montreal	1885
Cercle Littéraire Français, Montreal	1885
Cercle A. B. C. (Philosophical), Ottawa	1886
Canadian Society of Civil Engineers	1888
Wentworth Historical Society, Hamilton	1888
Society of Canadian Literature	1889
Natural History Society of British Columbia, Victoria	1889

Though the work the sections can hardly be said to have been fairly divided, some members contributing much more than others, while of a certain number the names have been conspicuous by their absence from the yearly programmes; it may, on the whole, be said that the promise of the opening session has been fulfilled in the successive meetings of the last eight years. In their chosen branches of study and research, all the four sections have added not a little to the sum of the world's knowledge, and if this total be enlarged by the aggregate of work done by the affiliated societies, the whole makes an intellectual product of which the Dominion has no reason to be ashamed.

The points most criticized in the constitution of the Society were the combination of science and literature and its bi-lingual character. As to the former, the first President took occasion, in the address already quoted from, to show that, instead of being a drawback, it was an advantage. After indicating the close relations between the two departments of intellectual effort, he thus expressed his satisfaction at the Society's comprehensiveness:—" For these reasons I rejoice that our Society embraces both science and letters, and I am profoundly convinced that it is for the highest interest of Canada that her scientific men shall be men of culture, and that her literary men shall be thoroughly imbued with scientific knowledge and scientific habits of thought." In a paper read before the Society on the relation of such bodies to the State, the late Dr. Todd showed that New South Wales had anticipated Canada by forming a Royal Society on the like broad basis, its avowed object being " the encouragement of studies and investigations in science, art, literature and philosophy." Lord Lansdowne also expressed his satisfaction at its twofold division, which, he said, greatly enhanced the interest and value of the Transactions.

As to the other point which was the subject of discussion—the union of French and English-speaking members—

so far from proving an obstacle to the Society's usefulness, it has been one of its most fruitful features. The French and English sections have, by their harmony and good-will, set an example which the whole Dominion might follow with advantage. Differences of race and creed have been revealed only by mutual courtesy and willing co-operation in the grand aims of the Society. From the rule of kindliness and deference there has been, from the opening of the first to the closing of the last meeting, no instance of departure. It is also noteworthy that the Society has been the means of renewing relations between the two branches of the French race in the new world—that of Canada and Acadia, and that of Louisiana—the *Athénée Louisianais* of New Orleans, being one of the first of foreign organizations to respond to the invitation of the Honorary Secretary. In the list of the corresponding members, moreover, eminent sons of the French race have their places along with illustrious Anglo-Saxons of both hemispheres. Had the Society effected nothing else than these exchanges of cordial sympathy, it would not have lived altogether in vain.

The letters from eminent foreign societies which greeted the entrance of Canada into their illustrious sisterhood were most gratifying. M. Camille Doucet, perpetual secretary of the French Academy, in acknowledging the Hon. Secretary's invitation to the Institute of France to send a delegate to the meeting at Ottawa, said that Dr. Bourinot's letter had been received with the most cordial sympathy by each of the five Academies that constitute that great centre of universal learning.

The circulation of the Transactions has done much to make Canada better known at the chief seats of enlightenment in the Old World. "Not a week passes, says the report of the Council for 1887, "without some evidence being furnished of the attention that the papers are receiving in cultivated circles abroad, and requests for the volumes are constantly at hand from various centres of intelligence to which they have not hitherto been sent. Only a fortnight ago, for instance, the Hon. Secretary received some very interesting volumes from the Imperial University of Japan, at Tokio, with an expression of the wish that the Transactions should be regularly sent to that institution." More than six hundred copies are thus distributed every year, and that they do not lie unread on dusty shelves is shown by the best of evidence—the extent to which they are quoted in works dealing with the themes of which they treat.

Apart from its relations to the centres of learning and research in other lands, and its attractive potency on the scattered circles of local intellectual effort in the Dominion, the Royal Society plays a not unimportant *rôle* in connection with the State. This phase of its usefulness (which has hardly yet, perhaps, been allotted due significance) was very clearly illustrated in a paper read by the late Dr. Alpheus Todd, C.M.G., before the Society not long before his death. Citing the example of New South Wales, which was the first of the British Colonies to establish a Royal Society, he commended the statesmen of that great country for availing themselves of the co-operation of learned and capable advisers to advance the public welfare in matters that lay distinctly apart from the domain of party politics. In so doing, however, they were simply following the precedent of the motherland, which had long assigned to the Royal Society of London certain duties of a scientific nature which it was peculiarly qualified to discharge. The application of the same principle in Canada was a logical sequel of the formation of such a body. The same subject was very appositely though indirectly treated by the first President in his second address (1883), wherein he outlined the progress already achieved mainly through the Geological and Natural History Survey and the provisions for science teaching in the Universities. A perceptible stimulus was given to the scientific movement in Canada, both in its practical and scientific aspect, by the departure of the British Association from its narrower early traditions in consenting to hold a meeting in Montreal. In that meeting (1884) members of Canada's Royal Society took an active part, and among the subjects which they chose for their papers there were several which had a distinct relation to the State—such as those on Standard Time, on Tidal Observations on Canadian Waters, on our Mineral Resources, on various branches and details of economic science, and on questions pertaining to our native races.

But, in reality, it is not occasionally but always that the Royal Society is, in sympathy, aspiration and the sphere of its labors, in close relation to the State and the needs of the country at large. Such relation arises necessarily from the fact that the membership of the scientific sections is so largely composed of officers of the scientific departments of the Government. The head of the Geological Survey and the principal members of his staff, the Surveyor-General, the director of the Experimental Farms, the chief Analyst, the head of the Meteorological Service, the director of State Telegraphs, the Government Entomologist, more than one *emeritus* official of high standing, and the several members of corresponding services in the provinces—these, with representatives of the Universities occasionally employed in public functions, form a sort of State Council on the whole range of important questions in which scientific knowledge and experience are essential to the general welfare. An examination of the contents of the Transactions for any and every year will, in fine, furnish convincing proof of the alliance between the Royal Society and the State, and of the benefits which the former renders to the latter.

BOOK NOTICES.

THE BIRDS OF GREENLAND.[1]—This work, edited by Montague Chamberlain, consists of two parts—the first, an annotated list of the birds of Ivigtut, by A. T. Hagerup, is based upon observations made at that place during a residence of fifteen months, published in the Auk, Vol. VI, Nos. 3 and 4. An additional fifteen months' residence at the same locality has enabled the author to "add considerably" to his former notes and to correct a few errors that had crept in.

Much interesting information is given respecting the habits of many species, particularly with regard to nesting and migration. Considerable attention appears to have been given to the vexed question of the Gyrfalcons, with the result that "as Holboll and Fencker repeatedly observed mated pairs, one of which was white (*F. islandicus*) and the other dark (*F. rusticolus*), and as Holboll also found light and dark young in the same nest, I conclude that there is only one species of Gyrfalcon found in Greenland." This certainly is strong evidence, but it is weakened by the statement that the light-colored birds breed chiefly in North Greenland, while the dark birds are chiefly restricted to South Greenland; perhaps further observations may show that they are now equally distributed. The second part, a Catalogue of the Birds of Greenland, "is based on the works of Holboll, Reinhardt, Alfred Newton Ludwig Kumlien and others. Use has also been made of the late Alfred Bewgon's collection of birdskins and eggs," and the author's own observations add much to its value. "The Catalogue comprises all the birds discovered up to date in that part of Western Greenland which is settled by the Danes, namely, the country lying south of 73° N. lat. This is divided at 68° N. lat. into North Greenland and South Greenland. Of the one hundred and thirty-nine species here enumerated, one is extinct, and fifty-three are merely accidental stragglers, while twenty-four others are so rare that they might be classed with the accidentals, leaving but sixty-one species that should be recognized as regular inhabitants of Greenland, and of these several are of quite uncommon occurrence. M.C."

The whole work forms a convenient handbook, its value being much enhanced by Mr. Chamberlain's critical notes, his knowledge of our northern forms pre-eminently fitting him for the task. It will be welcomed by all interested in the avifauna of Greenland.

F. B. C.

---

[1] The Birds of Greenland. By Andreas T. Hagerup. Translated from the Danish by Frimann B. Arngrimson. Edited by Montague Chamberlain. Boston: Little, Brown & Co., 1891.

Proceedings of the Society.

The fourth monthly meeting was held on Monday evening, Feb. 23rd, 1891, the President, Dr. Harrington, presiding.

On behalf of the Lecture Committee, Dr. Harrington reported that arrangements for the Somerville course had been completed, and that the first lecture would be delivered on the 17th of March, by Mr. J. M. Lemoine of Quebec.

The Curator reported the donation of a female Goshawk by Mr. E. D. Wurtele, to whom a vote of thanks was tendered.

The librarian reported the usual exchanges.

The following were elected ordinary members of the Society:—Mr. James Oxley, Prof. Charles Carus-Wilson and Prof. John Cox.

Dr. Archibald Campbell, who was about leaving for Colorado on account of ill health, was elected corresponding member.

Sir William Dawson then presented a paper on "Some Interesting Fishes from the Lower St. Lawrence." This paper was of a most interesting and instructive nature, and will be found in full in the present number of the *Record* It was illustrated by finely prepared specimens, and called forth many remarks from those present.

Dr. Ruttan also read a paper on "A form of Apparatus for Collecting Traces of Suspended Matter in Drinking Water." The author exhibited a simple but most efficient form of apparatus for collecting sediment from drinking water in process of analysis. The usual vote of thanks was tendered the authors of these papers.

The fifth monthly meeting of the Society was held on Monday, March 30th, 1891, Dr. Harrington presiding.

The routine business having been disposed of, Rev. Dr. Campbell presented a most interesting paper on "Wild Flowers of Great Britain in July and August." The paper was illustrated by a large collection of British wild flowers, which Dr. Campbell presented to the Society as the nucleus of a New Herbarium. A hearty vote of thanks was tendered the author for his paper and his valuable donation.

The sixth monthly meeting of the Society was held on Monday evening, April 27th, 1891. In the absence of the President, Mr. J. S. Shearer took the Chair.

The Field Day Committee reported that they recommended Calumet as the place of holding the next annual excursion in connection with the visit of the Royal Society of Canada. The report was adopted.

The Curator reported the following donation :—

Golden Wyandotte from Mr. Ulley.

The Librarian reported the usual donations of books, also fine photographs of Carboniferous Batrachians from the coal formation of Nova Scotia, and several authors' reprints from Sir William Dawson.

Dr. J. M. Stirling then presented a paper on "Our present knowledge of the projection of sound in space by the human ear," illustrating the same with beautiful diagrams. The paper called forth a very valuable and interesting discussion by the various members.

On suspension of the rules, Mr. R. W. McDougall was elected an ordinary member, and Mr. J. F. Hausen a junior member.

Notes.

At a meeting of the Biological Society of Washington, on February 7, Mr. Charles D. Walcott, of the U. S. Geological Survey, announced the discovery of vertebrate life in the Lower Silurian (Ordovician) strata. He stated that "the remains were found in a sandstone resting on the pre-Palæozoic rocks of the eastern front of the Rocky Mountains, near Canon City, Colorado. They consist of an immense number of separate plates of placoganoid fishes, and many fragments of the calcified covering of the notochord of a form provisionally referred to the Elasmobranchii. The accompanying invertebrate fauna has the facies of the Trenton fauna of New York and the Mississippi valley. It extends into the superjacent limestone. and at a horizon 180 feet above the fish beds, seventeen out of thirty-three species that have been distinguished are identical with species occurring in the Trenton limestone of Wisconsin and New York. Great interest centres about this discovery from the fact that we now have some of the ancestors of the great group of placoderm fishes which appear so suddenly at the close of the Upper Silurian and the lower portion of the Devonian groups. It also carries the vertebrate fauna far back into the Silurian, and indicates that the differentiation between the invertebrate and vertebrate types probably occurred in Cambrian time." Mr. Walcott is preparing a full description of the stratigraphic section, mode of occurrence and character of the invertebrate and vertebrate faunas, for presentation at the meeting of the Geological Society of America, in August next.

At the annual general meeting of the Geological Society of London, held on Feb. 20th last, the Bigsby medal was awarded to Dr. G. M. Dawson of the Geological Survey of Canada. This is a well deserved honour which Canadians will fully appreciate.

Following closely upon the award of the Bigsby medal, McGill University, through the initiative of its Graduates Society, has added one more to the list of honorary degrees worthily bestowed, by conferring upon Dr. G. M. Dawson, at its last convocation, the degree of Doctor of Laws.

We have just received from Mr. F. J. Hanbury a portrait sketch, reprinted from the Journal of Botany for December, 1890, of the late James Backhouse. Mr. Backhouse was chiefly known for his monograph on the British Hieracia, though his explorations in various parts of Great Britain and his close and accurate knowledge of the British flora, gave him great pre-eminence, especially in connection with the work instituted by his father, James Backhouse, sr. Mr. Backhouse died at West Bank, York, England, on the 31st August, 1890.

An interesting little pamphlet has recently been placed in our hands by Mr. Henry Mott. It is the "Objects and Constitution of the Botanical Society of Montreal." This Society was organized March 28th, 1855, under the direct inspiration of Dr. James Barnston. Its officers for the year 1856, embraced such names as those of Sir Wm. Dawson, Dr. T. Sterry Hunt, J. G. Barnston, Dr. James Barnston and Rev. Alex. F. Kemp. The Society was short lived, and it is a matter of regret that it could not have been perpetuated.

The local committee have just issued a little pamphlet in connection with the forthcoming meeting of the Royal Society of Canada, which contains much useful and interesting information. The larger part of the publication is devoted to the Royal Society itself, its organization and work up to the present time. There are also articles dealing with the Zoology and Botany of the immediate vicinity, as well as information more directly applicable to the immediate requirements of visitors during their sojourn in the city.

Y,1891.

t. C. H. McLEOD, *Superintendent.*

DA	DED HS. Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	10	00	0.04	Inapp.	0.04	1
	10	00	0.29	Inapp.	0 29	2
	0	96	....	....	....	3
SUNDAY.	..	60	....	....	....	4 ....SUNDAY
	7	56	....	....	....	5
	10	00	....	2.7	0.12	6
	0	78	...	....	....	7
	0	93	....	....	....	8
	0	00	...	...	...	9
	10	04	....	Inapp.	0.00	10
SUNDAY	..	00	....	8.0	0.80	11 .... SUNDAY
	0	00	0.09	0.2	0.11	12
	0	97	....	..	....	13
	0	05	....	2.7	0.20	14
	0	00	....	2.4	0.21	15
	0	82	....	0.2	0.02	16
	0	31	....	Inapp.	0.00	17
SUNDAY.	..	60	.....	Inapp.	0.00	18 ....SUNDAY
	3	50	......	Inapp.	0.00	19
	1	54	....	Inapp.	0.00	20
	10	00	....	1.4	0.11	21
	10	00	0.81	0.2	0 92	22
	4	16	Inapp.	Inapp.	0.00	23
	10	00	....	0.5	0.03	24
SUNDAY.		16	....	Inapp.	0.00	25 .... .SUNDAY
	1	49	....	0.2	0 02	26
	10	00	....	0.2	0.02	27
	9	33	.	Inapp.	0.00	28
	10	15	....	1.0	0 29	29
	6	28	0.06		0.06	30
	4	36	....	1.3	0.06	31
....	..	29.0	1.29	21.0	3.30	Sums ....
17 yrs. m including	..	¶33.0	0.87	29.8	3.66	17 years means for and including this month.

nd | giving a range of 1.845 inches. Maximum relative humidity was 100 on 7 days. Minimum relative humidity was 52 on the 26th.

Direction

Miles ....

Duration

Mean velc he th, es.

Rain fell on 6 days.
Snow fell on 23 days.
Rain or snow fell on 24 days.
Rain and snow fell on 5 days.
Hoar frost on 1 day.
Lunar halo 1 night.
Fog on 3 days.

Greates he
Greates
the 23rd. on
Resulta th,

NOTE.—Figures and letters, under wind, in bold face type, are from the City Hall record, the mileage of which has been multiplied by 1.25 in order to reduce it to the mountain anemometer.

ABSTRACT FOR THE MONTH OF JANUARY, 1891.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	* BAROMETER. Mean.	§ Max.	§ Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	10.43	34.0	—6.9	40.9	29.9117	30.197	29.547	.650	.0642	78 6	5.2	S.W.	13.1	10.0	10	10	00	0.04	Inapp.	0.04	1
2	31.37	38.5	18.5	20.0	29.4538	29.725	29.315	.410	.1638	87.0	27.8	N.	**16.9**	10.0	10	10	00	0.29	Inapp.	0 29	2
3	6.48	19.1	2.0	17.1	30.1722	30.329	29.910	.389	.0410	71.2	—1.0	....	....	0.0	0	0	96	....	....	....	3
SUNDAY 4	......	8.0	—4.0	12.0	....	......	......	....	.....		....	....	....	...	..	..	60	....	....	....	4 ....SUNDAY
5	11.58	15.9	6.0	9.9	30.1500	30.217	30.116	.101	.0607	81.8	7.2	....	......	9.0	10	7	56	....	....	....	5
6	16.37	20.2	12.8	7.4	30.0942	30.154	30.054	.100	.0785	85.7	12.8	**N.E.**	**14.7**	10.0	10	10	00	....	2.7	0.12	6
7	20.27	25.4	15.6	9.8	30.1980	30.329	30.110	.219	.0752	69.0	12 0	**N.W.**	**13.6**	3.7	10	0	78	...	....	...	7
8	14 18	21.2	9.2	12.0	30.5073	30 578	30.418	.160	.0602	72.7	7.2	**N W.**	**12.7**	0.0	0	0	93	....	....	....	8
9	14.27	20.0	3.7	16.3	30.4152	30.572	30.253	.319	.0713	84.3	10.5	S.W.	16.7	6.7	10	0	00	...	...	..	9
10	21.20	24.9	16.8	8.1	30.1880	30.272	30.128	.144	.1013	89.7	18.5	S.W.	14.9	10.0	10	10	04	...	Inapp.	0.00	10
SUNDAY 11	......	24.1	14.0	10.1	....	......	......	....	.....	....	....	N.E.	13.8		..	..	00	....	8.0	0.80	11 .... SUNDAY
12	22.72	30.1	10.6	19.5	29 1155	29.462	28.874	.588	.1102	84.7	16.8	S.W.	14.7	8.3	10	0	00	0.09	0.2	0.11	12
13	—1.85	11.3	—8.3	19 6	29.7587	29.885	29.566	.319	.0313	75.3	—8 0	S.W.	15.5	2.0	10	0	97	....	.	....	13
14	—2.78	3.7	—10.5	14.2	29.7828	30.009	29.651	.358	.0345	90.7	—5.2	N.E.	17.9	8.5	10	0	05	....	2.7	0.20	14
15	4.50	17.0	—4.7	21.7	30.2520	30.354	30.124	.230	.0465	84.0	0.5	S.W.	19 6	6.7	10	0	00	....	2.4	0.21	15
16	—6.68	10.5	—11.9	22.4	30.6578	30.719	30.525	.194	.0242	75 8	—12.8	N.E.	12 4	0.2	1	0	82	....	0.2	0.02	16
17	—1.18	13.8	—15 0	28.8	30.3942	30.591	30.208	.383	.0372	83.3	—5.3	N.E.	14.3	6.0	10	0	31	....	Inapp.	0.00	17
SUNDAY.... ...18	......	20 7	13.4	7.3	......	......	.....	....	.....	....	....	N.	27.3		..	.	60	.....	Inapp.	0.00	18 ....SUNDAY
19	13.82	16.3	11.9	4.4	30.2300	30.286	30 162	.124	.0682	84 2	10.0	N.	14.3	7.7	10	3	50	......	Inapp.	0.00	19
20	14.12	16.7	10.9	5.8	30.0992	30.195	30.032	.163	.0673	81.8	9.8	N.E.	8.5	8.5	10	1	54	....	Inapp.	0.00	20
21	19.15	22.2	15.8	6.4	29.9555	30.029	29.911	.118	.0973	93.5	17.7	E.	9.8	10.0	10	10	00	....	1.4	0.11	21
22	30.22	35.4	21.7	13.7	29.5047	29.916	29.177	.739	.1615	95.5	28.8	N.E.	15.5	10.0	10	10	00	0.81	0.2	0 92	22
23	30 87	34 9	27 0	7.9	29.7532	29.999	29.456	.543	.1288	77 3	23.7	S.W.	32 6	7.8	10	4	16	Inapp.	Inapp.	0.00	23
24	32.13	35.1	29.7	5.4	30.0220	30.052	29.993	.059	1520	83.5	27.8	S.W.	16.3	10.0	10	10	00	....	0.5	0.03	24
SUNDAY........25	.....	32.0	22.8	9.2	....	......	......	....	.....	....	....	W.	11.0	....	..		16	....	Inapp.	0.00	25 .... .SUNDAY
26	6.93	26.5	3.0	23.5	30 0947	30.133	30.017	.116	.0398	63.0	—3.3	N.E.	18.5	8.8	10	1	49	....	0.2	0 02	26
27	6.73	11.5	1.0	10.5	30.1460	30.165	30.119	.046	.0485	81 5	2.0	N.E.	14 4	10.0	10	10	00	......	0.2	0.02	27
28	16.88	23.0	10.7	12.3	30.2748	30 310	30.222	.088	.0777	83.0	12.5	S.W.	7 6	9.8	10	9	33	.	Inapp.	0.00	28
29	22.62	30.1	15.5	14.6	29.9778	30.293	29.537	.756	.1137	92.3	20.5	N.E.	9.0	10.0	10	10	15	....	1.0	0 29	29
30	32.90	37.0	28.7	8.3	29 6987	30.037	29.446	.591	.1537	81.2	27.7	W.	27.6	9.3	10	6	28	0.06		0.06	30
31	27.87	32.1	20.8	11.3	30.0253	30.149	29.772	.377	.1218	79 3	22.5	S.W.	14.5	9.0	10	4	36	....	1.3	0.06	31
............Means	15.38	22.94	9.06	13.88	30.0308	.....	......	.307	.0826	81.8	10.7	....	....	7 48	..	..	29.0	1.29	21.0	3.30	Sums ....
17 yrs. means for & including this mo.	12.00	20.57	3.85	16.70	30.0639	......	......	.341	.0730	80.7	....	....	. .	6.42	..	..	¶33.0	0.87	29.8	3.66	17 years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
Miles	1912	2440	338	462	288	3091	950	1018	
Duration in hrs	114	177	35	34	22	162	51	72	5
Mean velocity	16.8	13.8	9.7	13 6	13.1	19.1	18.5	14.1	

Greatest mileage in one hour was 53 on the 23rd.
Greatest velocity in gusts, 60 miles per hour on the 23rd.
Resultant mileage for 28 days, 2140.

Resultant direction for 28 days, N. 43° W.
Total mileage for 28 days, 10,499—equal 11,024 for whole month.
Average mileage, 15.62.

* Barometer readings reduced to sea-level and temperature of 32° Far.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Ten years only.

The greatest heat was 38.5 on the 2nd; the greatest cold was 15.0 below zero on the 17th, giving a range of temperature of 53 5 degrees. Warmest day was the 24th. Coldest day was the 16th. Highest barometer reading was 30.719 on the 16th; lowest barometer was 28.874 on the 12th, giving a range of 1.845 inches. Maximum relative humidity was 100 on 7 days. Minimum relative humidity was 52 on the 26th.

Rain fell on 6 days.
Snow fell on 23 days.
Rain or snow fell on 24 days.
Rain and snow fell on 5 days.
Hoar frost on 1 day.
Lunar halo 1 night.
Fog on 3 days.

NOTE.—Figures and letters, under wind, in bold face type, are from the City Hall record; the mileage of which has been multiplied by 1.25 in order to reduce it to the mountain anemometer.

RY, 1891.

eet. C. H. McLEOD, *Superintendent.*

DA	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY	..	00	....	5.3	0.44	1 ....SUNDAY
	0	74	....	1.0	0.04	2
	0	00	0.02	1.4	0.25	3
	0	96	...	....	....	4
	0	00	....	3.8	0.11	5
	10	00	...	1.8	0.09	6
	1	60	....	0.1	0.01	7
SUNDAY	..	00	....	1.7	0.17	8 ....SUNDAY
	10	00	0.18	1.3	0.31	9
	1	51	0.07	0.1	0.08	10
	0	95	....	....	....	11
	0	60	....	....	....	12
	0	36	....	....	....	13
	0	92	....	....	....	14
SUNDAY	..	64	.....	....	....	15 ....SUNDAY
	10	00	0.08	1.2	0.22	16
	7	18	....	0.3	0.05	17
	0	79	0.31	0.1	0.32	18
	0	100	....	....	....	19
	10	00	..	0.5	0.08	20
	10	00	0.38	....	0.38	21
SUNDAY	..	53	....	Inapp.	0.00	22 .... .SUNDAY
	0	47	....	....	....	23
	10	20	0.06	....	0.06	24
	0	00	0.52	....	0.52	25
	0	85	....	..	.. .	26
	0	53	......	....	...	27
	0	00	....	0.1	0.01	28
....	..	38.7	1.62	18.7	3.14	Sums ....
17 yrs. n includin	..	¶41.4	0.94	22.4	3.07	17 years means for and including this month.

and giving a range of 1.500 inches. Maximum relative humidity was 100 on the 4th. Minimum relative humidity was 48 on the 14th.

Directio

Miles ..

Duratio

Mean ve the 5th,

ees.

Great the

Great on

the 18th 5th,

Rain fell on 8 days.

Snow fell on 15 days.

Rain or snow fell on 18 days.

Auroras were observed on 3 nights.

Lunar halo on one night.

Lunar corona on one night,

Fog on 4 days.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1891.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				* BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	§ Max.	§ Min.	Range.				General direction.	Mean velocity in miles per hour	Mean.	Max.	Min.					
SUNDAY 1	......	32.0	17.2	14.8	....	.....	......	....	.....	....	....	N.	5.1	....	..	..	00	....	5.3	0.44	1 ....SUNDAY
2	3.07	18.0	—2.0	20.0	30.2757	30.387	30.107	.280	.0393	76.5	—3.0	S.W.	14.2	4.0	10	0	74	....	1.0	0.04	2
3	20.68	34.1	1.1	33 0	29.5108	29.830	29.332	.498	.1007	80.2	15.8	S.W.	21 8	6.7	10	0	00	0.02	1.4	0.25	3
4	—4.50	13.2	—10.5	23.7	30.0775	30.446	29.681	.765	.0285	79.7	—9.3	W.	24.6	1.0	6	0	96	...	....	....	4
5	—2.62	11.0	—13.0	24.0	30.3072	30.495	30.103	.392	.0353	88.3	—5.5	S.E.	12.5	8.3	10	0	00	....	3.8	0.11	5
6	17.02	29.7	—1.0	30.7	29.9940	30.075	29 924	.151	.0957	91.7	15.0	S.	11.2	10.0	10	10	00	...	1.8	0.09	6
7	18.68	26.0	14.0	12.0	30.0835	30.151	30.018	.133	.0867	84.8	15.0	N.E.	22.4	7.7	10	1	60	....	0.1	0.01	7
SUNDAY 8	......	16.5	11.4	5.1	......	......	......	....	.....	....	....	N.	27.1	.....	..	..	00	....	1.7	0.17	8 ....SUNDAY
9	17.78	33.5	8.6	24.9	30.0545	30.421	29.545	876	.0935	88.2	14.8	N.E.	15.0	10.0	10	10	00	0.18	1.3	0.31	9
10	26.32	36.0	12.4	23.6	29.6790	29.972	29.485	.487	.1142	73.8	19.5	S.W.	28.9	8.7	10	1	51	0.07	0.1	0.08	10
11	9.32	14.4	3.5	10.9	30.2455	30.297	30.153	.144	.0463	70.5	1.7	S.W.	17.7	2 0	10	0	95	....	....	....	11
12	21.78	30.6	8.4	22.2	30 1115	30.257	30.011	.246	.0878	74.0	15.0	S.	12.5	8.0	10	0	60	....	....	....	12
13	12.97	26.5	1.7	24.8	30 1945	30.362	30.061	.301	.0577	70.0	5.0	N.	15 3	4.0	10	0	36	....	....	....	13
14	—0.48	4.0	—6.9	10.9	30.6132	30.725	30.445	.280	.0248	60.0	—11.7	W.	8.2	1.3	8	0	92	....	....	....	14
SUNDAY 15	......	24.5	—7.9	32.4	.. ....	......	......	....	.....	....	....	S.E.	13.3	....	..	..	64	.....	....	....	15 ....SUNDAY
16	35.52	40.0	23.9	16.1	29.6102	29.673	29.555	.118	.1927	92.3	33.3	S.W.	15.5	10.0	10	10	00	0.08	1.2	0.22	16
17	17.55	31.7	14 9	16.8	29.7448	29.815	29.647	.268	.0748	77.2	11.5	N.E.	15 0	9.5	10	7	18	....	0.3	0.05	17
18	22.50	34.5	14.5	20.0	29.7327	30.174	29.358	.816	.0863	69.5	13.8	S.W.	28.2	3.3	10	0	79	0.31	0.1	0.32	18
19	10.92	15.1	7.0	8.1	30.4972	30.569	30.308	.261	.0432	60.7	—0.2	S.W.	12.5	0.0	0	0	100	....	....	....	19
20	11.47	22.6	0.0	22.6	30.2683	30.553	29.977	.576	.0672	85 3	7.7	E.	10.9	10.0	10	10	00	..	0.5	0.08	20
21	34.00	37 8	21.8	16.0	29.6088	29.768	29.531	.237	.1768	89.8	31.2	S.	15.0	10.0	10	10	00	0.38	....	0.38	21
SUNDAY.... ...22	.....	34.8	8.9	25.9	....	......	......	....	.....	....	....	S.W.	25.2	....	..	..	53	....	Inapp.	0.00	22 .... .SUNDAY
23	12.05	20.3	2.1	18.2	30.4112	30.557	30.194	.363	.0542	70.3	3.7	S.E.	6.4	8.0	10	0	47	....	....	....	23
24	30 43	39 0	11.8	27.2	29.9843	30.197	29.686	.511	.1477	84.2	25.7	S.	21·9	10.0	10	10	20	0.06	....	0.06	24
25	41.43	45.2	37.5	7.7	29.3513	29.571	29.225	.347	.2382	90.5	38.8	S.	27 7	10.0	10	0	00	0.52	....	0·52	25
26	25.80	37.5	22.5	15.0	29 5992	29.668	29.496	.172	.0948	67.3	16.5	S.W.	20.5	5.0	10	0	85	....	..	.. .	26
27	16.85	23.0	12.5	10.5	29.8388	30.139	29.633	.506	.0588	62.8	6.5	W.	18.5	4.8	10	0	53	......	....	...	27
28	18.20	26.2	8.2	18.0	30.1485	30.260	30.033	.227	.0808	78.0	12.7	S.	17.5	8.0	10	0	00	....	0.1	0.01	28
....Means	17.36	27.06	7.95	19.11	29.9984	.....	......	.373	.0886	77.7	11.4	....	17.3	6 68	..	..	38.7	1.62	18.7	3.14	Sums ....
17 yrs. means for & including this mo.	15.59	24.13	6.85	17.27	30.0389	......	......	.326	.0825	78.5	....	....	....	5.89	..	..	¶41.4	0.94	22.4	3.07	17 years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
Miles	1022	812	713	1091	2189	3930	1680	189	
Duration in hrs ..	50	66	41	77	122	186	97	20	13
Mean velocity....	20.4	12.3	17.4	14.2	17.9	21.1	17.4	9.4	

Greatest mileage in one hour was 45 on the 18th.
Greatest velocity in gusts, 58 miles per hour on the 18th.

Resultant mileage, 4750.
Resultant direction, S. 32° W.
Total mileage, 11,626.
Average mileage, in miles per hour, 17.3.

* Barometer readings reduced to sea-level and temperature of 32° Far.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Ten years only.

The greatest heat was 45.2 on the 25th; the greatest cold was 13.0 below zero on the 5th, giving a range of temperature of 58.2 degrees. Warmest day was the 25th. Coldest day was the 4th. Highest barometer reading was 30.725 on the 14th; lowest barometer was 29.225 on the 25th, giving a range of 1.500 inches. Maximum relative humidity was 100 on the 4th. Minimum relative humidity was 48 on the 14th.

Rain fell on 8 days.
Snow fell on 15 days.
Rain or snow fell on 18 days.
Auroras were observed on 3 nights.
Lunar halo on one night.
Lunar corona on one night.
Fog on 4 days.

H, 1891.

eet. C. H. McLEOD, *Superintendent.*

DAY.	OUDED NTHS. Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
Sunday...	.	..	99	....	....	....	1 ....Sunday
	o	o	78	....	....	....	2
	o	o	45	....	....	....	3
	o	10	00	...	9.1	0.67	4
	o	10	00	....	0.2	0.03	5
	o	o	89	...	....	...	6
	o	o	89	....	....	....	7
Sunday ..	.	..	72	....	....	....	8 ....Sunday
	o	10	00	1.41	....	1.41	9
	o	o	53	0.20	1.9	0.39	10
	o	o	81	....	....	....	11
	o	o	00	0.30	....	0.30	12
	o	10	00	0.29	....	0.29	13
	o	10	03	....	0.8	0.04	14
Sunday...	.	..	93	.....	....	....	15 ....Sunday
	o	o	52	....	0.8	0.08	16
	o	o	98	....	....	....	17
	o	10	00	....	3.5	0.26	18
	o	o	96	....	....	....	19
	o	o	18	Inapp.	....	0.00	20
	o	8	05	0.19	Inapp.	0.19	21
Sunday..	.	..	31	0.12	....	0.12	22 .... Sunday
	o	9	31	Inapp.	....	0.00	23
	o	o	31	0.14	....	0.14	24
	8	o	95	....	....	....	25
	o	o	98	......	..	.. .	26
	o	o	97	....	....	..	27
	o	o	57	....	Inapp.	0.00	28
Sunday..	.	..	95	....	....	....	29 .... Sunday
	o	o	97	....	....	...	30
	o	o	86	....	....	....	31
....	.	..	54.7	2.65	16.3	3.92	Sums ....
17 yrs. mea including	.	..	46.5	0.96	25.0	3.44	17 years means for and including this month.

and

Direction

Miles ....

Duration i

Mean velo ; the 2nd,

grees.

Greates s the

Greates 9 on

the 14th. 13th,

giving a range of 1.541 inches. Maximum relative humidity was 99 on the 4th. Minimum relative humidity was 36 on the 29th.

Rain fell on 9 days.

Snow fell on 8 days.

Rain or snow fell on 15 days.

Auroras were observed on 2 nights.

Hoar frost on 2 days.

Solar halo on 1 day,

Lunar halo on 3 night.

Fog on 2 days.

ABSTRACT FOR THE MONTH OF MARCH, 1891.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				* BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	§ Max.	§ Min.	Range.				General direction.	Mean velocity in miles per hour	Mean.	Max.	Min.					
SUNDAY........ 1	......	14.4	2.0	12.4	....	.....	......	....	.....	....	....	W.	18.2	....	..	..	99	....	....	....	1 ....SUNDAY
2	5.53	10.8	—2.1	12.9	30.5788	30.659	30.478	.181	.0357	64.7	—4.2	W.	2.7	2.2	10	0	78	....	....	....	2
3	16.33	25.0	4.0	21 0	30.3410	30.481	30.137	.344	.0672	69.8	8.3	N.E.	11.0	6.8	10	0	45	....	....	....	3
4	19.42	24.3	14.8	9.5	29.9103	30.080	29.820	.260	.0973	92.2	17.3	N.E.	17 6	10.0	10	10	00	...	9.1	0.67	4
5	19.32	26.5	13.0	13.5	30.0188	30.155	29 905	.250	.0817	78.3	13.7	W.	15.8	10.0	10	10	00	....	0.2	0.03	5
6	18.30	22.5	10.9	11.6	30 1712	30.256	30.102	.154	.0690	69.5	10.2	W.	17.3	2.8	10	0	89	...	....	...	6
7	20.75	26.9	15.1	11.8	30.2003	30.229	30.182	.047	.0737	66.3	11.5	S.W.	8.7	2.3	10	0	89	....	....	....	7
SUNDAY 8	......	28.9	13.0	15.9	....	......	......	....	.....	....	....	N.E.	10.7	....	..	..	72	....	....	....	8 ....SUNDAY
9	33 67	39.9	20.8	19.1	29.9150	30.092	29.743	349	.1592	81.0	28.3	S.E.	13 1	10.0	10	10	00	1.41	....	1.41	9
10	30.60	36.0	26.9	9.1	30.0573	30.245	29.794	.451	.1320	77.0	24.2	S.W.	24.7	4.5	10	0	53	0.20	1.9	0.39	10
11	35.32	42.2	25.7	16.5	30 1988	30.282	30.145	.137	.1290	63.3	23.8	S.	21.0	3 0	10	0	81	....	....	....	11
12	37.02	39.0	35.7	3.3	30.0698	30.158	30.027	.131	.1730	78.5	30.5	S.	20.2	8.3	10	0	00	0.30	....	0.30	12
13	37.40	40.9	32.5	8.4	29.5005	29.988	29.118	.870	.1982	87.7	34.0	E.	19 4	10.0	10	10	00	0.29	....	0.29	13
14	24.05	33.1	17.5	15.6	29.5273	29.916	29.251	.665	.0892	67.6	15.2	S.W.	39.7	10.0	10	10	03	....	0.8	0.04	14
SUNDAY........15	......	29.0	10.6	18.4	.. ....	......	......	....	.....	....	....	S.W.	20.3	....	..	.	93	.....	....	....	15 ....SUNDAY
16	23.13	33.0	8.5	24.5	29.9210	30.187	29.755	.432	.0897	66.0	13.2	W.	26.0	4.7	10	0	52	....	0.8	0.08	16
17	14.10	22.0	3.8	18.2	30.2278	30.324	30.126	.198	.0553	66.5	5.0	S.W.	18.7	3.0	10	0	98	....	....	....	17
18	22.90	27.6	17.8	9.8	29.9730	30.064	29.894	.170	.1085	88.3	20.0	S.E.	8.5	10.0	10	10	00	....	3.5	0.26	18
19	10.28	25.1	5.0	20.1	30.3767	30.446	30.246	.200	.0432	61.7	—0.7	N.	16.5	0.0	0	0	96	....	....	....	19
20	19.42	32 0	3.0	29.0	30.2923	30.363	30.243	.120	.0853	72.5	12.3	N.E.	8.5	6.7	10	0	18	Inapp.	....	0.00	20
21	31.65	35.0	22.8	12.2	30.0778	30.247	29.883	.364	.1403	78.2	25.7	N.E.	16.3	10.0	10	8	05	0.19	Inapp.	0.19	21
SUNDAY........22	.....	42.0	33.7	8.3	....	......	......	....	.....	....	....	N.E.	14.0	....	..	.	31	0.12	....	0.12	22 .... .SUNDAY
23	41.02	47.8	34.6	13.2	30.0455	30.069	30.024	.045	.2258	87.8	37.5	N.E.	12.2	9.7	10	9	31	Inapp.	....	0.00	23
24	37 43	42.9	31.9	11.0	30.1768	30.218	30.128	.090	.1808	80.0	31.7	S.W.	17.8	7.8	10	0	31	0.14	....	0.14	24
25	26.90	33.0	21.8	11.2	30.3057	30.368	30.262	.106	.0815	55.2	13.7	W.	16.1	1.3	8	0	95	....	....	....	25
26	21.30	27 0	13.9	13.1	30.4588	30.516	30.429	.087	.0767	66.5	12.3	S.W.	8.4	1.8	10	0	98	......	..	.. .	26
27	27.63	36 0	17.8	18.2	30.3030	30.451	30.147	.304	.0985	65 8	17.8	N.E.	5.7	0.0	0	0	97	....	....	..	27
28	35.45	38.5	29.6	8.9	30.0285	30.125	29.982	.143	.1313	63.2	24.2	N.	12.4	5.3	10	0	57	....	Inapp.	0.00	28
SUNDAY........29	......	49.0	34.8	14.2	....	......	. ....	....	.....	....	....	N.	18.5	....	..	..	95	....	....	....	29 .... SUNDAY
30	33.20	40.0	27.6	12.4	30.1968	30.231	30.171	.060	.1128	59.5	20 8	N.	10.5	0.0	0	0	97	....	....	...	30
31	32.25	40.0	23.7	16.3	30.1155	30.2:8	30.050	.168	.1205	67.3	22.5	N.E.	13.1	1.8	10	0	86	....	....	....	31
....Means	25.94	32.59	18.41	14.18	30.1157	.....	......	.243	.1098	72.1	18 0	....	15.60	54.6	..	..	54.7	2.65	16.3	3.92	Sums ....
17 yrs. means for & including this mo.	23.99	31.22	16.30	14.92	29.9671	......	......	.263	.1069	75 4	....	....	....	61.4	..	..	46.5	0.96	25.0	3.44	17 years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
Miles	1412	2142	694	671	1087	2546	2555	495	
Duration in hrs ..	97	179	53	52	57	119	120	36	31
Mean velocity....	14.6	12.0	13.1	12.9	19.1	21.4	21.3	13.7	

Greatest mileage in one hour was 52 on the 14th.
Greatest velocity in gusts, 66 miles per hour on the 14th.

Resultant mileage, 2020.
Resultant direction, S. 87°.5 W.
Total mileage, 11,602.

* Barometer readings reduced to sea-level and temperature of 32° Far.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Ten years only.

The greatest heat was 49.0 on the 29th; the greatest cold was 2.1 below zero on the 2nd, giving a range of temperature of 51 1 degrees. Warmest day was the 29th. Coldest day was the 2nd. Highest barometer reading was 30.659 on the 2nd; lowest barometer was 29.118 on the 13th, giving a range of 1.541 inches. Maximum relative humidity was 99 on the 4th. Minimum relative humidity was 36 on the 29th.

Rain fell on 9 days.
Snow fell on 8 days.
Rain or snow fell on 15 days.
Auroras were observed on 2 nights.
Hoar frost on 2 days.
Solar halo on 1 day.
Lunar halo on 3 night.
Fog on 2 days.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. IV. JULY, 1891. NO. 7.

On a New Horizon in the St. John Group.

By G. F. Matthew, M.A., F.R.S.C.

Read at Meeting of the Natural History Society of New Brunswick, 5th October, 1891.

Among fossils which are considered to be of special importance in determining the age of Cambrian strata, none are thought to be of greater value than that curious net-like organism called *Dictyonema flabelliforme*.

Most of the continental geologists regard the beds which contain this fossil as the highest which should come under the name of Cambrian, as distinguished from Ordovician or Lower Silurian, because at these beds there is an important palœontological break which we now know to be only local for the Atlantic region, but which seems in Europe to be of unusual importance.[1]

In Great Britain, however, another set of beds, the Tremadoc slates are included in the Cambrian rocks. This group contains many Cambrian types, occurs in the original Cambrian area, and for these reasons is attached to the Cambrian system. The next system begins with the Arenig group in which the true graptolites come in in strength and variety.

[1] Prof. G Lindström asserts that in Sweden not a single species passes this limit.

Dictyonema flabelliforme had been sought for in the black shales of Division 3 (Bretonian) unsuccessfully until this year. Films, probably due to this fossil had been met with, but they were too much distorted and obscured by slaty cleavage to be with safety referred to it. Now, however, the presence of this fossil is undoubted, and serves to add another to the known palœontological horizons of the St. John group.

Mr. G. Stead, whom the writer had sent to search for the Tremadoc fauna on Navy Island, in St. John harbour, found Dictyonema in the ledges at the west end of the island. Subsequent examinations resulted in the discovery of fine examples of the fossil, and showed that it occurs at intervals through a considerable thickness of beds. Judging from the position at which Dictyonema was found, it is probable that the Tremadoc fauna is not on the island, but to the north of it in the channel of the river St. John.

The history of this Dictyonema is interesting, as showing through how many successive phases of increasing accuracy the knowledge of an extinct organism may pass. The original describer of the species evidently thought it related to the sea-fans as he called it a Gorgonia. The rising, branching and spreading hydrosome, with its sub-parallel, occasionally forking branches, would seem to favour this reference of the species. The branches too, are covered with minute pores, or what appear to be such, and thus in another respect the species resembles the sea-fans.

But Eichwald could not have discovered that he was dealing with a hollow cup or bell, and not a fan-like expanded organism, or he would scarcely have applied the specific name by which he designated the fossil.

Still further from a correct understanding of the nature of this fossil, were Goeppert and Unger, who thought it to be a plant of some kind. These men were palœobotanists, and so less prepared to look for analogies to the fossil in the animal kingdom.

It is now generally admitted that the fossil described by the late J. W. Salter as *Dictyonema sociale* is identical with

D. flabelliforme. Mr. Salter fully understood the cup-like form of the species which he described and its relation to the graptolites, and his name well expresses the multitudes of these delicate organisms which are exposed in breaking open layers of the Dictyonema shale.

For a long time the idea prevailed that this organism was rooted in the mud and grew on the sea bottom. One author speaks of the lower part of the hydrosome as a kind of cage buried in the mud, which supported the cup in an upright position, but it does not seem at all clear that Dictyonema was in any way thus attached. The sicula or initial point is altogether too small and slight to give support to the structure growing from it, and the living cells begin immediately above the sicula, and therefore, it is improbable that the lower part of the hydrosome was buried in the mud. Dictyonema seems rather to have been a free organism, floating in the ocean, and perhaps capable of moving by means of ciliæ or fleshy appendages which have not been preserved.

Dictyonema began life as a Bryograptus, if we may judge by the appearance of the hydrosome, which did not develop connecting threads on the primary branches, and usually not until the growth of the secondary branches was completed. Then gradually and more numerously as the hydrosome grew, the cross threads appeared.

It is in keeping with this that Dictyonema was not the first form of the Graptolite family that appeared. Beside a few poorly preserved forms of the Lower Cambrian rocks, there were in Sweden and Acadia two genera of graptolites which either preceded it or appeared with it; these are Trichograptus or Clonograptus, and Bryograptus.

G. Linnarsson discovered a graptolite in West Gotland, which he referred to Dichograptus. It is a small, slender form with distant cells, which, by H. A. Nicholson, has been referred to Trichograptus, and by O. Hermann to Clonograptus. The species was found with the trilobite *Sphærophthalmus alatus*, and therefore, should be older than the Dictyonema schists.

Charles Lapworth in many places in his "Geological distribution of the Rhabdopora," recognized Bryograptus as older than the Dictyonema shale,[1] but Dr. W. C. Brögger disputes this, and says that in Scandinavia that genus appeared above the Dictyonema beds. He cites three species which appeared very soon after Dictyonema, and one of these is referred by Hermann to Trichograptus.

Our observations in the St. John basin favour Lapworth's views, as we find a Bryograptus mingled with the earliest examples of Dictyonema, and below the proper Dictyonema beds.

Dictyonema flabelliforme ranges through a greater thickness of beds in Acadia than it does in Sweden or Norway, and perhaps for this reason, has a greater variety of Brachiopods and Trilobites associated with it than are found in these countries, or indeed any where else. Included in the beds where Dictyonema is found, there are trilobites belonging to Angelin's genus Leptoplastus and to Agnostus. *Parabolina* cf *heres* Brögg, and *Protopetura* cf *acanthura*, Ang., also occur, and as the fossil is found about fifty feet lower down than the bed where these trilobites occur, it may even reach the zone of *Parabolina spinulosa*, Wahl. But the Dictyonema of these lower layers is a bushy form like var. *confertum* of Sweden.

Only one trilobite is mentioned as occurring in Sweden in the Dictyonema beds. This is Angelin's species *Acerocorne ecorne*, a species resembling *Peltura scarabeoides*, but possessing a pygidium devoid of spines. J. C. Moberg has thrown doubt on the occurrence of even this one trilobite in the Dictyonema beds. He mentions that it is said to have been found at Sandby in Scania where *Protopeltura acanthura* occurs, and it is thus possibly with fossils somewhat older than the true Dictyonema beds. Further, it may be added that Linnarsson says the Dictyonema beds in Scania contain (beside their characteristic fossil) a species of Dichograptus in great numbers, and that in that province a "transition

[1] Dic. Silurischen Etagen 2 und 3, p. 37.

might occur between the Olenus schists and the Dictyonema schists." The conditions in Scania appear to correspond with those in Acadia, as the trilobites of the "Upper Olenus Beds," (Div. 3*a.* and *b.* of the St. John Group), are mingled with Dictyonema. But on the other hand, the upper or typical Dictyonema beds (Div. 3*c.*) at St. John, have so far yielded no trilobite

Dictyonema also has associated with it at St. John, several species of Brachiopods,—an Obolus somewhat like *O. Apollonis*, Eichw, also an Obolella, a Linnarssonia like *L. misera*, Bill; and a Lingula or Linguella.

Dictyonema lived long enough in the St. John basin to develop considerable differences in the appearance and structure of the hydrosome. We recognize two varieties which are probably the same with those mentioned by Dr. Brögger as existing in Scandinavia, and we also observe that the variety most common in Acadia differs from the type in having more numerous, because more closely set hydrothecæ. The variety *Norvegicum* characterised by heavy cross-bars has changed from the type in the direction of *D. quadrangularis* Hall, of the Levis shales, and the special Acadian variety in the direction of Sir J. W. Dawson's species *D. delicatulum* of the same shales. The former variety is known to occur in the St. John basin at the Arenig horizon (Div. 3*d.*), but the latter though known at Quebec, has not been found here.

Including the Dictyonema beds we now have in the third or Bretonian division of the St. John group the following well characterized horizons :—

a. Zone of *Parabolina spinulosa* (formerly described as Zone of *Leptoplastus stenotoides*).

b. Zone of *Peltura scarabeoides*, contains also *Dictyonema flabelliforme.*

c. Zone of *Dictyonema flabelliforme*, typical development of the species.

?. Several hundred feet, fauna unknown.

d. Zone of *Dichograptus Logani* and *Tetragraptus, 4-branchiatus*, &c.

On Some Granites from British Columbia and the Adjacent Parts of Alaska and the Yukon District.

By Frank D. Adams, *Lecturer in Geology, McGill University.*

Some three years ago, when on the staff of the Geological Survey of Canada, the writer was requested by Dr. G. M. Dawson, to examine a series of rock specimens collected by that gentleman and his assistants, Messrs. McConnell and Ogilvy, during their explorations in the Yukon Districts and Northern British Columbia in 1887. The results of this examination were published as an appendix to Dr. Dawson's Report on the Yukon District.[1]

The rocks examined were, for the most part granites, but included also, diabase porphyrites, diabase tuffs and other rocks, which, however, were normal in character, and possessed of no features which here deserve especial mention or further description.

Among the granites, however, there were three which were rather remarkable and seemed to be worthy of a more extended study than it was at that time possible to make. I have accordingly, through the kindness of Dr. Dawson, re-examined the hand specimens, and with the aid of additional thin sections have made a more detailed study of the rocks in question.

Granite from Wrangell Island, Alaska.—The first of these rocks is a rather fine grained grey granite from Wrangell Island, Alaska. In Dr. Dawson's Report it is referred to as follows: "The rocks along the west shore of Wrangell Island, in the vicinity of the town and harbor, are chiefly black flaggy argillites, remarkably uniform and regular in their bedding and with a westward dip. They are considerably indurated and contain small staurolite crystals in some layers, while on the surface of others crystals

[1] Appendix V. Notes on the Lithological Character of some rocks collected in the Yukon District and adjacent Northern parts of British Columbia, by Frank D. Adams. Annual Report of the Geological Survey of Canada 1887.

of mica have been developed. Similar rocks are found on other parts of the coast, both in the north and south, and from a lithological point of view, they much resemble the Triassic argillites of the Queen Charlotte Islands, though no fossils are found at this place. The ridge behind the town of Wrangell is chiefly composed of rather fine grained grey granite, which is probably intrusive and may have been the cause of the incipient crystallization observed in the argillites. The north part of the island is formed of a similar granite, probably a continuation of the same mass." Dr. Dawson informs me that the granites all through this district seem to be more recent than the slates and that he regards the mass in question as almost certainly of eruptive origin.

The hand specimen when examined seems to show a very indistinct tendency towards parallelism of mica individuals, and when thin sections are examined there is evidence in the somewhat uneven extinction of the quartz grains as well as in the twisting of the biotite, that the rock has been submitted to pressure. It is composed essentially of quartz, orthoclase, plagioclase and biotite, with epidote, allanite, garnet, sphene, zircon and apatite, as accessory constituents. The essential constituents show nothing especially deserving of mention. The feldspars are generally fresh and frequently show a beautiful zonal structure due to growth-rings. Occasionally a distinct border with well marked granophyre structure is seen about a portion of a feldspar individual. The garnet, of which a few grains are present in most of the sections, is light brown in colour. The interest of the rock centres in the epidote with its associated allanite.

The epidote is present in considerable amount and is generally associated with the biotite. It is colourless and has rather a high index of refraction, occurring in prisms elongated, parallel to the *b* axis with a perfect cleavage parallel to the length. Examined in convergent light between crossed nicols it is seen to be biaxial, the plane of the optic axes in all cases being at right angles to the length of the prism. In some instances the double refraction is sufficiently strong to give rise to the greenish-yellow, yellow and pink colours usually seen in thin sections of this mineral, but in others, and almost invariably in very thin sections the mineral shows the deep blue interference colours characteristic of Zoisite. It was thought at first that both minerals were present, but a more careful study of the slides showed that the blue colour was given by thinner parts of individuals which elsewhere polarize in yellow tints, the blue colour appearing as border around the little bays or cavities in the crystals to be described further on, and where, therefore, the epidote was thinner than elsewhere. Since, however, normal epidote has a sufficiently strong double refraction to give brilliant yellow interference colours even in the thinnest sections ordinarily attainable, it is probable that this is a variety poor in iron, and thus approaching Zoisite in composition, these two minerals being dimorphic, their formula being identical, except that in epidote a portion of the alumina is generally replaced by ferric oxide. The absence of the usual pleochroism in the mineral points to the same conclusion.

Associated with some but by no means with all of these crystals of epidote are little individuals of allanite. These are sometimes very small and of a more or less irregular shape, but frequently have a good crystalline form consisting of a prism elongated in the direction of the *b* axis and generally having what are probably pyramidal terminations at one extremity. The plane of the optic axis is at right angles to the longer axis of these crystals. It has a high index of refraction, possesses a distinct zonal structure and is pleochroic, the colours being as follows:—

$\mathfrak{a}$—Light yellowish brown.
$\mathfrak{b}$—Purplish brown.
$\mathfrak{c}$—Pale yellowish brown.

The light passing through the crystals parallel to $\mathfrak{a}$ is of nearly the same colour as that passing through parallel to $\mathfrak{c}$. The colour is not so intense as is usual in allanite, although this may be due in part to the fact that these crystals are very small.

In two or three cases twin crystals of allanite were found. the twinning line probably being $\infty P\bar{\infty}$, in one case extinctions of 23° and 27° respectively on either side of the twinning line were observed, but none of the crystals were cut quite parallel to the clinopinacoid. The epidote, when associated with these allanites, has crystallized around them, sometimes enveloping them completely, but at other times only partially, forming what is generally a very irregular border. The allanite and epidote are probably intergrown in parallel position, but no section was found so cut that this could be actually proved. The mode of occurrence of these two minerals is seen in the accompanying cut (Fig. 1) in the upper left hand division, the epidote being represented in outline, while the allanite is black. This association of epidote and allanite has already been described from a number of localities.[1]

The epidote is remarkable, not only as occurring in very considerable amount in the granite, but also from its mode of occurrence. It is evident at the first glance that it does not result from the decomposition of the plagioclase or other constituents of the rock, as is frequently the case in much decomposed igneous rocks, since it occurs in large well defined crystals, these however seldom have a perfect form but possess a very peculiar eaten or corroded appearance, being traversed by little irregular canals and arms of another colourless mineral with much lower index of refraction. These arms are in many cases, too small to enable their character to be determined, but on careful examina-

[1] Becker, Ewald.—"Ueber das Mineralvorkommen im Granit von Striegau, insbesondere über den Orthorlas und dunkelgrünen Epidote."—Breslau.

Hobbs, W. H.—"Ueber die Verwachsung von Allanite (Orthit) und Epidote in Gesteinen."—Tschermak's Min. and Pet. Mitt., 1889, i., also Johns Hopkins University Circular, April, 1888.

Lacroix, A.—"Contributions à l'etude des Gneiss à Pyroxene et des roches à Wernerite." Bull. Soc. Min., France, April, 1889.

Tornebohm, A. E.—"Mikroskopiska Bergartstudier XII.,Epidot gneiss," Geol. For. i., Stock Forh. No. 75, 1882.

tion it is found that they are for the most part quartz, in fact arms of quartz can in many places be seen running into the epidote crystals from adjacent quartz grains, the arm and the external portion of the grain belonging to the same individual. In other places, however, these little arms were found to consist of plagioclase and to be continuous with the plagioclase associated with the epidote in the same manner as in the case of the quartz described above, probably some of them may also be orthoclase. Three of these epidote crystals are represented in outline in Fig. 1, (Nos. i, ii, iii). They were drawn with the aid of a camera lucida from epidote crystals occurring in the sections of the Wrangell Island granite. In the second one (No. ii), however, it was found to be impossible to show all the inclusions and little arms, only the largest and best defined being represented, while a number of smaller ones are omitted.

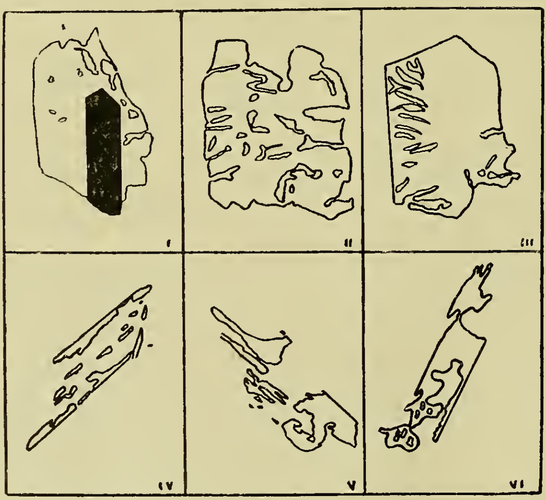


FIGURE 1.

i.—Epidote, enclosing Allanite in Granite from Wrangell Island.

ii, iii.—Epidote in Granite from Wrangell Island.

iv, v, vi.—Single individuals of Muscovite in Granite from Pelly River.

The mode of occurrence is exactly the same as that described by Dr. Geo. H. Williams in the case of the epidote occurring in the Mica Diorite from Stony Point on the Hudson River (*American Journal of Science*, June, 1888). The nearest analogy to it observed in other rocks, is the structure of the garnets in many garnetiferous gneisses. In the garnetiferous gneisses of the Laurentian System which I have had an opportunity of examining in thin sections, the garnets, although sometimes forming compact individuals, in other specimens have a structure closely resembling, and often apparently identical with that above described. This structure in gneisses and in the granite under consideration, does not seem to be due to the eating away or partial solution of crystals which originally had a perfect form, as in the quartz phenocrysts of quartz porphyries, where fragments of what were evidently once quartz crystals which have been eaten apart, can often be found lying near each other having lost their common orientation, nor are the bays which run into the epidote always or generally large and well defined like the arms of the groundmass in the quartz phenocrysts in question, but on the contrary, they are generally long, slender curving arms and little irregular canals, and are frequently found closed at the outer end, forming cavities which then apparently become filled up, leaving finally one or more minute inclusions or little points of the quartz or feldspar completely isolated in the epidote individual. In other grains these have apparently also disappeared, and a crystal free from all inclusions is the result. The epidote, like the garnets in the gneiss, presents the appearance rather of having grown into the surrounding minerals by first sending out little arm like extensions of its substance which subsequently meet one another, in this way including some of the foreign mineral which may or may not finally disappear. The few grains of garnet which as above mentioned, occur in sections of the Wrangell Island granite have this same structure.

Where an allanite crystal is enclosed in the epidote this irregularity in structure does not extend to the allanite. The latter has the appearance of a primary mineral, around which the epidote would naturally tend to crystalize, if any were developed in the rock, the two minerals being isomorphous.

As it was necessary to carry as little weight as possible over the long stretches of country traversed by the Yukon expedition, only single hand specimens of each rock were collected, and the description given above is that of the single specimen of this Wrangell granite collected by the party. The only other specimen which I could obtain from Fort Wrangell was one kindly given to me by Mr. R. G. McConnell of the Geological Survey of Canada, which was collected by him from the slopes of the hill behind Fort Wrangell some years previously, and which proves to be a fine grained Muscovite Granite or Aplite. It occurs associated with the argillites, probably in the form of a dyke. The occurrence of this rock in the vicinity would also point to a probable eruptive origin for the granite above described. The rock is a typical Aplite being composed of quartz, orthoclase, plagioclase, and a large amount of muscovite. The muscovite is quite normal in its mode of occurrence, and shows no signs of the fretted or indented outline possessed by muscovite in the Pelly River granite to be described further on. It occasionally holds little bunches of black rutile needles, sometimes geniculated twins, and associated with these in the muscovite, a few stout little crystals were observed having a very high index of refraction and well defined crystalline form—acute double pyramids truncated by basal planes. These are probably anatase. A few grains of topaz are also present.

Granite from Pelly River, Yukon District.—The second rock, unlike that just described, was collected in the interior of the Yukon District, being found on the upper Pelly River near to its confluence with the Lewes River. The specimen is marked "61," the exact point from which it was taken being indicated on Dr. G. M. Dawson's "Map of the Yukon District and British Columbia," Sheet 3.

In his report, Dr. Dawson refers to this granite as follows: (p. 132).

"Nine miles above the confluence, by the course of the river, a great mass of impure serpentine comes out on the bank, and six miles and a half above the same place, grey granite of the usual character is again met with and appears to constitute the hills to the east of the river for the remaining few miles of its course." It is a grey muscovite biotite granite of miduum grain. There is a barely perceptible parallelism visible in the arrangement of the constituents, so that it might possibly be termed a granitic gneiss. It consists of the following minerals, quartz, orthoclase, microcline, plagioclase, muscovite, biotite, epidote, garnet, calcite, sphene and pyrite. The quartz and orthoclase constitute a large proportion of the rock, while the plagioclase, micas and other constituents are less abundant. The quartz and feldspar are sometimes broken and show uneven extinction, in fact the rock seems to have been considerably crushed, but I can see no evidence of anything like complete re-crystallization. The biotite is not very abundant and is sometimes partly altered to chlorite. The garnet, which like the sphene and pyrite is present in small amount, occurs in irregular shaped isotropic grains which are much cracked. The epidote, muscovite, and calcite, however, are of especial interest.

The epidote is the normal variety with one good cleavege at right angles to the plane of the optic axes and generally possesses a faint pleochroism, colourless and greenish yellow. It occurs occasionally in fairly perfect crystals, but is frequently found in the same curiously imperfect forms which it assumes in Wrangell Island rock. The little arms and bays which run into these epidote individuals are sometimes quartz. In very many cases, however, they are feldspar (plagioclase) as indicated by the biaxial figure and polyoynthetic twinning, the included portions being continuous and having the same optical orientation as the feldspar surrounding the epidote, being in fact, a portion of the same individual. The muscovite is rather more plentiful than the biotite, being present in rather large amount. It has the same curiously irregular outlines as the epidote, being sometimes in very slender forms and delicate skeleton crystals and at other times in tolerably stout individuals. The little indentations which frequently form a very delicate and complicated lace work about the edge of the crystals are occupied by whatever mineral the mica happens to be embedded in, sometimes quartz, but at other times orthoclase or plagioclase, and in the great majority of cases when the little arms are so cut that they can be accurately studied, the mineral occupying them is seen to have the same extinction and to be continuous with that surrounding the mica, forming in fact, as in the case of the epidote, part of one and the same individual. Sometimes a number of little muscovite crystals situated near each other will be found to have the same orientation, although in the plane of the section there is no connection between them, in fact in one grain of feldspar, probably plagioclase, two well defined sets of small slender muscovite individuals were seen crossing one another at an angle of 55°, the members of each set extinguishing simultaneously, while a third set formed of fewer individuals also similarly oriented was arranged in a third direction cutting across these. In Fig. 1, (Nos. iv, v, vi), three occurrences of this muscovite are represented, the separated parts in each case having a common orientation.

The muscovite showing this peculiar structure is frequently found immediately in contact with biotite which shows no signs of it, nor is the muscovite a bleached biotite, for no transition stages are ever observed, though both are seen in contact along a sharp line in several cases. The biotite, however, is as above mentioned, sometimes altered to chlorite. The calcite occurs in large individuals, sometimes alone and sometimes associated in groups of two or three. They are generally irregular in shape and show the usual twinning. Like the muscovite and epidote it is frequently developed as skeleton crystals, and has been found enclosed in muscovite, in plagioclase, and in untwinned feldspar, presumably orthoclase. It has also been found partly surrounded by quartz, but never completely embedded in that mineral. All three minerals, muscovite, epidote, and calcite, frequently occur associated and intergrown, all having apparently a similar origin, the calcite, like the other two, apparently growing into the other constituents of the rock.

Figure 2 shows the mode of occurrence of these minerals in this Pelly River granite and their relation to the other constituents of the rock. All the little inclusions and arms in the central portion of the large muscovite crystal have precisely the same orientation as the large plagioclase individual which here bounds the muscovite on one side, having formed apparently at one time portions of the same individual.

FIGURE 2.

Section of the Granite from Pelly River × 42 diameters.

M—Muscovite. B—Biotite.
E—Epidote. P—Plagioclase.
C—Calcite.

Muscovite occurring in skeleton crystals in plagioclase in precisely the manner described above was also observed in thin sections of a granite collected by Mr. J. B. Tyrrell of the Canadian Geological Survey at Rock Point, Lake St. Martin, Manitoba. Mr. Tyrrell states that it is, without doubt, an eruptive granite. It occurs penetrating a dark green hornblende schist through which arms of the granite run in all directions while the schist contains imperfectly developed staurolitic minerals, the result of contact metamorphism. In other similar rocks from the Lake Winnipeg district, epidote occurring in these peculiar forms was observed.

Granite from Coast Ranges, British Columbia.—The third rock is from the Coast Ranges of British Columbia, where it forms large exposures on the Stikine River not very far from its mouth. It is of medium grain, grey and porphyrtic with numerous small plagioclase crystals. It is composed of quartz, plagioclase, orthoclase, biotite and hornblende, and should be classed either as a quartz diorite or a biotite hornblende granite, according to the relative amounts of plagioclase and orthoclase present in the rock, amounts which can only be determined by a separation of the constituents by means of heavy solutions or by chemical analysis. The rock is interesting from the occurrence in it of allanite in rather large brown pleochroic crystals with well marked zonal structure which must be rather abundant, as they were found in three of the six thin sections of this rock which were prepared.

Conclusions.—The origin of the epidote and muscovite, as well as of the calcite above described, is a question of considerable interest. We may suppose these minerals to have been produced in one of three ways. They might be:—

1. Original minerals which were crystallized from a granitic magna and subsequently corroded, eaten away and partially reabsorbed as in the case of the quartz phenocrysts in quartz porphyries, or the biotite and hornblende in many volcanic rocks.

2. Minerals which have been developed during a complete re-crystallization of the original rock, owing to pressure or

some other metamorphic agency, but which did not complete their growth.

3. Minerals which have grown in the rock after its solidification, but without re-crystallization of the other constituents.

The first hypothesis does not seem to be tenable in the present case, for not only is epidote a mineral which occurs but very rarely in granites, except as a decomposition product, but a careful examination under the microscope would seem to show that, as above mentioned, the apparent corrosion of the crystals, whether epidote, muscovite or calcite, is quite different in character from that produced by the corrosion and partial resolution of a caustic magma. If the muscovite were so corroded, the biotite should also have been attacked with the removal of the muscovite molecule at least.

Further, if a crystal of muscovite were eaten away until the merest skeleton alone remained, or until the crystal had actually been separated into several pieces, it would be impossible for the entire skeleton and even the several disconnected portions to preserve exactly the same orientation had there been the slightest motion in the molten magma, and we cannot but suppose that there would be a certain amount of motion when such extensive resolution was taking place.

Moreover, as above mentioned, there is reason to believe from their similarity in mode of occurrence and close association, that the epidote, muscovite and calcite, have had a similar origin, but we would hardly expect calcite as an original mineral in so acid a rock, much less crystallized in large individuals in actual contact with quartz.

Neither does there seem to be reason to believe, after a careful study of the thin sections of the rock, that anything like an entire crystallization of the granite has taken place as supposed in the second hypothesis. Were it not for the epidote, muscovite and calcite, the rocks would be considered normal granites probably somewhat crushed. Their character is that of eruptive rocks, not of crystalline schists.

The third hypothesis, namely that the minerals in question have been developed in the rock after its solidification, perhaps by dynamic action, and indicate a first stage of metamorphism but without complete re-crystallization, is not nearly so startling as it might seem at the first glance. We have examples of such a development in a number of cases, and it may be that the growth of minerals in this way is a much more common factor in development of crystalline schists than is generally supposed. It is what takes place in almost every case of pseudomorphism by alteration.

"All the rocks situated at considerable depths in the earth's crust must be subject to great pressure resulting from the weight of the superincumbent masses. Under these pressures, liquids and gases may be made to penetrate between the molecules of the solid crystals. The evidence that such permeation of solid crystals by liquids and gases has taken place is overwhelming. In the words of Van der Waals, 'All bodies can mix with one another when the pressure exceeds a certain value.'"[1] That by the action of such solutions secondary minerals may be developed is a very reasonable supposition, and that they have been so developed in the rocks at present under consideration seems to be the explanation which best accords with facts observed.

As a good example of the growth of one mineral in and through another after the solidification of the rock of which it is a component part, the development of wollastonite in the plagioclase, of a plagioclase-pyroxene rock from Brittany described by Dr. Whitman Cross may be cited.[2]

Another example is the alteration of quartz into steatite described by Dr. Weinschenk.[3] In this case the steatite was found to grow in the crystals of quartz which were traversed by very fine capillary cracks, thus forming a net work

[1] Chemical changes in rocks under Mechanieal Stresses" by Prof. J. W. Judd, Journal of Chemical Society. May, 1890. (p. 410).

[2] "Studien über bretonische Gesteine Tschermach's Min. u. Pet. Mittheil, 1880. iii.. 369."

[3] "Ueber die Umwandlung des Quarzes in Speckstein." Zeit. fur Kryst, 1888. (p. 305).

enclosing angular bits of quartz which were finally completely altered to soapstone. It was found, moreover, that the process could be repeated artificially. By boiling finely powdered rock crystal in a solution of carbonite of potass and sulphate of magnesia, the quartz grains were found to become corroded and converted along their outer portions into a scaly aggregate, rich in magnesia, undecomposed by aqua regia, and having the optical properties of talc.

The development of andalusite and staurolite in contact zones might in many cases also serve as an excellent example of this mode of growth, since in many cases such slates have not undergone complete re-crystallization.

Lastly, there are the double zones of pyroxene and hornblende, which have been described as surrounding the olivine where it would come in contact with the plagioclase in so many gabbros from various parts of the world. If these "rims" are really the result of dynamic action as has frequently been asserted, they afford one of the best instances of the growth of one mineral in another in a solid rock, for here we have the hornblende in many cases occurring in the most delicate acicular crystals, distinctly growing out into the large unfractured plagioclase crystals on all sides. In the norite from Lake St. John,[1] however, where these zones are especially well developed and which is the occurrence that I have been able to study most carefully, there is practically no evidence of great dynamic action, and the zones seem to be due to the caustic action of the molten magma before the solidification of the rock. There is, however, one difference between occurrences described in this paper and those described by Cross and Weinschenk, namely, that in these Yukon rocks the minerals in question penetrate and apparently grow into, not one mineral but several minerals.

This third hypothesis seems, therefore, to be the one which best accounts for the very peculiar mode of occur-

[1] "On the presence of zones of certain Silicates about the Olivin occurring in Anorthosite rocks from the River Saguenay." American Naturalist, Nov., 1885.

rence of these minerals in the rocks described in this paper. It is hoped that similar occurrences may present themselves in more accessible localities so that a more thorough study of them may be made, since, if it could be shown that secondary minerals are commonly developed in this way much light would be thrown on the nature of the complicated processes at work during the metamorphosis of rocks.

Philip Henry Gosse.

By Carrie M. Derick, B.A.

One of the earlier explorers in the rich field of Canadian natural history, and a man who did much towards the popularization of scientific knowledge, the late Philip Henry Gosse, has been excellently portrayed in a recent biography by his son, the London poet, who not only brought to his task rare literary ability, but had at his command a great mass of biographical material collected by his father. From his "Life"[1] the materials for the following sketch have been obtained.

In their married life, Thomas and Hannah Gosse presented a curious picture of incongruity. He was a wandering miniature-painter, shy and unambitious, not an inspired artist but a good draughtsman with a keen appreciation of the beautiful. His wife was strikingly handsome, an uneducated, passionate woman, whose strong practical nature made her the ideal mainstay of the family under the most trying circumstances.

Their second son, Philip, was born in Worcester in 1810. But his parents soon removed to Poole, where his childhood was passed. He obtained the rudiments of an education in an ordinary day-school, but the truly educative influence of these early days was constant association with his aunt, Mrs. Bell, who was a woman remarkable for her devotion to

[1] The life of Philip Henry Gosse, by his son Edmund Gosse, London, Keegan, Paul, Trench, Trubner & Co., 1890.

science, and filled with a passionate love of nature, with which she succeeded in so imbuing her nephew that scientific research remained for him the one unfailing charm of his existence.

Mrs. Gosse, though herself uneducated, appreciated the talents early displayed by her son, and made strenuous efforts to advance his education, sending him for a short time to the Blandford School, where he received the only classical training he ever enjoyed.

The extreme poverty of his parents forced them, in 1814, to place him in a large mercantile house in the Newfoundland trade. His duties were not heavy and he found much time for miscellaneous reading. The magic of romantic poetry took him captive. His chief amusement, however, was zoology, and from every source he added to his information in this department, searching for specimens, copying plates, reading descriptions. When he was sixteen, a travelling menagerie aroused in him one of the strongest passions of his life, a love of tropical lepidoptera. The collection contained one of the grand silver-blue butterflies of South America, and "this created an extraordinary longing in the boy's heart to go out and capture such imperial creatures for himself." The gratification of this desire was long delayed but in 1827, an appointment in a counting-house in Carbonear, Newfoundland, enabled him to begin his studies of the insect-life of the New World.

The next five years were spent in work uncongenial but not arduous. A visit of six weeks to his old home was his only holiday, but his opportunities for pursuing his studies were many. The period is very important, marking as it does, his transition from boyhood to manhood, and the development not only of his scientific tastes but of that peculiar religious fervor which characterized him throughout his life.

His studies were made without the aid of books or proper apparatus, so that he was largely thrown upon his own resources. Turning to nature, the great fountainhead, he so assimilated her teachings, that he was afterwards the better able to profit by the records of the researches of others.

His business duties were uninteresting, the comparatively minute and inconspicuous character of the insects of Newfoundland failed to satisfy him, and his discontent was further increased by the social gloom that darkened the life of the colony. Little, therefore, was needed to make him sever his connection with Carbonear. Many circumstances combined to turn his thoughts towards Canada. It had the fascination of the unknown, the romance of the "forest primeval," its riches were described in glowing terms by emigration agents, its insect life was glorified in a popular work which fell into his hands. He felt destined for a successful farmer, skill being of secondary consideration in a land so wonderfully rich. Confident of success, he wrote to his brother asking him to join him in an Arcadian life, saying: "We would have all things in common; we could entomologize together in the noble forest, and, in the peaceful and happy pursuits of agriculture, forget the toils and anxieties of commerce. Not that our lives will be idle, for we shall have to work with our own hands, but there will be the pleasing and stirring consciousness that our labor is for ourselves, and not for an unkind, ungrateful master. The land where I go is exceedingly fertile and productive, and, with little more than half the toil necessary on an English farm it will yield not only the necessaries, but even the luxuries of life." At first, he intended to go to the shores of Lake Huron, but acquaintances in Quebec dissuaded him, and he made an excursion to Compton where he finally decided to buy a partially cleared farm; doubtless induced by the profusion of butterflies. Long afterwards, he wrote in regard to his settlement at Compton, "I felt and acted as if butterfly-catching had been the one great business of life."

Ploughing and sowing, teaching in the district schools, failing in all his attempts, he nevertheless managed to retain his rosy dreams for many months. Rejoicing in the beautiful scenery, revelling in the novel riches of the animal life, he forgot his troubles and enthusiastically studied not only the insects, but all the natural objects, keeping copious notes which he afterwards embodied in the "Canadian Naturalist," his first published book. "The first encouragement from without which came to him in his career," says his biographer, "the earliest welcome from the academic world, arrived in the spring of 1836, in the modest shape of a corresponding membership of the Literary and Historical Society of Quebec. This was quickly followed by a similar compliment from the Natural History Society of Montreal. Those elections indeed conferred in themselves no great honour, for these institutions in those early colonial days, were then in their boyhood and too inexperienced to be critical in their selection. It was none the less a great gratification to the young man. He contributed papers to the *Transactions* of either societies, sending to Montreal a *Lepidoptera Comptoniensa*, and to Quebec an essay on *The Temperature of Newfoundland* and *Notes on the Comparative Forwardness of Spring in Newfoundland and Canada.* He also sent to the new museum at Montreal a collection of the lepidoptera of Compton." But poverty, fatigue, ill-health and a sense of failure at last overwhelmed him. He yielded to his misfortunes and sold his farm, blaming the country for the sad ending of his bright hopes.

One turns with relief to the record of his scientific life. The "Canadian Naturalist," was intended by him to be a kind of "Naturalist's Calendar," setting forth the praise of God and showing the delights he felt in study. Unfortunately, it is presented in the form of a dialogue between a father and a son, which is sometimes tiresome, always rambling, but which notwithstanding its crudity, shows the germs of those qualities which afterwards made Gosse a popular and useful writer:—"picturesque enthusiasm, scrupulous attention to truth in detail, a quick eye and responsive brain, and a happy gift in direct description." It was one of the earliest books to call students from the laboratory and museum to the woods and streams and bid them "observe the living heart of nature." Appearing at a time when little was known of the natural wonders and resources of Canada, it was a valuable addition to the scientific knowledge of the land, and, doubtless, inspired some of its sons to undertake a more systematic study of the natural history of their native country.

Looking with longing eyes towards the semi-tropical life of the Southern States, in 1838 Philip Gosse left Canada, the only trophy of his struggles there being a large cabinet of insects. The next year he spent in Alabama, teaching a small school for the sons of planters. In his leisure, he continued his favorite pursuits in the midst of delightful natural surroundings. In a letter of July of that year, he says:—"An eye accustomed only to the small and generally inconspicuous butterflies of our own country, can hardly picture to itself the gaiety of the air here, where it swarms with large and brilliant hued swallow-tails and other patrician tribes, some of which, in the extent and volume of their wings, may be compared to large bats. These occur, too, not by straggling, solitary individuals, in glancing over a blossomed field, you may see hundreds, including I think, more than a dozen species, besides other butterflies, moths and flies.

A rather amusing incident is related as having occurred about this time. "In Alabama the squirrel question was one of great importance in local politics. These delightfully amusing animals are unfortunately wasters of the first order; they are in the cornfield morning, noon and eve, from the time that the grain is growing in the sheath to the moment when what remains of it is housed in the barn. While Philip Gosse was at Mount Pleasant, a fellow from the north sent round an advertisement that he would lecture in a neighbouring village, and that the subject of his discourse would be to reveal an infallible preventive from the thefts of the squirrels. The announcement attracted great curiosity, and the planters assembled from all sides. A deputation started from Mount Pleasant itself, and Philip Gosse, thinking to hear what would be of interest to a naturalist, was of the party. A considerable entrance fee was charged but very willingly paid. At last the room was full, the doors closed, and the orator appeared on the platform. He began by describing the depredations of the squirrels, the difficulty of coping with them, and various other circumstances with which his audience was familiar. He was a plausible fellow and seemed to have mastered his subject. At last he approached the real kernel of the question." "You wish," he said, "to hear my infallible preventive, the absolute success of which I am able to guarantee. Gentlemen, I have observed that the squirrels invariably begin their attacks *on the outside row* of corn in the field. *Omit the outside row*, and they won't know where to begin!" The money was in his pocket; he turned and vanished by the platform door; his horse was tied to the post, he leaped into the saddle and was seen no more in that credulous settlement. The act was one of extreme courage as well as impudence in that land of ready lynching, but my father was wont to say that after the first murmur of dissatisfaction and words of anger, the disappointed audience dissolved into the most good-humoured laughter at themselves."

Notwithstanding this delightful field for study and the kindly, rough-and-ready hospitality of the planters, after the first few months Gosse was utterly miserable. As an Englishman, his prejudices clashed with those of his companions, and though no humanitarian, he was sickened by the horrors of slavery, which even to him, seemed indispensable in Alabama. In January, 1839, he, therefore, abruptly took his departure, seeking after a twelve years' exile, his life-work in his childhood's home. He was reduced to extreme poverty, and knew not where to turn, when his cousin, Prof. Bell, recommended the manuscript of the "Canadian Naturalist" so highly to Mr. Van Voorst, the publisher, that he offered one hundred guineas for the work. This offer was accepted with joy, and never again in his career as an author was Philip Gosse reduced to such straits. The next few years were full of intellectual effort, but little of his work during this period was published. Two books, however, "An Introduction to Zoology," and the "Ocean," written for the Society for Promoting Christian Knowledge, opened his eyes to the fact that he was destined to be a popular author. "The Ocean" showed a great advance in literary style, and was fully illustrated by the author himself who, without imaginative power, was a correct and minute reproducer of animals and plants.

Towards the close of 1844, a pleasant break occurred in the monotony of his life. He was sent upon an exploring expedition to Jamaica, a land at that time almost unknown to naturalists. The two following years were spent in a careful, thorough investigation of the ornithology of that island. During his stay he made many important contributions to the science of zoology, proving two hundred species of birds to be indigenous to the country, and discovering twenty-four new species of mammalia, reptiles and fishes. His "Naturalist's Sojourn in Jamaica" is probably the most delightful of his books. Full of lovely descriptions of the picturesque scenery of the island, it also shows his life there to have been crowded with scientific incident and valuable experiences. A more technical record of his work is found in "The Birds of Jamaica," written shortly after his return to London; but, though well received by those best qualified to judge of its merits, the book was a financial failure.

His religious life was always intense and of that stern character which brooks no compromise with the world. About this time, therefore, becoming dissatisfied with Methodism which he considered to have fallen from its former high estate of unworldliness, he connected himself with the "Plymouth Brethren." At these meetings, he frequently met Miss Emily Bowes, whom he married in 1848. She was a woman of mature mind and sober tastes; of great tact and wisdom, and during the nine years of her married life she did much towards developing the gentler side of her husband's character, rendering him less shy and reserved, more sympathetic and genial. While sharing his religious views, she exercised an influence over him opposed to his naturally stern and fanatical temperament.

The first year of their married life must have been one of self-repression difficult to her social, cheerful nature, for Philip Gosse's "ideal of life was to exist in an even temperature of domestic solitude, absorbed in intellectual work, buried in silence." However, as time passed on, the two grew nearer together and daily became more harmonious in feelings and tastes.

In 1849, their son Edmund was born. But an event of far greater interest to Gosse marked the year for in June, "he made his first independent examination of a rotifer under the microscope, and the date may be worth noting, as that of the opening of one of the most important of all the branches of his labours. The extreme ardour with which he took up subjects sometimes wore itself out rather rapidly. He grew tired of birds, afterwards he grew tired of his once well-beloved sea-anemones. But in the rotifers, the exquisite little wheel animalcules, whose history he did so much to elucidate, in these he never lost his zest, and they danced under his miscroscope when he put his faded eye to the tube for the last time."

For the last five years Gosse had been leading a life of severe work, almost without social interests and unbroken by holidays. Its monotony proved injurious to his health, and he consequently left London in 1852 and for a time established himself at St. Marychurch, South Devon. He remained there long enough to develop the idea of the marine aquarium, and to carry on the researches described in "A Naturalist's Rambles on the Devonshire Coast." After a few months however the climate proved enervating, and he removed to Ilfracombe, where he threw himself with ardour into the work of exploration and made several discoveries recorded in "The Devonshire Coast."

The chatty style of his books seems to have suggested the idea that he might prove a popular lecturer, and though he had never attempted such a thing, in 1853 he consented to make a few remarks about sponges which he was studying at the time. He illustrated his lecture with large drawings in chalk upon the blackboard, and the success of the novel experiment was such that he continued lecturing for several years.

In 1854, Gosse gave to the world "The Aquarium," a delightful record of eight months hard work on the Dorsetshire Coast, where he had been collecting material for the aquaria of Regent's Park. The volume was reviewed by Charles Kingsley who subsequently expanded the review into that charming little book "Glaucus," the pages of which are full of the praises of Gosse, his recently acquired friend. Gosse further extended his acquaintance with the English coast by a visit in 1854 to Tenby in Pembrokeshire. "Its honeycombed rocks and weedy basins" made his work there uniformly brilliant and successful, and a graphic account of his experience is given in "Tenby," a book which displays more than any other his "air of taking us upon his knees like a grandpapa."

He was elected a "Fellow of the Royal Society" in 1856, and his treatise on the "Manducatory Organs in the Class Rotifera," published in the Society's Transactions, brought him into further notice in scientific circles.

But the joy of success was soon dimmed by a great sorrow. Emily Gosse, while helping her husband, attending to household duties, and occupied with the writing of popular Gospel Tracts, had been slowly failing, and in February 1856 she died. The loss of this noble woman and true wife marked a crisis in her husband's career. Every year her influence had become more apparent, and had added to the brightness of their life; but now Gosse became more reserved than ever, and withdrawing to Sandhurst near St. Marychurch, he made there his solitary home.

Given up to morbid musings and in a state of mental exhaustion, he turned his thoughts towards evolution, a subject to which previously he had paid but little attention. In 1855 he had been presented to Charles Darwin, and had, at once, yielded to the fascination of his simple, cordial nature. For some years he continued in correspondence with him, helping him by investigations and memoranda which tended to strengthen those evolutionary ideas, destined to stand opposed to his dearest beliefs. Gosse was not a philosophical thinker, but a minute observer and accurate describer of facts, and for sometime he did not concern himself with the theories developed from the details he furnished. At last, however, his conscience forced him to enter a protest against the hypothesis of evolution. "The current interpretation of the Bible lay upon his judgment with a weight he could not throw off. Therefore, leaving his own field of research, he entered the list with scientific philosophers to his own discomfiture and the regret of his friends."

"Omphalos" was an attempt to reconcile the six-day theory of creation with the facts of geology. His theory was this: "Life is a circle, no one stage of which more than another affords a natural commencing point. Every living object points irresistibly to the existence of a previous living object of the same kind. Creation, therefore, must mean the sudden bursting into the circle, and its phenomena produced full-grown by the arbitrary will of God, would certainly present the stigmata of a pre-existent existence." By many examples he strives to show that this has been the case with living forms and concludes that the various formations of the earth's crust with their fossils, are not records of past ages teeming with strange life, but mere marks upon the surface of a world, full-grown from its birth, representing links in the cycle of its development which had no existence except in the thought of the Creator.

His argument is ingenious, but the book was an utter failure from the first, not even receiving the approval of the orthodox party. Kingsley's criticism voiced their feelings. In a characteristic letter to Gosse, he said: "I do fear your book has given the 'Vestiges of Creation' theory the best shove forward it has ever had."

The work, nevertheless, served a good purpose in removing the author's depression. He returned with enthusiasm to his proper sphere of observation and gave to the world in 1860, "A History of the British Sea-anemones and Corals." As if for recreation, he then turned to the poetic side of nature, and his "Romance of Natural History" has, perhaps, more purely literary merit than any of his other writings, and still possesses a charm for readers long accustomed to popular works on science.

A kind of inertia had begun to creep over Gosse. One by one, he had dropped his old acquaintances, and daily retired more within himself. In 1860 however he married again, and Miss Brighton, who became his second wife, proved the good genius of his home.

Orchids and coloured stars now became the objects of his devotion. In 1875 he wrote: "In enthusiasm, in the zest with which I enter into pursuits, in the interest which I feel in them, even in the delights of mere animal existence, and the sense of the beautiful around me, I feel almost a youth still."

His latter years were passed in the enjoyment of the new hobbies and of the old ones revived. Butterflies and rotifers again occupied his attention; and at the close of his career, he had the great pleasure of sharing in the compilation of Dr. Hudson's well-known work on "The Rotifera." But the end of his labours was fast approaching. One night, while searching for double stars, he took a severe cold which resulted in his death on August 23rd, 1888.

His works live after him and in them is found the fullest expression of his mind and character. His reserved and unsympathetic nature made it difficult for him to reveal himself to those about him. His friendships, therefore, were ephemeral. Even Charles Kingsley tired of constant efforts to come into closer touch with one entrenched behind an impenetrable wall of reserve. His peculiar religious views increased his isolation, but all who knew him respected him for his rigid adherence to his sacred beliefs, for his pure heart, and his reverential faith.

Of him, as a careful student of the details of science, too much can hardly be said. "His extreme care in diagnosis, the clearness of his eye, the marvellous exactitude of his memory, his recognition of what was salient in the characteristics of each species, his unsurpassed skill in defining those characteristics by word and by pencil, his great activity and pertinacity, all these combined to make Philip Gosse a technical observer of unusually high rank."

Notes on the Flora of St. Helen's Island, Montreal.[1]

By D. P. Penhallow.

In the latter part of June of the present year, a visit was paid to St. Helen's Island, not so much in the expectation of discovering any striking features in the flora of that delightful park, as for a quiet afternoon's enjoyment. It was, therefore, a matter of considerable surprise to find not only a rather rich flora for so small an area, but several species not found elsewhere or but rarely, growing in considerable abundance. Mr. Henry Mott has recently drawn my attention to a little book on St. Helen's Island, by A. Achintre and Dr. J. A. Crevier,[2] in which an account of the plants is given. The list comprises ninety species for the entire season, a number probably much below what would actually be found by careful examination. So far as we are aware this is the only list published up to date. It is much to be hoped that the short list now given may be extended and made complete in the near future. It comprises some plants not noted in the list above referred to.

It may be noted that the peculiar situation of the Island, surrounded as it is by a large body of water, undoubtedly tends to more equable conditions than obtain on the main land, and hence favor the establishment there of species which might not be found elsewhere in the neighborhood of Montreal. The former occupation of the Island as a military post by the British troops, would also serve in large measure to account for the presence of several species which do not flourish elsewhere.

As we follow the main walk leading from the landing to the band stand, and about two thirds way across the Island,

[1] Contribution from the Botanical Club of Canada.

[2] L'Isle Ste. Helene, passé, présent et avenir, par MM. A. Achintre et J. A. Crevier, M.D., Montreal, des ateliers du journal *Le National*, 1876.

several species of the nettle tree (*Celtis occidentalis*, L.) will be observed. From this point to the band stand and as far beyond as the entrance to the fort, numerous specimens will be found. The only other locality near Montreal, where this species occurs, is at St. Anne's. On the road from the station to Dr. Girdwood's, and about half way to the latter place, a number of fine trees may be seen on each side of the highway. Again, about two miles beyond, near Mr. Forget's, there are several more trees.

The three thorned acacia (*Gleditschia triacanthos*, L.), is found within the fort, near the old officers' quarters. The trees are fine specimens and stand in a row where planted for ornamental purposes. While this species is commonly cultivated in Southern Ontario, it is but rarely found in Quebec, the only other locality known to me being Cote St. Antoine.

The other trees found are chiefly those common to the vicinity of Montreal. They embrace the common beech (*Fagus ferruginea*, Ait.), white oak (*Quercus alba*, L.), an occasional specimen of the white hickory (*Corya alba*, Nutt.), one specimen of black walnut (*Juglans nigra*, L.) This tree is never found in Quebec in the wild state, and but few instances of its occurrence in cultivation here are known to me. At the Botanic Garden, at the top of Cote des Neiges hill, are one large tree and two small ones, all apparently thrifty.

White birch (*Betula populifolia*, Ait.), sugar maple (*Acer saccharinum*, Wang.), and silver maple (*Acer dasycarpum*, Ehrh.), the latter planted along the road for shade purposes, are abundant, as also are the American basswood (*Tilia americana*, L.), white elm (*Ulmus americana*, L.), and butternut (*Juglans cinerea*, L.) Slippery or red elm (*Ulmus fulva*, Michx.), and English elm (*Ulmus campestris*), are met with occasionally.

Of the smaller trees and shrubs, the hawthorns, so abundant everywhere about Montreal, are represented by *Cratægus coccinea* and *Cratægus tomentosa*. The round leaved cornel (*Cornus circinata*, L'Her.), common elder (*Sambucus racemosa*, L.), choke cherry (*Prunus Virginiana*, L.), sumac

(*Rhus typhina*, L.), are all common. The common lilac (*Syringa vulgaris*,) and buckthorn (*Rhamnus cathartica*, L.), are found near the old officers' quarters, where they were evidently planted for ornamental purposes. The common mountain maple (*Acer spicatum*, Lam.), is quite common through the woods.

The other plants found present no other features of interest beyond their representation there, as shown in the following enumeration:—

Acer dasycarpum, Ehrh.
" *saccharinum*, Wang.
" *spicatum*, Lam.
Achillæa millifolium, L.
Ampelopsis quinquifolia, Michx.
Anemone virginiana, L.
Aquilegia canadensis, L., very common.
Archangelica gmelini, D C., abundant.
Artemisia vulgaris, L., very common.
Arctium lappa, L.
Asclepias cornuti, Decaisne, very common.
Aspidium filix-mas, Swartz.
Betula populifolia, Ait.
Carya alba, Nutt.
Celtis occidentalis, L.
Cnicus arvensis, Hoffm.
Cratœgus coccinea, L.
" *tomentosa*, L.
Cratœgus oxycantha, L. Introduced here for ornament. One of the few places about Montreal where it has become established.
Cornus circinata, L'Her.
Cynoglossum officinale, L.
Erigeron philadelphicus, L.
Fagus ferruginea, Ait.
Geranium maculatum, L.
Gleditschia triacanthos, L.
Impatiens fulva, Nutt.
Inula helenium, L., very common.
Juglans cinerea, L., occasional.
" *nigra*, L., rare.
Lithospermum officinale, L., rather common.
Menispermum canadense, L.
Onoclea sensibilis, L.

Pastinaca sativa, L.
Plantago major, L.
Potentilla anserina, L., very common.
" *norvegica*, L.
Prunus virginiana, L.
Quercus alba, L.
Ranunculus acris, L.
Rhamnus cathartica, L. Introduced, but apparently spread from the original location.
Rhus typhina, L.
Rosa blanda, Ait.
Rubus odoratus, L.
Rumex crispus, L.
Sambucus racemosa, L.
Sanguinaria canadensis, L.
Scrophularia nodosa, L., very abundant within the fort's limits.
Solidago canadensis, L.
Syringa vulgaris,
Taraxacum dens-leonis, Desf.
Tilia americana, L.
Trifolium repens, L.
Typha latifolia, L.
Ulmus americana, L.
" *campestris ?*
" *fulva*, Michx.
Urtica gracilis, Ait.
Verbascum thapsus, L.
Vicia sativa, L.

Annual Presidential Address.

By Prof. Bernard J. Harrington.

I suppose that most of us have at some time stood at the stern of an Ocean steamship and gazed back at the great expanse of water left behind, and the long line marking the vessel's course. Perhaps, too, we have gone forward and looked out upon the stretch of waters ahead, wondering as to the future calm or storm, or endeavouring to peer through rising mists and see the light on some distant headland. So we, as a Society may—and I think with advantage—from time to time, look backwards and then forwards, endeavouring to learn from the past lessons that may help us in the future. I am not one of those who delight in calling attention to past failures, or who rejoice in gloomy forebodings as to the future. Nor would I, on the other hand, paint in golden hues what would be more accurately depicted by neutral tint. Hopefulness is an essential element of success in such a Society as ours, but croaking is not the parent of hopefulness, and exaggeration invariably begets disappointment.

The Natural History Society of Montreal is now 64 years old, and considering the difficulties with which it has to contend, the mere fact of its continued existence is something to be proud of. Like most organizations of the kind it has had its ups and downs; but on the whole its course has been one of progress. Beginning in 1827 with 26 members it now numbers, apart from corresponding members, 222. Then its property was entirely prospective, while today it is entirely free from debt, owns a building which originally cost nearly $11,000 apart from the land, and is now worth a much larger sum. It has brought together large and valuable collections representing different departments of natural history, ethnology and archæology, and a library containing over 3,000 volumes, many of them of very great value to the scientific man. I refer more particularly to the bound series of scientific journals and the transactions of many learned societies.

But while our Society was founded in 1827, its true life dates from 1857, when it adopted the "Canadian Naturalist and Geologist" as its organ of publication. It will be remembered that this journal was begun in 1856 by the late Mr. Elkanah Billings, at that time a barrister at Ottawa. The first volume was published by him, but on being called to Montreal to occupy the important position of Palæontologist to the Geological Survey, the continuance of the "Naturalist" was assumed by our Society. In 1884, owing to circumstances which it is unnecessary to detail here, the title of the journal was changed to that of the "Canadian Record of Science," under which name it has been most ably edited by Prof. Penhallow. Altogether we have published 21 volumes with an aggregate of nearly 10,000 pages. Scientifically, the value of these pages is very great, and, but for our Society, a large proportion of the information which they contain would have been lost to Canada and the world. To-day, anyone working at Canadian science must make frequent reference to them, and the more he studies them the more he will be impressed with their value. This, at least, is my experience. Their usefulness, however, would be greatly enhanced by a general and properly classified index, and I may perhaps, be allowed to suggest to the incoming editorial committee the advisability of preparing and publishing one.

Our original constitution states that "the chief object of the Society shall be the investigation of the Natural History of Canada." According to the original By-laws, too, we find provision made for a Committee of Publication, to whom "all essays read before the Society shall be referred, to the end that they may select those which may appear of sufficient value to cause them to be published."

Great importance was obviously attached to the publication of papers giving the results of original work, and this, it seems to me, is really our most important function, being the most lasting in its results and serving to connect us with the scientific world outside.

There is, however, another portion of our work to which I attach very great value. I refer to our free popular lectures—the "Somerville Course." Having been Chairman of the Lecture Committee for the past eight years, I have come to feel a deep interest in this department of the Society's work, and it is not without much regret that I now—as I must—resign it to other hands.

Previous to the bequest of Mr. Somerville, we find that popular lectures under the auspices of the Society had been attempted, though not always with success. The first course was during the winter of 1832-33. In 1835, a popular course on Botany was undertaken by Dr. Hall, but had to be given up for want of an audience. In 1837, the Rev. James Somerville, Minister of St.

Gabriel Street Church died, leaving a sum of £1,000 currency to maintain an annual course of lectures in connection with the Society. Exactly how this money was utilised at first I am not aware, but we all know that eventually it was put into our building, the Society, however, making itself responsible for the provision of an annual course of free lectures. I do not say that this appropriation of the money was unwise, but I have long felt it to be the duty of this Society to raise an equal, or if possible, a very much larger sum, the interest of which could be made available in connection with the lectures. Had the Society means at its disposal, the usefulness of the lecture work could be greatly extended. It would, for example, be possible to secure from time to time, services of distinguished lecturers from the neighbouring republic, and to hire a larger hall than ours for special occasions. During the past few years we have been able to induce scientific men to come from other cities of the Dominion to address us, but have been unable to offer them anything but their travelling expenses in return. Nor is it right that gentlemen from our midst should be called upon so often, not only to lecture without remuneration, but to pay the cost—often considerable—of the materials used to illustrate their lectures.

It is to be regretted that our own hall is not larger; for on lecture evenings it is often overcrowded, and for the past five years we have been afraid to advertise our courses fully, knowing that it would be impossible to accommodate larger audiences.

The interest shown by the public in our lectures convinces me that they are one of the needs of our growing city, and I sincerely hope that before long it may be possible to greatly expand the work. During the past five years we have done what we could to improve and systematise the courses, and in this we trust we have not wholly failed.

Apart from our Somerville lectures, it would perhaps be worth while to try short courses on special subjects by one lecturer. Such courses have recently been tried in the

Manchester Museum, and have, we are told, been fairly attended. A course of evening demonstrations by the keeper in the museum there has also been attempted, but has been given up as it did not meet with satisfactory encouragement.

We are sometimes told that our Society does little for the public; but such a statement can only arise from ignorance. Much more I admit might be done, but if we measure what has been accomplished by the support which we have received from the apathetic public of this city, then I say there is little ground for complaint on the part of the public. Let any fair-minded person study our Records with care, and I believe he will admit that they contain a history of self-sacrificing endeavour to benefit the community and advance the cause of science. If we have failed to accomplish very grand results, it must be borne in mind that all along we have had to struggle for bare existence, that our work has, for the most part, been done by men harassed with the cares of business life or worried with the ever increasing duties of modern educational or professional work.

I have referred to the value of our journal, to the importance of our lectures and museum as means of public education, but let me remind you that the inception of the Geological Survey of Canada was largely due to the energetic action of this Society in 1841; that the city owes the visits of the American Association for the advancement of science in 1857 and 1882, and of the British Association in 1884 to this Society. The Royal Society of Canada, too, holds its meeting here next week owing to an invitation from our body, and there is every reason to believe that good results will flow from this gathering. Speaking as one of the Fellows, I may say that, while I believe that Ottawa should be the permanent headquarters of the Royal Society and the place where most of its meetings should be held, an occasional gathering elsewhere will be beneficial both to entertained and entertainer. It was never, however, intended that the Royal Society should be peripatetic like the British and American Associations, of which it is not the Canadian analogue. The French Academy and the National Academy at Washington, are rather the models after which our Royal Society was formed.

The monthly meetings of the Natural History Society are its strictly scientific evenings, the Somerville Lectures its popular evenings. At the former the papers are of a technical character, and therefore, the meetings are apt to be small, though really not smaller than in the case of similar societies elsewhere, and now much larger than they have been at times in the past. If we look back at the Records of 1844 and 1845, we read of meetings with an attendance of six, five, or even four members. In 1848, again, after the Society had been in existence for more than 20 years, we find the council regretting that at several of the ordinary meetings business could not be proceeded with for want of a quorum.

Now the question sometimes arises, "Would it not be better to make the monthly meetings less technical—more popular?" Personally I do not think so. What we want, it seems to me, is not fewer meetings for the discussion of purely scientific questions, but more occasions for the popular presentation of science. On such occasions, I am sure that our friends of the Microscopical and Entomological Societies would be willing and happy to give us their kindly aid. Here let me say, that I regard the affiliation of the latter society with ours as a step in the right direction. In a community like this, what is needed is concentration of energy rather than multiplicity of organizations. In connection with the subject of meetings and members, I would suggest that an effort be made to get more lady associates and to have more of them at our meetings. From remarks which I have recently heard, it does not seem to be generally known that ladies may become associate members, and that the annual fee is only $1. Additions should also be made to the number of our corresponding and honorary members, and unless we wish to be accused of holding intercourse with the spirit world the roll of the former should be revised; for there remain upon it names of many who have long gone hence.

The recent donation to the Museum by the Rev. Dr. Campbell of a collection of British plants, and the necessity of providing a proper place for its preservation, brings prominently before our notice the fact that this Society—a Natural History Society—has no herbarium. That it once had a nucleus of a herbarium we know; and it is a disgrace that it should have been allowed to go to destruction; for special interest attached to it on account of those who contributed to its formation. I am told that it once included the Macrae collection containing 2,000 specimens, the Holmes collection of 750 specimens, 300 specimens from the neighbourhood of Edinburgh collected by the late Dr. Hall, a collection of Canadian plants made and presented to the Society by Lady Dalhousie, &c., &c.

It is not for me to enter into details with regard to the recent improvements in the museum, but I am sure that the Society is under great obligation, not only to the Honorary Curator, Mr. Brown, but to all the gentlemen who have so ably assisted him in the work of re-arrangement. In the museum too, as well as in all matters pertaining to the interests of the Society, the services of Mr. Griffin the superintendent, have been invaluable, and I hope that before long the Society may be able to make his position a much better one than it is at present.

The need of means for improving the museum and adding to our collections is, I know, deeply felt by the Honorary Curator; for while some branches of Natural History are well represented, others require great additions to bring them up to date. Take our mineral collection for example, I suppose that it is little better now than it was forty or fifty years ago.

In our library great improvements have been made by Mr. Chambers; but here again money is required. The additions consist almost entirely of miscellaneous journals and pamphlets received in exchange for the Record of Science, and while these are of great value, the library would be rendered far more attractive if we could now and then place on our shelves, or better still, upon our table, some of the more recent books on different branches of natural history. I am sure this would be a great boon, more particularly to our younger members.

But it is easy to expatiate upon the needs of such a Society as this. Every advancing institution has ever increasing needs, and you may be sure that a society without needs is in a state of stagnation. Some of the improvements which I have suggested I had hoped to see carried out during my own tenure of office; but a year soon rolls by, and what I anxiously hoped to do I must leave to others to perform. I have so many claims upon my time and strength that I now wish to retire to the ranks of this Society, and in doing so, let me thank you heartily for the honour that you did me in making me your President, and for all the kind indulgence that you have shown me during the past year. Though unwilling longer to hold any office in the Society, I trust that indirectly I may be able to advance its interests in different ways.

In conclusion, gentlemen, let me remind you of the great satisfaction which everyone may derive from a study of nature, who, as Wordsworth puts it,

> "Never did betray the heart that loved her."

Sometimes down at the sea-side I fall in with people who tell me that the time hangs heavily on their hands—there is nothing to do—nothing to see; and yet every wave that breaks upon the beach at their feet is filled with surpassing forms of beauty, whose study would make the hours all too short.

One man some years ago asked me how I could endure the monotony of such a place as Little Metis. "I like," said he, "to go where I can see horse races every day and fire works every night." Is there pity too deep for such a man?

"The soft blue sky did never melt into his heart."

The busiest among us are those most in need of change of thought and scene, and nowhere can more complete change be found than in the fairyland of nature. The man who perpetually harps upon one string will no doubt become familiar with its vibrations, but he will never be a musician, and he who, year in and year out, keeps his nose on the same grindstone, is not likely to become a man of much breadth of view.

I do not think that anyone's business will suffer seriously because he devotes an occasional hour to the study of nature, and if occasional "sermons in stones" can make him "see good in everything," he ought not to grudge the loss of a few dollars.

Proceedings of the Society.

The annual meeting of the Society was held on Monday the 21st. of May, Dr. B. J. Harrington in the Chair.

The following reports were read and adopted :—

Report of the Council.

Gentlemen :—The Council beg to submit their Report for 1890–91. Decided progress has been made by the Society during the session just closed, and great interest manifested in all its proceedings. Eleven meetings of Council have been held, and seven monthly meetings of the Society, at which valuable and instructive papers were read. Fourteen ordinary members, and two associates, have been elected during the year. The Museum has been re-arranged, and a considerable amount of money spent upon it; the Hon. Curator's report will contain all the details. The Library also has come in for a large share of attention and expenditure, and will be reported on. The building of the Society is in good order, and the hall has again been rented to the Congregation worshipping there. At the invitation of our Society, which has done much for the advancement of science and education in Montreal, the Royal Society of Canada will hold its next meeting in this city on the twenty-seventh of May. This will be the first time the Royal Society has held its meetings outside of Ottawa, and a large number of men of science are expected from all parts of Canada and the United States. It would have been a source of pleasure and profit if some of the savants of England and France who were invited, could have met with the Royal Society on this occasion, but, we regret to say, the time between the invitations and the meeting was too short to permit of their making suitable arrangements to be present. The several committees which have been appointed to receive the Royal Society and the Governor General, who is to be present on this occasion, will, we are sure do everything in their power to make the meeting one of the most successful ever held by the Society, and we hope it may lead them to select other cities in the Dominion for future meetings.

The Somerville Lectures were unusually interesting this year, and the attendance large. They were six in number, and delivered in the following order:—

Thursday, March 12th—" A Popular talk about Birds." By J. M. Lemoine, Esq., F.R.S.C., Quebec.

Thursday, March 19th—" Ants—A Home Study." By Very Rev. Dean Carmichael, M.A., D.C.L.

Thursday, March 26th—" The Squid and its Relations." By Sir J. Wm. Dawson, C.M.G., F.R.S.

Thursday, April 2nd—" Coral Animals." By F. D. Adams, M.A.Sc.

Thursday, April 9th—" Domestic Pets." By Professor D. McEachran, D.V.S.

Thursday, April 16th—" Domestic Fowls." By Dr. T. Wesley Mills.

(Then follows an account of the Society's Field Day at Lachute, a report on which will be found on page 199 *et seq.* of this volume.)

The thanks of the Society have been tendered to the distinguished gentlemen who gave their valuable time for the advancement of its interests. The next Field Day will be held at Calumet on Saturday May the 30th, leaving Windsor St. depot at 9.10 a.m. by special train. It is expected that a number of the members of the Royal Society will join the excursion. The whole respectfully submitted.

JOHN S. SHEARER,
Chairman

CURATOR'S REPORT.

To the President and Members of the Natural History Society,

GENTLEMEN :—I have the honor to report that the work of re-arranging the Museum which was commenced nearly two years ago, may now be said to have been completed—so far as space and accommodation would allow—in accordance with the plan outlined in my last Annual Report.

During the year, three large cases have been added to the main floor of the museum and occupy the centre space, and in these the mammals have been appropriately arranged, labelled, and classified by Mr. Horace T. Martin. This arrangement has allowed more space to be devoted to the birds which were previously too crowded to be seen advantageously.

A most complete classification of the Ornithological Collection has been made by Mr. Caulfield. The Canadian specimens have been kept separate, and the various families and groups so arranged as to be of the greatest scientific value to the student in quest of knowledge in this field.

The classification of the Entomological Collection has been completed by Mr. Winn, and an examination of this cabinet will show, that not only has the work been done with scientific accuracy, but also with so much neatness and taste as to reflect no small degree of credit on the efforts of this young worker.

The fossils have been arranged in the floor cases to the left of the main entrance, while the sponges and corals will be found immediately following. The Conchological collection has likewise been arranged to the right of the main entrance.

The rocks and minerals now occupy a prominent place in the gallery. Duplicate specimens have been removed and new ones introduced. Upwards of 2,000 neat white boxes have been made wherein to arrange the specimens. To Mr. E. H. Hamilton we are indebted for the very complete re-arrangement of this important department.

The Ferrier collection of Egyptian antiquities has been completely overhauled, the cases cleaned and relined and their contents carefully re-arranged.

The Indian relics, Esquimaux implements and Mexican antiquities, together with various other specimens of an historic nature have also been re-arranged and placed in new, or renovated cases and are now to be found at the south end of the gallery, where a complete re-arrangement of the cases having been made, and due regard to light having been paid, they are now seen to better advantage than ever before. This part of the work as well as that connected with the fossils and shells has been conducted by Messrs. John S. Shearer, E. T. Chambers and myself. To these two gentlemen along with the others whose names I have already mentioned am I specially indebted for the willingness and heartiness with which they have responded to the numerous demands made upon their time, and for their valuable assistance in aiding me to carry out these important changes. In this connection it is also my pleasing duty to refer to the assistance rendered by the Superintendent, Mr. Griffin, not only to me personally, but also to those who have been associated with me in this work, and to say that Mr. Griffin by hard work and earnest endeavour, has shown an interest in the affairs of the museum, far beyond what might be termed the ordinary line of duty.

During the alterations it was found necessary to close the museum for several months, and no accurate record of visitors was kept.

The work remaining to be done consists chiefly in labeling and placing a few new specimens.

The following specimens have been added to the museum during the year:—

DONATIONS.

Musk Rat, *Fiber Zebethicus.*

Antlers of Virginian Deer.
American Merganser, *Merganser Americanus.*
American Bittern.
Bobolink, *Dolichonyx Oryzioorous.*
American Pipits, (pair.)
Olive Backed Thrush.
Varied Woodpecker.
" " (young.)
Cedar Waxwing, (male.)
" " (female.)
Semipalmated Plover.
Buff Breasted Sandpiper.
Rose Breasted Grosbeak, (young.)
Cape May Warbler, *Dendroica Tigrina.*
Virginian Horned Owl.
Surf Duck.
American Goshawk, *Accipiter Antricapillus,* (female.)
Golden Wyandotte.
Lake Trout.
Three Cases Exotic Insects.
Caterpillar Fungus, *Sphaeria Robertsii,* from New Zealand.
Fossils from the Trenton formation.
Concretions from the Connecticut Clay.
Apatite, Renfrew, Ont.
" Templeton, Que.
Titanite, Renfrew, Ont.
Phlogopite, Templeton, Que.
Dawsonite, Montreal.
Copper Ore and Boulder from the Conglomerite vein of the Calumet and Hecla Mine, Michigan (Lake Superior.)
Nickel Ore and Nickel Matte from the Blizard Mine, Sudbury, Ont.
Specular Iron from the Republic Mine, Michigan.
Magnetic Specular Ore (Iron) from the Champion Mine, Michigan.
Japanese Tray.

By Exchange.

Buffalo Horns.

Respectfully submitted,

J. Stevenson Brown,
Hon. Curator.

Report of the Librarian.

Gentlemen:—In addition to our usual exchanges the following books have been added to your Library during the past year:—

The Mineral Resources of Ontario.
Report of the Royal Society of Canada, vol. 7.
Reports of the U. S. National Museum, 1886-87.
Proceedings of the U. S. National Museum, vol. 12.
Smithsonian Report, 1887.
Reports of the U. S. Geological Survey, 1886-87, pts. 1 and 2.
Monographs of the U. S. Geological Survey, vol. XV, pts. 1 and 2.
" " " " vol. XVI.
Fishery Industries of the United States.
Mineral Resources of the United States.
Occasional Papers of the Californian Academy of Science
Missouri Botanical Garden.
Bulletins of the N. Y. State Museum.
Proceedings of the Manchester Philosophical Society.

The following were presented by the authors:—

Birds of Greenland, by Andrews, T. Hagerup.
Physiographical Geology of the Rocky Mountain Region in Canada, by Dr. G. Dawson.
Sculptured Anthropoid Ape heads, by J. Terry.
Useful and Ornamental Stones of Ancient Egypt, by Sir W. Dawson.
Pleistocene Flora of Canada, by Sir W. Dawson and Prof. Penhallow.
Geology of Quebec and its Environs, by H. M. Ami.

The whole of the contents of the cases have been examined, the loose parts put up into volumes as far as they are complete, and 171 volumes have been bound and put on the shelves. The books have been classified in the cases as far as possible, and good progress is being made with the catalogue.

The exchanges have been duly acknowledged by the hon. librarian, and the following have been added to the list:—Bulletins of Scientific Laboratory, Denison's University; West American Scientist and Zoe, published at San Francisco; Bulletins Laboratory of Natural History State

University, Iowa; Proceedings of Academy of Sciences, Rochester; Journal of Comparative Neurology; Oregon Naturalist; Mining and Scientific Review.

Although so many volumes have been bound, there are still a large number of valuable exchanges in the German, Italian and French languages which should be bound up. There are also several volumes in paper boards which certainly deserve better covers. So many volumes of exchanges are completed in the course of the year that the Committee would suggest an annual appropriation from the funds of the Society for binding.

The attention of your Committee has been drawn to the fact, that although your library contains most valuable treatises on the different departments of Natural History and interesting records of the progress of Science in all parts of the world, it is still somewhat deficient in modern works of reference, such as are continually asked for, particularly works on Entomology, Palæontology, Ornithology, Mineralogy and Botany. The Committee would therefore respectfully suggest that such works as Dana's "Mineralogy," Nicholson's Palæontology, new edition of Gray's works on Botany, Carpenter on the Microscope, etc., be added.

Your Committee consider that as a new catalogue is being made, it offers a good opportunity to members and friends of the Society, to have included in it any number of works they may be inclined to present to the Library.

Respectfully submitted on behalf of Library Committee.

E. T. Chambers.

Report of the Editing Committee.

The past year has witnessed very gratifying progress in the work of the Editing Committee. The plan of producing biographical sketches of Canadian men of science has been continued, and will be extended in the future. The editors have felt that the increasing importance of the *Record* as a medium of scientific thought, and the possibility of securing papers of superior merit justified a greater effort in providing increased illustrations. Their work in this direction has met with gratifying encouragement from the Society, which has placed a small sum at their disposal. The amount thus provided has again been supplemented by a donation of fifty dollars from Mr. P. S. Ross.

The exchanges have largely increased during the year, while requests for the *Record* either by purchase or exchange have been constant and of increasing frequency, showing that the position of our publication abroad is annually becoming better.

The editors would venture to remind the Society that the position now held by the *Record* has been obtained only by great effort and in the face of unusual difficulties. This publication constitutes, practically, the work of the Society and every effort should be made not only to continue it uninterruptedly, but to increase in every possible way the reputation it has now gained.

As it is my intention to now resign the position I have held as chairman of this committee from the foundation of the *Record*, I would express my indebtedness to my associates for the valuable assistance given me in this work.

Respectfully submitted,

D. P. Penhallow,

Chairman.

The Treasurer then presented the following statement:—

Natural History Society of Montreal—In Account with James Gardner, Treas.

RECEIPTS.		DISBURSEMENTS.	
To Balance from last year	$ 101 53	By Salary Superintendent and commissions	$ 493 35
" Rents	1,112 50	" Sundry expenses	206 83
" Members' annual subscriptions	697 00	" Light	206 14
" Walter Drake, Esq., life membership	50 00	" Fuel	160 22
" Samuel Finley " "	50 00	" Insurance	60 00
" Jonathan Hodgson " "	50 00	" Taxes	24 00
" P. S. Ross, Esq., special donation towards illustrating Record of Science	25 00	" Soil temperatures	7 50
" Government grant	400 00	" Somerville lectures	35 44
" Field day surplus	33 18	" Record of Science	509 04
" Interest	6 40	" Museum ordinary expenditure	30 00
" Entrance fees museum	8 48	" " extra ordinary "	579 85
" Balance due treasurer	40 99	" Improvements on building	156 88
		" Library	105 83
	$2,575 08		$2,575 08
		May 21, 1891—By balance due Treasurer	$ 40 99

Examined and found correct.

R. W. McLACHLAN,

J. W. STIRLING, M.B.

Montreal, May 21, 1891.

The rules being suspended, the following were elected ordinary members :—George Hague, G. Kinloch, John Macfarlane and John C. Hodgson. Mrs. Horace T. Martin was elected an associate member.

The following officers were then elected for the ensuing year:—

Honorary President—Sir J. Wm. Dawson.

President—Dr. B. J. Harrington.

Vice-Presidents—Hon. E. Murphy, J. H. R. Molson, Jno. S. Shearer, Sir Donald Smith, Very Rev. Dean Carmichael, Rev. Dr. Campbell, Geo. Sumner, Rev. J. W. Smyth and J. H. Joseph.

Recording Secretary—Frank D. Adams.

Corresponding Secretary—Dr. J. W. Stirling.

Curator—J. S. Brown.

Treasurer—James Gardner.

Members of Council—J. S. Shearer, *Chairman;* J. A. U. Beaudry, Major Latour, R. W. McLachlan, Dr. Ruttan, S. Finley, P. S. Ross, H. R. Ives, Dr. Wesley Mills and Edgar Judge.

Editing and Exchange Committee—Dr. T. Wesley Mills, G. F. Matthews, J. F. Whiteaves, F. D. Adams and Rev. Dr. Campbell.

Library Committee—E. T. Chambers, J. A. U. Beaudry, F. B. Caulfield, R. W. McLachlan and Joseph Fortier.

Lecture Committee—Dr. T. Wesley Mills, Rev. Dr. Campbell and P. S. Ross.

House Committee—John S. Shearer, J. Stevenson Brown and Edgar Judge.

Membership Committee—S. Finley, P. S. Ross, Dr. J. W. Stirling, Geo. Sumner, J. A. U. Beaudry, R. W. McLachlan, E. H. Hamilton, J. H. Winn, E. Judge and Rev. J. W. Smyth.

The Annual Field Day.

The annual field day of the Natural History Society took place this year on the 30th of May, a date somewhat earlier than usual. This day was chosen in order that the members of the Royal Society of Canada, which had met in the city in the early part of the week and had ended its sittings the evening before, might be invited to share in the pleasures and advantages of the occasion. It was a happy thought which led to the proposal to ask the Royal Society to be the guests of the Natural History Society, even though the time was a trifle early for seeing the country in the full glory of its verdure, or for capturing so many specimens of insect life, or witnessing so large a floral bloom as usual. Such members of the Royal Society as honoured the Natural History Society with their presence on the occasion expressed themselves as delighted with the excursion, feeling that it was a pleasant variety in the duties which had engaged their attention during the week, to turn from the dry details of scientific symbols, mathematical processes and musty manuscripts, to look at a page of the grand open volume of nature. It was to them a happy rounding off of the series of events by which the reception committee of Montreal citizens had sought to make the first visit of the Royal Society of Canada to the commercial metropolis of the Dominion an agreeable one. And it added immensely to the pleasure and profit of the members of the Natural History Society and their ordinary patrons to have with them on their annual outing so many distinguished *savants*, who could help them to interpret better than usual the phenomena of nature.

Letters of apology from the President of the Royal Society, Very Reverend Principal Grant, D.D., and others were read, regretting their inability, owing to previous engagements and the necessity they were under to leave the city, to accept the invitation of the Natural History Society. But there were a good many of the invited guests present, among others Monseigneur Tanguay, Prof. Prescott, of the

American Association for the Advancement of Science; Prof. Bailey, of Fredericton; Prof. Macoun, of the Geological Survey; Prof. McKay, of Halifax; Professors Penhallow, Johnston, Murray and Dr. Wesley Mills, of McGill College, Mr. Geo. Murray, of the High School; Revs. Dr. Patterson and Withrow, Thos. McIlwraith, Esq., of Hamilton, one of the great ornithologists of the continent; Jas. H. Coyne, Esq., of the Elgin County Pioneers; H. Ami, Esq., of the Geological Survey, and Messrs. W. D. Lighthall and A. E. Lyman, representing affiliated societies.

Among the members of the Natural History Society accompanying the excursion were Messrs. J. S. Shearer, Vice-President; Senator Murphy, Vice-President; J. S. Brown, President of the Microscopical Society; Professor Cox and Mr. Adams, of McGill College; Capt. Adams, Dr. McConnell, R. W. McLachlan, S. Finley, H. T. Martin, H. McLaren, F. B. Caulfield, J. B. Goode, Edgar Judge, Hon. J. K. Ward, T. H. Carter, J. Harper, Rev. Dr. Smyth and Rev. Dr. Campbell, Vice-President. The citizens generally were represented by Aldermen Rolland, Martineau, Shorey and Griffin, Rev. Principal Barbour, Messrs. Geo. Lighthall, E. H. Hamilton, Dr. E. H. Clarke, Eugene Beaudry and others, and a very large number of ladies, who have always proved the most enthusiastic patrons of our annual field day. The excursionists filled five cars to their utmost capacity.

The place selected for this year's visit was Calumet, a station on the main line of the Canada Pacific Railway midway between Montreal and Ottawa. At this point the southernmost ridge of the Laurentians almost touches the north bank of the Ottawa river, and a lovelier spot, or one likelier to yield a day's profitable search to the naturalist could not have been chosen. The weather proved most propitious and great was the delight of all the excursionists as the train bowled past numerous orchards white with fragrant blossoms and grassy meads dotted with the golden radiancy of the dandelion, and pastures enlivened with the brightest of buttercups. Calumet was reached at 11 a.m. and as the guests defiled from the train laden with baskets, nets, vasculums, bottles, and the other appliances provided for the day's enjoyment or work they were met and welcomed by Mr. Brown, Mayor of the Parish, Rev. R. Hamilton, of Grenville, and other friends, who gave advice and directions as to the way in which each could best secure the end he or she had in view in coming to Calumet. The naturalists divided into three parties: The *Geologists*, under the direction of Mr. Adams and Mr. Tyrrell: the *Entomologists*, under the guidance of Messrs. Caulfield and Wynn, and the *Botanists*, superintended by Professors Macoun and McKay, accompanied by Rev. Dr. Campbell, with Rev. R. Hamilton who resides in the district as *cicerone*. A large party went off with Hon. J. K. Ward to his lumbering establishment near by, where they were entertained to a real shanty dinner. Carriages were in waiting for such as wished to drive to Grenville or Point du Chene, past the mouth of the River Rouge, and not a few took advantage of the opportunity of having a drive over the country roads. Lovers of scenery and those bent on securing sketches for their portfolios, fresh from nature, hovered around the picturesque little river, ascending to the foot of the cascade, which makes a leap of about 80 feet, but a short distance up, or climbing to the top of the hills near by, the sunny, well-wooded slopes of which tempted the more vigorous pedestrians to try their muscle, and which, when they succeeded in scaling them, afforded a prospect that was a full reward for the labour of the ascent. The broken face of the ground in the neighbourhood gave promise of much variety, especially in the vegetable and mineral products of the district, and the day's investigations made good this promise. The banks of the Rouge are well known haunts of the botanist, where his practised eye discerns a greatly mixed *Flora*, many species being found there far away from their native *habitat*, carried down from the north by the force of the current, but the fierceness with which the sun's rays beat down upon perspiring pedestrians effectually barred the progress of all but a few ardent collectors. Consequently that interesting point was not reached by the main body of the botanical party. Yet enough was seen and noted to show that the county of Argenteuil is a very paradise for the botanist. The collections submitted in competition for the society's prize embraced not a few specimens that are comparatively rare. The excursionists reassembled at the station at 5 p.m., when prizes for the collections of the day in the several departments were adjudged, as follows:

GEOLOGICAL—*Named specimens.* Mr. F. S. Jackson, 9; *unnamed,* Mr. G. Saxe, 16.

BOTANICAL—*Named species* (1), Dr. Edward H. Blackader, 87; (2), Miss Addie Van Horne, 62; *unnamed,* Master Percy Penhallow, 52.

ENTOMOLOGICAL—*Named specimens,* Mr. J. F. Hausen, 40; *unnamed,* Mr. W. H. Adams, 145.

Before boarding the train on the return journey a vote of thanks to the Mayor, Mr. Brown, was moved and seconded, in short speeches, by Rev. Dr. Smyth and Ald. Rolland. This done the train started at 5 p.m. and reached the Windsor station at 7.30 p.m. Everything was done to promote the success of the excursion by the authorities of the C. P. Railway, whose chief engineer, Mr. Peterson, accompanied the train and formally superintended the arrangements. Light refreshments were also served by the Railway Company to the Natural History Society and its guests. Altogether the day will be marked as a red letter one in the society's annals.

THE BOTANICAL CLUB OF CANADA.

At the last meeting of the Royal Society of Canada, held at Montreal, an important measure was introduced into Section IV, looking to the promotion of botanical study and research throughout Canada. Dr. George Lawson of Halifax, presented a short paper outlining the present position of botanical studies here, and pointing out the necessity of some concerted action on the part of botanists similar to that undertaken by the United States botanists in connection with the American Association, whereby greater interest in the study might be promoted, and more tangible results produced in the study of local floras. The suggestions were very heartily supported by the botanical members of the section, who forthwith organized themselves into a club under the patronage of the Royal Society, to be known as the Botanical Club of Canada.

The organization is of the most simple character, the idea being to offer the least impediment to membership by making the duties and regulations as light as possible, it being held that each member acting as a free agent, would be capable of doing the best work. The officers for the present year are:—

PRESIDENT:

PROF. GEO. LAWSON, PH. D., LL. D., F. R. S. C., Halifax, N. S.

SECRETARY-TREASURER:

A. H. MACKAY, B.A., B.Sc., F.R.S.C, Halifax, N. S.

SECRETARIES FOR THE PROVINCES:

ONTARIO: PROF. JOHN MACOUN, M.A., F.L.S., F.R.S.C., Ottawa.
QUEBEC: PROF. D. P. PENHALLOW, B.Sc., F.R.S.C., Montreal.
NEW BRUNSWICK: GEO. U. HAY, PH. B., St. John.
NOVA SCOTIA: E. J. LAY, ESQ., Amherst.
PRINCE EDWARD ISLAND: FRANCIS BAIN, ESQ., North-River.
NEWFOUNDLAND: REV. A. C. WAGHORNE, New Harbour.
MANITOBA: —— BURMAN, ESQ., Winnipeg.
ALBERTA: W. H. GALBRAITH, ESQ., Lethbridge.
BRITISH COLUMBIA: DR. NEWCOME, Victoria.

Membership is secured by the annual payment of twenty-five cents, or five years' membership for one dollar, or life membership for five dollars.

Through the various local secretaries acting under the direction of the provincial secretaries, it is hoped to stimulate a spirit of study and research among scholars in the various schools, give aid to more experienced collectors and eventually to distribute accurate data concerning the vegetation of Canada through the publications of local floras.

The Record of Science has been selected by the Club as the recognized medium through which all publications will appear.

Notices of Books and Papers.

The Geology of the State of Maryland.

There are probably few areas of the same size in which are represented so many geological formations and which also shows such a diversity in surface configuration as does the State of Maryland. The geology of the northern portion of the state and especially that portion about Baltimore has been carefully studied and accurate geological maps are nearly ready for publication. The southern portion of the state has, however, attracted less attention, although one of the finest geological sections through the tertiary to be found anywhere is that exposed along the Chesapeake, Potomac and Patuxent rivers. The strata are also very highly fossiliferous rivaling in this respect the classic tertiary deposits of the Paris basin and we are happy to be able to state that a large collection of these fossils has recently been obtained for the Peter Redpath Museum of the McGill University. For our knowledge of the geology of this region we are principally indebted to Mr. N. H. Darton, of the United States Geological Survey, whose paper in the last volume of the Transactions of the American Geological Society (vol. ii), entitled "The Mesozoic and Cenozoic Formations of Eastern Virginia and Maryland" gives us the most complete account that has yet appeared of the geology of the "Costal Plain" in these states.

A further contribution to the Geology and Paleontology of this region is that published in a recent circular of the John Hopkins University (June, 1891) in which Dr. W. B. Clarke gives a resumé of the results obtained by the expedition recently fitted out under the joint auspices of the Johns Hopkins University, the Maryland Agricultural College and the United States Geological Survey to examine and report on the geology, agriculture and archæology of the southern portion of the state. Dr. Clark gives a geological section across the state from the highlands of the Piedmont Plateau to the Atlantic coast, the various deposits being classified as follows ;—

Cenozoic.	Recent.
	Pleistocene.
	Neocene.
	Eocene.
Mesozoic.	Cretaceous.
	Potomac.

The marked influence of the underlying formations on the soils of the country, described in this paper, is of especial interest as well as great practical importance. Referring to this Prof. Whitney, of the State Agricultural College, writes as follows. "The soils of each formation are so very characteristic and so uniform throughout that there will be little trouble in establishing the following soil types and showing the difference in the physical condition and properties in their relation to plant growth : 1, Neocene, forming the wheat and tobacco lands; 2, Eocene, the fruit and truck lands; 3, Columbia (Pleistocene), the fertile river terraces; 4, Appomatox (Pliocene?), the pine barrens; 5, Cretaceous. Mr. W. H. Holmes gives a brief description of the Kitchen-middens or great shell heaps marking the sites of ancient Indian villages or resorts at many points and some of which rank both as to mass and horizontal extent with some of the minor sub-divisions of the geological formations. A single one of these situated at the mouth of Pope's Creek is about half a mile long and 100 yards wide, the shells in many places being heaped up to a depth of ten feet. This great shell heap overlies the miocene beds of this locality, not only in the valley of the creek, but on the slopes and summits of the hills on either side and contains in addition to the shells a great many Indian remains. About 200,000 cubic feet of these shells have been burnt into lime for fertilizing purpose. This amount, however, constituting but a very insignificant proportion of the whole.

The "oyster question" evidently attracted as much attention in Maryland in those early times as it does at present.

Frank D. Adams.

Notices of Books and Papers.

Catalogue of the Fossil Cephalapoda of the British Museum, Part I, Nautiloidea. London, December, 1888. By Arthur H. Foord, F. G. S.

I.

This very handsome and important contribution to the history and classification of one of the most prolific groups of palæozoic fossils which reached us some time ago, would deserve a more lengthy notice than can be given here. Its author, well known to most of the Canadian geologists, as late assistant Palæontologist to the Geological Survey of Canada, and formerly a member of our Society, has been zealously engaged in the work which is now before us, and made it an indispensable treatise for reference. "Mr. Foord has diligently worked at the literature of the subject," says Dr. Woodward, keeper of the British Museum, "and has spared neither time nor labour in clearing up the many difficult points connected with the priority of names and in the verifying of generic and specific determinations," in all of which he has been eminently successful.

The following species from Canadian localities are described or referred to in the text, and are therefore of especial interest :—

LIST OF SPECIES FROM CANADA AND ARCTIC AMERICA.

SPECIES.	FORMATION.	LOCALITY.
ORTHOCERATIDÆ.		
Orthoceras decrescens, ...Billings.	Black River...........	St. Joseph Island, Lake Huron, Ont.
" *arcuoliratum*, ... Hall.	" "	Allumette Island, Ottawa River.
" *multicameratum*.......Emmons.	" "	Grenville, Montreal.
" *lamellosum* ....Hall.	Hudson River	Western Ontario.
" *laqueatum ?*...............Hall.	Trenton	Montmorenci Falls.
" *? sp. ?*	Silurian.	Griffith's Island, Arctic America.
" *arcticum*.................Foord.	"	Offley Island, Arctic America.
" *Griffithi ?* ....Houghton.	....	
" *annulatum*............Sowerby.	....	
" *var. Americanum*.. .....Foord.	Niagara...............	Canada.
" *Darwini*...............Billings.	Niagara Formation....	Offley Island, Arctic America.

LIST OF SPECIES FROM CANADA AND ARCTIC AMERICA (*continued*).

SPECIES.	FORMATION.	LOCALITY.
ENDOCERATIDÆ.		
Endoceras Rottermundi. .... Barrande	Black River............	Lake Huron, Ont.
" *proteiforme* ....Hall.	Trenton................	Montreal, Que.
" *? Ommaneyi* ....Salter.	Silurian................	Cornwallis Island, Arctic America.
" (*? Orthoceras*) *explorator*, Billings.		
" *sp*	Calciferous............	Mingan Islands, Que.
Piloceras Canadense .... Billings.	"	" " "
ACTINOCERATIDÆ.		
Actinoceras Bigsbyi..... ....Brown.	Black River.	Igloolik Island, Arctic America.
" *Beloitense*............ Whitfield.	" "	Thenalm Is., Lake Huron.
" *remotiseptum* .... Hall, sp.	Trenton................	Canada, probably.
" *Richardsoni.* ....Stokes.	Galena Limestone......	Lake Winnipeg.
" *Backi* .... Stokes.	Niagara Group.........	Cape Louis Napoleon, Smith's Is., Dobbin Bay, Arctic America, etc.
" *sp*	" "	" "
" *Whitei*............ ..Stone, sp.	" "	Drummond Is., L. Huron.
" *vertebratum* .. . .Hall, sp.	" "	" " "
" *spheroidale* ....Stone, sp.	" "	" " "
" *inops ?*..... . . .. Dawson.	Carboniferous limestone	Brookfield, N.S.
Discosurus conoideus............ ....Hall.	Niagara Group	Drummond Is., L. Huron.
" *remotus*... .... Foord.	" "	" " "
" *gracilis*... ....Foord.	Niagara Group... ...	" " "
Huronia Bigsbyi..................Stokes.	" "	" " "
" *vertebralis.* .... Stokes.	" "	" " "
" *minuens* ....Barrande.	" "	" " "
" *persiphonata* .... Billings, sp.	" "	" " "
" *obliqua* .... Stokes.	" "	" " "
" *turbinata* .... Stokes.	" "	" " "
" *[d]istincta* . .... :. .. Barrande.	" "	" " "
GONIPLEOMATIDÆ.		
Septameroceras inflatum ....Billings, sp.		
ASCOCERATIDÆ.		
Poterioceras constrictum..... .....Hall, sp.	Trenton & Hudson Riv.	Montmorenci and Nottawasaga, Ont.
CYRTOCERATIDÆ.		
Cyrtoceras (*Meloceras*) *falx* ....Billings.	Black River	Allumette Is. Riv. Ottawa.
(GENUS OF DOUBTFUL AFFINITIES.)		
Jovellania Murrayi ....Billings, sp.	Trenton	St. Joseph's Island.

II.

IBID:—Part II, 1891, Containing the remainder of the NAUTILOIDEA. The second part of this admirable work which Mr. Foord has undertaken and carried out so successfully, is an indispensable book of reference for all working palæontologists, well illustrated and with supplement. It contains 407 pages.

The following four species recorded from Canadian collections, and at present in the British Museum, (Nat. History Department) are of special interest to us, viz ;—

TROCHOCERATIDÆ.

1. *Trochoceras boreale,* Foord, from the Silurian Rocks of Wellington Channel, in British Arctic America, collected by Capt. Inglefield, p. 23
2. *T Halli,* Foord, ("Lituites undatus" of Hall, Chapman, Billings and others).

   From the "Black River" rocks of Lorette, near Quebec, Canada, of which two views of a good specimen with description of this new species are given. pp. 41-44.

NAUTILIDÆ.

Trocholites planorbiformis, Conrad.

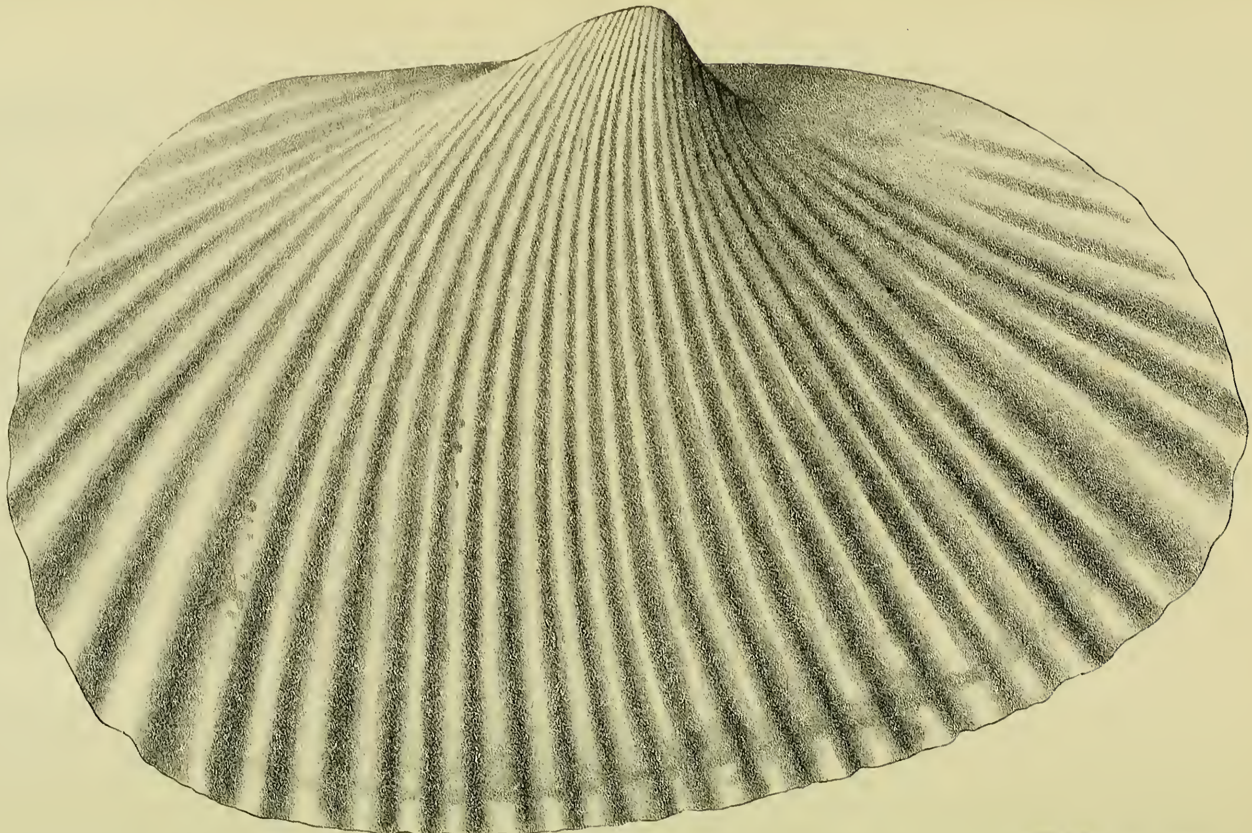
This form is recorded from the Trenton limestone of Montmorenci and Lorette, Que., which were presented to the British Museum authorities by Dr. Bigsby. Mr. Foord gives interesting notes on the early and nepionic stages of growth of the Canadian example of T. planorbiformis after which he appends a list of references to the British fossils, which have been referred by different authors to Trocholites planorbiformis, pp. 48-49.

SUPPLEMENT.

ACTINOCERATIDÆ.

Huronia, Portlocki Stokes :—From the Niagara Group of Drummond Island, Lake Huron, where Stokes obtained the specimen from which he described and figured the species in "Trans. Geol. Soc., London ; Ser. ii, vol. V, pt. iii, p. 710, pl. IX, figs. 5, 1840.

HENRY M. AMI.



L. M. LAMBE, F.G.S., DEL.

MORTIMER & CO., LITHO.

PANENKA GRANDIS (SP. NOV.) CORNIFEROUS; ONTARIO.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. IV. OCTOBER, 1891. NO. 8.

Description of a New Species of Panenka from the Corniferous Limestone of Ontario.

By J. F. Whiteaves.[1]

In August last four specimens of the shell of a lamelli-branchiate bivalve, of unusually large size, of a compressed, transversely elongated and subovate form, and with the surface marked with numerous coarse radiating ribs, were collected by Mr. L. M. Lambe, of the Geological Survey, in the Corniferous limestone at St. Mary's, Ontario. The specimens consist of two nearly perfect and tolerably well preserved single valves, one a right valve and the other a left, and two imperfect right valves, all of which evidently belong to a single and undescribed species of *Panenka*.

Although not mentioned in the latest manuals of palæontology, the genus *Panenka* was duly proposed and characterized by Barrande in 1881, in the sixth volume of his " Système Silurien du centre de la Bohême," in which memoir no less than 231 species of this genus were described and figured. The word *Panenka* is there stated to be the equivalent of the Latin *puella,* in " la langue tcheque," *i. e.*, Czech or Bohemian. In Schmidt's Polish dictionary *Panienka* is given as the diminutive of *Panna,* a girl. The genus was regarded by Barrande as peculiar to

[1] Communicated by permission of the Director of the Geological Survey Department.

his Fauna No. 3, the representative of the Silurian (Upper Silurian), as distinguished from what is now called the Cambro-Silurian or Ordovician System. In 1885, however, in volume V, part 1 (Lamellibranchiata) of the "Palæontology of the State of New York," Professor James Hall described and figured fifteen species of *Panenka* from the Devonian rocks of the United States. Some of these species had previously been referred to *Pterina* and *Monotis* by Conrad and S. A. Miller, and by Hall himself to *Cardiola*. The names of three additional species of *Panenka* from the Devonian of North America are given in S. A. Miller's "North American Geology and Palæontology," published in 1889.

This genus was, and still is, based exclusively upon the external characters of the shell, the hinge dentition, muscular impressions and pallial line of the interior of the valves being unknown. It is described as having no distinct cardinal area, like that of the *Arcadæ*, but some species are said to show obscure evidence of a ligamentary groove. The systematic position of *Panenka* is therefore quite uncertain. It is placed by Hall in the *Cardiidæ*, but Rudolf Hörnes has constituted a special family, which he calls the *Præcardiidæ*, for the reception of *Præcardium*, *Panenka* and several other similar and apparently closely related genera described by Barrande. This latter view of its relations, which seems to be the most satisfactory one in the present state of our knowledge, is adopted by Dr. Paul Fischer in his "Manuel de Conchyliologie." In that volume the family *Præcardiidæ* is placed between the *Grammysiidæ* and the *Pholadomyidæ*, but its author states that it seems to him to have closer relations with the *Anatinacea* than with any other suborder of the *Dibranchiata*. The species indicated by the four specimens collected by Mr. Lambe may be described as follows.

PANENKA GRANDIS. (Sp. nov.)

Plate 1.

Shell very large, attaining to a length of from six to nine inches, strongly compressed at the sides, though perhaps abnormally so, subovate in marginal outline, about one-third longer than high and highest posteriorly, the greatest height, exclusive of the beaks, being at or near the posterior termination of the cardinal border.

Anterior side produced and somewhat pointed, its outer margin sloping obliquely and rapidly downward from the cardinal border above, and forming a rather narrowly rounded junction with the ventral margin below: posterior side about equal to the anterior in length, but broader in the direction of its height and much more broadly rounded at the end: ventral margin moderately convex and most prominent posteriorly, nearly straight but ascending very gradually in the centre and anteriorly: superior border nearly straight or but slightly convex on each side of the beaks, curving gradually and somewhat convexly downward at each end, but rather more rapidly so at the posterior end than at the anterior: umbones oblique, prominent, central: beaks curved inward and a little forward.

Surface marked by from thirty-five to forty large, simple and rounded radiating ribs, which are nearly straight anteriorly, but slightly curved in the centre and posteriorly, also by numerous and unequal concentric lines of growth. In some specimens an occasional intermediate and very much smaller rib is developed between two of the larger ones. Characters of the interior of the valves unknown.

The figure on plate 1 is of the natural size. The specimen which it represents is the most perfect of the right valves collected, and measures 16.2 cm., or six inches and four-tenths, in length, and 10.7 cm., or four inches and two-tenths, in maximum height, inclusive of the beak. It does not happen to show any of the smaller intermediate ribs nor the concentric lines of growth mentioned in the description of the species, these being seen in other specimens. The shell attains to a much larger size than the specimen figured, for an imperfect right valve collected by Mr. Lambe was probably a little more than nine inches in length, when entire, and not far from seven inches in its maximum height.

OTTAWA, October 9th, 1891.

NOTE ON THE OCCURRENCE OF PAUCISPIRAL OPERCULA OF GASTEROPODA IN THE GUELPH FORMATION OF ONTARIO

BY J. F. WHITEAVES. [1]

Opercula of gasteropoda appear to be of rather rare occurrence in the palæozoic rocks of Canada. The best known and earliest described are those of *Maclurea Logani*, from the Black River limestone of Paquette's Rapids, on the Ottawa River, which were first described and figured by Salter in 1851, in the first decade of "Canadian Organic Remains." The operculum of this shell, which has fortunately been found occupying its normal position in the aperture of the shell to which it belongs, is in many respects unlike that of any known gasteropod, whether fossil or recent, both in its internal and external characters. It was described by Dr. S. P. Woodward as "sinistrally subspiral, solid, with two internal projections for the attachment of muscles—one of them beneath the nucleus and very thick and rugose."

A specimen of another species of *Maclurea*, which has since been described and figured under the name *M. Manitobensis*, with its operculum in place, was collected by Prof. H. Y. Hind in the Trenton limestone at Punk Island, Lake Winnipeg, but this operculum is very imperfect and badly preserved.

In 1874-82 several solid, calcareous and multispiral opercula were collected by Mr. Joseph Townsend in the Guelph limestone at Durham, Ont., but none of these were found *in situ*. These opercula, some of which are described and illustrated in a report on the fossils of the Guelph forma-

[1] Communicated by permission of the Director of the Geological Survey.

tion of Ontario,[1] are circular in outline, their inner surface being flat, or nearly flat, and their outer surface convex. They vary considerably in the amount of their external convexity, some being nearly hemispherical and others conical externally, and probably belong to more genera than one. By analogy with similar specimens that have been found in place, in shells of the genera *Polytropis*, De Koninck (=*Oriostoma*, Munier Chalmas), and *Cyclonema*, Hall, in the Upper Silurian rocks of Gothland, these multispiral opercula from Durham are presumed to belong to species of those genera, the *Euomphalus macrolineatus* of Whitfield, and the *Straparollus crenulatus* of the present writer, both of which occur at Durham, being now known to be referable to *Polytropis*, and the genus *Cyclonema* to be represented at Durham by the *C. sulcatum* of Hall, though this latter shell also may be a true *Polytropis*. Both *Polytropis* and *Cyclonema* are referred by Lindström to the family *Turbinidæ*, partly because their shells "have retained the most evident traces of a nacreous layer," and partly on account of their solid calcareous opercula.

About five or six years ago, a few opercula of an entirely different character to any of those already mentioned were collected by Mr. Townsend in the Guelph formation at Durham. These, so far as the writer has been able to ascertain, are so unlike any opercula that have hitherto been described as occurring in palæozoic rocks, that it is thought desirable to place a short description of them upon record. They are rather thin, nearly flat, but slightly concave externally and as slightly convex internally, broadly subovate, about one-fifth longer than broad, obtusely pointed at the end corresponding to the posterior angle of the mouth of the shell whose aperture they closed, *paucispiral* and composed of from two and a-half to three rapidly expanding volutions, the nucleus being subcentral. Only the outer or concave surface of each of these opercula is exposed to view, the inner side being buried in the matrix. The accompany-

[1] "Geological and Natural History Survey of Canada. Palæozoic Fossils," vol. III, pt. 1, Montreal, 1884, p. 33, pl. iii, figs. 10, 10 *a-b* and 11, and pl. vii, fig. 7.

ing woodcut represents the exterior of the best specimen known to the writer, of natural size. Its maximum length is twenty millimetres and its greatest breadth sixteen.

Figure 1. Paucispiral operculum of a gasteropod, genus and species unknown, from the Guelph Formation of Ontario.

It is at present quite impossible to determine to which of the known gasteropoda from the Guelph formation in Ontario these opercula should be referred, if, indeed, they are referable to any. Judging by the shapes of the apertures of the shells into which they may have fitted, the most likely species, perhaps, are the *Holopea gracia* or *H. harmonia* of Billings, or a small and undescribed naticoid shell from Durham, which, so far as can be ascertained from a few casts of the interior, seems to be closely related to the *Holopea nux* of Lindström, from the Upper Silurian of Gothland. The resemblance of the operculum here figured to that of *Litorina* and *Natica* is very striking, and in this connection it is to be noted that Lindström places *Holopea* in the *Litorinidæ.* In the recent species of *Litorina* the operculum is invariably chitinous and extremely thin, while in *Natica* proper it is calcareous and not nearly so thin. The one here figured is so highly dolomitized that it is difficult to estimate its exact thickness, but it gives the writer the impression of being thicker than that of a recent *Litorina.* At the distance of a millimetre from the edge, its thickness, at the somewhat truncated termination of the outer volution, is between one-half and three-quarters of a millimetre, but it seems to increase rather rapidly in thickness inward.

The only other opercula known to the writer as occurring in the Palæozoic rocks of Canada are the depressed multispiral ones of *Euomphalus Manitobensis*, one of which was obtained in place. These were collected by Mr. J. B. Tyrrell, of the Geological Survey, in 1889, from limestones of Devonian age at Dawson Bay, Lake Winnipegosis, and are described and illustrated in the eighth volume of "Transactions of the Royal Society of Canada."

OTTAWA, October 24th, 1891.

NOTES ON TREES ON THE GROUNDS OF MCGILL UNIVERSITY.

By SIR WILLIAM DAWSON, F. R. S., &c.

In the year 1855, the grounds of McGill College were unfenced and practically a common, used for pasturage and open to all intruders. A few large trees existed on the banks of the little brook which then ran through the grounds, and to which, I suppose, the McGill Estate owed its name of Burnside; and along the brook there was a certain amount of coppice of thorn, young birch and alder, but so cropped by cattle and cut and broken by juvenile ramblers that it presented a very unsightly appearance. So soon as a fence could be erected, steps were taken to lay out the grounds and plant trees. I was induced to give attention to this by the wish to have the surroundings more in harmony with an academical building, and by the hope that attractive grounds might tend to induce efforts to improve and complete the buildings, might give more public interest in the institution, and might lead to a wish to retain the grounds for academical uses rather than to dispose of them for building purposes. To me and my wife the improvement of the grounds was a congenial task; and the late Mr. Baynes, then Secretary of the University, cordially seconded the effort, while the Board of Governors granted a little pecuniary aid. The old McGill house and garden at that time existed immediately below Sherbrooke Street, though rented to a market gardener. The garden contained many good shrubs and herbaceous plants, and was laid under contribution in aid of our plans, and many native trees and shrubs were obtained by collecting on the mountain, or by purchase from country people and from Guilbault's nursery. At a later date Prof. Penhallow commenced a botanical garden on a portion of the grounds set apart for that purpose.

Aid was also received from friends. The late Hon. John Young had imported a large number of European trees for his own property at Cote St. Antoine, and liberally presented many healthy young plants to the College, and the late Mr. William Lunn, whose zeal in gardening is well known, presented rare shrubs and trees. Somewhat later, Mr. Charles Gibb, having commenced his experimental farm at Abbottsford, sent a number of rare species, and Major Campbell of St. Hilaire, presented spruces and other trees from his estate. Seeds were also collected, and a little nursery of young trees was commenced in a suitable place in the ravine near Sherbrooke Street. Though neither my means nor those of the College were sufficient to provide proper attendance and sufficient labour, and though much damage was necessarily done by the public use of the grounds, yet they were beginning to present a creditable appearance and contained a large number of valuable foreign as well as native trees, when the unavoidable sale of land on University Street, and later, the exigencies of more direct educational work, in connection with the generous bequest of Mr. Workman, and the princely benefactions of Mr. W. C. McDonald, terminated our attempt to have a College garden and arboretum.

It is proper to state that, before our improvements began (as early as 1853), the late Mr. Shepheard of Montreal, in conjunction with the late Mr. J. Symmers, had presented to the College a plan for the laying out of the grounds, along with one for converting Sherbrooke Street into a boulevard with four rows of trees; which plans are still preserved. The formation of a central avenue consequent on the passage of the main pipes of the reservoir through the grounds, had rendered this original plan impracticable;

but on application to Mr. Shepheard, he kindly consented to lay out the portion of the ground on the east side of the avenue, in a manner suitable to the changed conditions.

Early in our planting operations, the Graduates' Society, at that time recently organized by Mr. Brown Chamberlin and others, took an interest in the matter, and proposed to plant a "Graduates' Walk," extending from the great elm round by the bank of the brook to Sherbrooke Street. They prosecuted the work actively and in a few years had the walk stocked with trees, the latest of which was an elm planted in honour of the visit of H. R. H. the Prince of Wales in 1860. The Graduates' Walk is now for the most part merged in the approach to the new W. C. McDonald Physics Building, and most of its trees have disappeared except those at its extremities.

Notes have been kept since 1855, of the results of the planting and attempts to introduce foreign trees and shrubs, and it was hoped that these experiments and observations would have been continued by Prof. Penhallow, but since the park and its trees may now be considered as things of the past, and any experiments hereafter made will be carried on under new conditions in the ground leased from the Trafalgar Institute, or elsewhere, it may be well to record for the benefit of others the results of the observations made.

It may be premised here that the grounds are sheltered by the mountain, have a favourable exposure to the south-east, and have three varieties of soil—the sandy soil afforded by the Pleistocene Saxicava-sand toward the front, clay soil resting on Leda-clay and Boulder-clay and the alluvial soil in the little ravine, not to mention the rocky ground on Trenton limestone and old quarry pits, which was, for the most part, occupied by the Medical Faculty's building.

In noticing the trees and shrubs, I shall take them in no very definite order, but shall give a list with notes on each species, taking native trees and shrubs first.

1. The Red Oak. *Quercus rubra.*

Several fine specimens of this tree existed along the bank of the brook—four of which still remain intact (1891). The finest specimen was drawn and engraved for the restoration of the Indian town of Hochelnga in my book "Fossil Men," in consequence of Cartier's note, that on his visit to the village of Hochelaga, he saw great oaks with large acorns on the path leading from the landing place below the current to the village. Our oaks are not those of Cartier's time. One of the largest, cut down last year, showed 160 rings of growth, so that it may be regarded as a child of the oak forest of three centuries ago. Sandy soil, especially with clay underlying at some depth, seems to be specially suited to this tree, whose large shining leaves and spreading form make it one of our finest forest trees.

2. The White Oak. *Quercus alba.*

This species was not indigenous to the College grounds, but a few fine plants were purchased. They throve well in the more moist and rich ground, but were only young trees, and all have perished in the progress of improvements. There seems no reason why this species should not be cultivated as a timber tree in the Province of Quebec; but it requires a good soil and exposure.

3. The Overcup White Oak. *Quercus macrocarpa.*

This is not an indigenous species, but a few acorns from the North-west were presented to me some years ago by Dr. G. M. Dawson. One good plant was raised from these and was carefully tended. It grew well and promised to be a fine tree, but had to be removed last year, and I fear has perished. I have found that oaks do not readily transplant, as we have lost several good trees in this way. This species deserves to be introduced in Lower Canada as an ornamental tree. Its large leaves give it a fine appearance. It loves limestone soil.

4. The English Oak. *Quercus robur L.*

Specimens of this species were presented by Mr. Young, and were planted in different soils and exposures; but they proved incapable of enduring the winter and all perished; those in the lighter and more sandy ground surviving longest. In any case this tree is not comparable as an ornamental tree with our native species, and its leaves hanging withered on the branches in autumn give it an unsightly appearance.

5. The Beech. *Fagus ferruginea.*

A bed of young plants of this fine tree was raised from the nuts, and one specimen still remains. It grows well but not in the sandy soil, and as only very young trees have been on the grounds, little can be said respecting it. It is known, however, to love a rich calcareous soil, and, where this exists, to thrive even on rocky ground. Our beech is scarcely so fine a tree as the European beech, the hardiness of which, in Canada, I have had no opportunity of experimenting on.

6. The Hazel. *Corylus americana.*

A plant of this species obtained on the mountain about 1858, has grown luxuriantly and bore fruit every year. It was destroyed last year. The hazel is a long lived and beautiful shrub. As one usually sees it on poor ground and cropped by cattle it has a shabby appearance, but under more favourable circumstances it forms a fine element in shrubbery. Its catkins are pretty in the spring, and in autumn its fruit is curious and is edible.

7. The Hornbeam. *Carpinus americana.*

A fine and somewhat aged specimen of this little tree, native to the place, existed till last year in the lower part of the grounds. It is of slow growth and straggling form. One young tree still remains near the head of the avenue, and is noteworthy for the brilliant crimson and yellow colours which its leaves assume in autumn ; and as the leaves are somewhat persistent, their beauty remains till late in the season.

8. Birch. *Betula papyracea* and *B. populifolia.*

These white birches, so common throughout Eastern Canada, were native to the soil. One very old and spreading tree was probably the finest in Montreal. Its main trunk was short and the young people used to ascend and use the spreading branches as a study in the warm weather of summer. The white birches are trees of rapid growth and extremely hardy. I have specimens growing on somewhat poor soil, which, in twelve years, have attained the height of 30 feet and are beautiful trees.

9. European White Birch. *Betula alba.*

The cut-leaved variety of this tree has grown very successfully, and its pendulous branches and pure white bark produce a fine effect. Several other species or varieties of foreign birches were presented by Mr. Gibb, but had to be removed to the new botanical garden on the Trafalgar property. The bronze-leaved variety did well and had a fine appearance. The remaining specimens are of the green and cut-leaved variety. Being more graceful and pendulous than our native species, and apparently quite hardy, they deserve cultivation.

10. The Yellow Birch (*B. lutea*) was not originally on the grounds, but a good specimen was planted on the Graduates' walk and has thriven, though perhaps the soil is rather light for this species.. I had hopes that it might have gone on to rival our oaks and elms, as when mature, it is a majestic tree, one of our finest native species, but unfortunately it is too near the line of the approach to the Physics building and probably is doomed to disappear.

11. The Arctic Birch. *Betula pumila.*

A plant of this species presented by Mr. Gibb was tended for several years on the terrace in front of the College, but did not thrive and eventually died. I planted it alongside of a Tamarisk in hopes of reconciling to the same conditions these two trees of so different habitat. But the birch drooped in the heat of summer and the branches of the tamarisk were winter-killed, so the experiment was not successful. The tamarisk survives as a small shrub, sending up shoots from the root. The dwarf birch is dead.

12. The Alder. *Alnus incana.*

This common shrub grew plentifully on the borders of the brook, forming a dense thicket on the flat ground near University street, under which were many shade-loving ferns and herbaceous woodland plants. It is now extinct. I may mention with it the English Alder—*A. glutinosa*—a much finer plant, attaining to the dimensions of a small tree on one stem. Specimens of this were given to me by Mr. Young and grew vigorously for a few years, but seemed liable to have the young wood nipped by frost in winter, and finally perished. The cut-leaved variety seems more successful; and one specimen, presented by Mr. Gibb, still remains.

13. The Basswood. *Tilia americana, L.*

This tree is common on the mountain, but did not exist on the grounds till planted. It is a rapidly growing and beautiful tree, forming a fine variety with maples and elms, and interesting in spring from its clusters of fragrant flowers on a leafy peduncle, while its large heart-shaped leaves afford a grateful shade. It does not appear to be a tree of long life, and when pruned or wounded is very apt to decay in the stem. A large specimen in the avenue, which will have to be removed for the approach to the engineering building, has suffered in this way, and though by no means an old tree, is little more than a picturesque ruin. Another and younger specimen remains and may serve to represent the interesting botanical relationships of the Tiliaceæ.

14. The Elm. *Ulmus americana.*

One fine specimen stood on the ground in 1855, and was usually known as the "Founder's Tree," having been planted or preserved by Mr. McGill. It still stands, and is tall in form and less spreading than elms usually are near Montreal, and is now (1891) 10 feet in circumference at two feet from the ground. Many others have been planted, especially along the avenue, where it was intended to have a row of elms along each side. Great difficulties were found however, in planting them successfully in the drier parts of the ground, and in some places they would succeed only after digging up a wide and deep bed and filling it with manure. So soon, however, as the roots reached the moist clay of the subsoil the trees grew vigorously. It has happened in this way that some of the dying trees have been replaced by maples; so that our avenue of elms is not altogether complete. An inner row of soft maples was planted at the same time, partly to protect the elms and partly to form a shade in advance of the latter, the intention being ultimately to remove the maples and to leave merely the avenue of elms. The elm is the favorite ornamental tree in the province of Quebec, not only because of its beauty, but on account of its rapid growth. A tree planted in 1858 by Lady Dawson on the east side of the avenue has now a circumference of 6 feet near the ground, and is quite a stately tree. It has grown more rapidly than some of the others on account of the more suitable soil. The rough foliage of the elm is remarkably exempt from the attacks of caterpillars. Its worst enemy in my experience is the prickly black caterpillar of the mourning cloak butterfly — *Vanessa antiopa.*

15. The Red or Slippery Elm. *Ulmus fulva.*

In 1855 there was a moribund tree of this species at the foot of the terrace in front of the college. Its roots had been in great part buried under the excavators' rubbish used in forming the terrace, and it was gradually dying. I planted at its root the wild vine and the Ampelopsis or five-fingered ivy, which in a few years completely clothed its stem and dead branches, giving it a fine appearance, especially in autumn, when the bright yellow of the vine and the crimson of the Ampelopsis had a most brilliant effect. It was one of the chief ornaments of the front of the buildings for many years, when, decaying at the base, it was finally overthrown in an autumnal storm. Other trees of this speeies were planted, but their inferiority to the ordinary American elm, both in form and stature was too manifest to encourage their multiplication.

16. The Corky Elm. *Ulmus racemosa.*

This species is distinguished by the curious corky excrescences on its trunk and branches, and by its stiffer and more rigid branching as compared with the ordinary species. A fine young specimen from St. Andrews was presented some years ago by Dr. Harrington and was growing well, but it was one of the victims of the recent improvements.

17. The English Elm. *Ulmus campestris.*

Specimens of this tree were presented by Mr. Young, and having been planted on good soil grew vigorously ; but the twigs were liable to be winter killed and the tree then sent off shoots from the root, giving it an unsightly appearance. It is much stiffer in habit of growth than our elm, with smaller foliage and a tendency to corky excrescences on the bark. It is evidently scarcely hardy enough for our climate, though it has succeeded well in New England. All those in the College grounds have perished, except one young tree; but I still have a plant in my garden in Walbrae Place.

18. The Butternut. *Juglans cinerea.*

A row of these trees of large size formerly existed in continuation of the oaks along the bank of the brook to the rear of Mr. McGill's property of Burnside. They were probably along the line of an old fence or farm road. Five or six of these trees existed in 1855, and were regularly visited every autumn by troops of nutters from the east end of the town. The best of the survivors occupies a large space in my garden in Walbrae place, part of which was purchased from the rear angle of the McGill property. The ruins of another stand in front of the Medical Faculty's building and are at least picturesque. This tree was partly buried by excavated material, but has survived this, though many of its branches were killed. Another stands in front of the Thomas Workman Technical building and may probably be spared. Several young trees intended to renew the old ones have been destroyed except one near the chemical laboratory of the Medical School.

The butternut is a very beautiful tree and well deserving cultivation, though it has the fault of leafing late in the spring, and dropping its foliage early in autumn. It is easily raised from the nut if planted in autumn, and grows with rapidity. It is quite a common tree on the farms northward and westward of Montreal.

The butternut, owing to the food it affords and to the shelter provided in the older trees by decayed spots, is a favourite home of the red squirrel. A pair of these animals has continued to maintain itself in the great tree near the Workman building for thirty years, notwithstanding occasional stoning by boys, and one individual at least still holds its ground up to the present autumn.

19. Hickory. *Carya porcina.*

A few fine specimens of this beautiful and stately tree occurred on the line of the Burnside brook. The best was destroyed in 1890. One remains on the lower part of the grounds, and another still survives between the Thomas Workman building and the Medical School. This is a more lofty but less spreading tree than the butternut; and in autumn its bright yellow foliage forms a beautiful variety. Though less rapid in growth than the butternut, it grows quickly in good soil and should be cultivated, both on account of its beauty and the utility of its remarkably strong and tough wood. In appearance it resembles the ash, but is a more beautiful tree.

20. THE MAPLES. *Acer saccharinum, A rubrum, A dasycarpum.*

Curiously enough no maples existed on the grounds in 1855. Now they are the prevalent trees, and many of the best trees are from seed collected in 1856, and sowed in our little nursery on the flat near Sherbrooke street. All the three species above named are on the grounds. The first is the most stately and enduring, but of less rapid growth than the others. In autumn its foliage is variegated with red and orange. The red maple, a more rapid grower but less grand and enduring, has the most brilliant red leaves in autumn. Those of the white maple, *A. dasycarpum*, are yellow in autumn. The belt of red and white maples along the east side of the grounds, all from seed sown by ourselves, was one of the finest bits of woodland foliage about Montreal, but was destroyed to make room for the Thomas Workman building. The thinner belt on the west side of the campus is also a good feature, but much inferior to the other, owing to poorer soil and the injury done to the trees by boys and spectators on occasion of games and athletic sports.

21. THE MOUNTAIN MAPLE. *Acer spicatum.*

This tree, better suited to the colder and more bleak portions of the country, has been naturalized on the college grounds, where one plant still survives. It is of small stature, rather a large shrub than a tree, but its white bark, its peculiar light green foliage and its beautiful spikes of green and red samaras in autumn, entitle it to attention as an ornamental plant. It is easily cultivated and an excellent shrub for hiding palings or other unsightly objects.

22. The Norway Maple. *Acer platanoides.*

Several specimens of this tree were presented by the Hon. Mr. Young, and it proved the finest of all those given by him as an ornamental tree. Our only remaining example is that near the Peter Redpath museum. This tree somewhat resembles our sugar maple, to which it is nearly allied, but it has larger and deeper green foliage, is earlier in putting forth leaves in spring, and retains them longer in autumn. It seems perfectly hardy, and is in all respects one of the finest ornamental trees from abroad ever introduced into this country. A seed bed was established for the sake of propagating plants for distribution ; but the plants had to be removed owing to building operations. A number of them, however, still exist in care of Prof. Penhallow.

No tree better deserves the attention of arboriculturists. It would probably yield sugar, but I am not aware that its properties in this respect have been tested.

23. The English Maple. *Acer campestre.*

This very beautiful small-leaved maple was introduced by Mr. Young, and a number of specimens were planted on the grounds. All those on the richer and less sheltered ground were so much winter-killed that in a few years they perished ; but a few plants which happened to be put on the dry terrace, sheltered by the buildings, have held their ground, not however as trees, but as shrubs. Their beautiful and singular foliage always attracts attention. It is deep green in summer and pale yellow in autumn. They have never borne fruit, and every spring require pruning of dead twigs. The variety which has succeeded best is that having the roughest and most corky bark. The plants now in front of my residence, though mere shrubs, are about thirty years of age.

24. The Sycamore Maple. *Acer pseudo-platanus.*

A fine healthy specimen of this tree was presented by the late Mr. Gibb and proved to be hardy and a vigorous grower, while its great glossy leaves were more showy than those of any of our other maples. It had attained to a height of more than thirty feet, and was a beautiful and shapely tree. Being a little removed from the new buildings I had hoped that it might be preserved ; but on occasion of cutting down some common trees which were in the way, the workman extended his commission to this tree also, and I arrived on the ground too late to save it.

25. The Ash-leaved Maple. *Negundo aceroides.*

Our experience with this handsome tree is of interest, as showing the difference in hardiness of specimens from different localities, a point to which attention has recently been directed by Mr. Fletcher, of the Experimental Farm, Ottawa. Desiring to introduce the tree as a botanical specimen, in consequence of the peculiar form of its leaf, I purchased some plants from a nursery in the State of New York, but was much disappointed with the result. The ends of the twigs were winter-killed and the trees soon began to lose their beauty in consequence, so that I regarded the experiment as a failure. A little later some seeds from Manitoba were sent to me in a letter by Dr. G. M. Dawson and produced healthy plants, which showed no sign of winter-killing, and now I have healthy and vigorous trees perfectly suited to the climate. They have already borne abundance of seed which has been cultivated by Dr. Harrington, and numerous plants have been distributed by him. He has even found that this progeny of the North-west Negundo will grow successfully as far to the North-east as Little Metis on the Lower St. Lawrence, where he has plants ten feet high. One of my original Negundos still exists in the College grounds, and I hope will be spared to become an old tree. Dr. Harrington has ascertained, from specimens on McGill College grounds, the proportion of sugar yielded by this tree, as compared with the sugar maple, which is so considerable as to warrant its culture as a producer of sugar.[1]

26. The White Ash. *Fraxinus americana.*

A great number of trees of this species were raised from the seed, and have been planted in various parts of the grounds. The belt of trees on the east side of the Medical building consists of this species, and presents a fine mass of foliage in summer, through the trees are still young. The ash suffers in some years from the attacks of the tent caterpillars (*Clisiocampa*), and is rather straggling and slender in its habit of growth, but it is easily cultivated and is a rapid grower, especially in moist ground.

27. The English Ash. *Fraxinus excelsior.*

A few specimens of this species were presented by Mr. Young. One still survives in front of the east wing, but is in danger of death from being embanked in earth. It grows vigorously and stands the climate well, but puts forth its leaves very late in spring, so that a casual observer, seeing it bare after other trees are in leaf, would suppose it dead. It is a finer and more stately tree than any of our species, and deserves cultivation.

28. The Mountain Ash *Pyrus Americana* and *P. aucuparia.*

The first named species is the native mountain ash and the second is the European species. Both are handsome small trees and produce beautiful pinnate leaves and rich clusters of scarlet berries in autumn The American spe-

[1] Trans. Royal Society of Canada, vol. v. 1888, p. 39.

cies is the more luxuriant grower and has larger and more shining leaves. The English species is more delicate and graceful. Both are perfectly hardy, of rapid growth and easily propagated, and are not uncommon in gardens and shrubberies in and near Montreal. We had young trees of both species on the grounds as well as some varieties with peculiar leaves presented by Mr. Gibb, but they had to be removed to the botanical garden.

29. Hawthorn. *Cratægus.* (Species.)

In 1855 the most abundant shrubs on the grounds were hawthorns, whose spines had enabled them to resist the attacks of cattle and boys. They also sheltered wild vines and other climbers. There were three species; the most abundant was *C. crusgalli*, the cockspur thorn, but *C. coccinea*, the crimson-fruited thorn was also present though rare, and one specimen of it still survives near the Medical building. The finest species, however, was *C. tomentosa*, the apple or pear thorn, which becomes when full grown a small tree, throwing out its branches horizontally with a very fine effect, and presenting an object of rare beauty when covered with blossom in spring. One of the finest specimens I ever saw was on the east side of the grounds toward University street. When it was proposed to sell lots on this street, Mr. D. Davidson,[1] then a member of the Board, declared that one of his chief objections to the sale of these lots was the probable destruction of this tree. It survived this ordeal, however, being a little beyond the limits of the building lots, but now its place knows it no more. A very fine, though younger, specimen still exists in front of the Library at the foot of the terrace.

Some years ago I suggested to the gatekeeper to plant a row of seedlings of this species along the Sherbrooke street front, in hope that they might replace as a hedge the old

[1] While these pages were in the press the news arrived of the death of this venerable and true friend of education, to whom both the University and the High School of Montreal are most deeply indebted.

paling along that front. The attempt was quite successful and the hedge still stands, though the paling has been replaced by an iron railing.

When in England in 1865, I procured some plants of the pink and crimson double hawthorn, so ornamental in that country in spring, and planted them in different parts of the grounds. One of them, planted in a rich and sheltered spot, grew well and flowered several times. The others were less successful, and eventually all succumbed to the rigour of the winter. The common variety of the English thorn is however more hardy.

30. June-Berry. Wild Pear. *Amelanchier canadensis.*

This beautiful little tree was introduced to the grounds many years ago, and was the first to gladden our eyes in spring with its white blossoms, though the wild plum was sometimès about as early. I took special care of one specimen training it on a single stalk and cutting away the shoots which this tree is so prone to form at the base. The result was a specimen of unusually large size and beauty, which several botanists informed me was the finest they had seen. It was destroyed to make room for the engineering building.

On our grounds the delicious fruit of this tree, so mueh prized by the Indians of the North-West, could not be obtained, owing to the constant depredations of a grub which destroyed or rendered it unsightly, and the birds quickly disposed of the remainder. I had hoped by culture to improve the fruit, but could never obtain it in any quantity.

31. Poplars. *Populus.* (Species.)

The Abele or European white poplar and the Lombardy poplar were early introduced on the grounds, and have grown vigorously. The former is too rapid in growth and too wide-spreading for limited grounds, and both are very exhausting to the soil in their vicinity. Of the native species the only one to which I gave attention was the *P. grandidentata,* the large-toothed aspen, because of its resemblance to some fossil species, and the wonderful variety in form and texture of the leaves on shoots and branches of different ages, as illustrating the diversities of foliage in these fossil species. The tree is, however, of straggling and irregular habit of growth, and scarcely worthy of cultivation except for its tremulous leaves, in which property it is surpassed by its ally, *P. tremuloides,* but this also is a straggling and usually ungraceful tree.

32. Willows. *Salix.* (Species.)

Some plants of native willows existed originally in the grounds, and seemed to have been less attractive to browsing cattle than most other shrubs. The bright yellow catkins of the male plants formed an attractive feature in early spring. They appear, however, to be of short life and require to be frequently renewed. In recent years some foreign species of fine appearance were presented by Mr. Gibb. Two of these, more particularly, a gray or olive-leaved species and one with shining dark green leaves, were especially attractive and proved hardy and rapid growers. They are well deserving of attention where beautiful foliage is desired in a short time and where the soil is moist. The same remark may be made as to some of the finer varieties of the white-leaved poplar. The beautiful golden willow was early planted along the side of the brook, and though for some years it was impossible to protect the plants from the knives of schoolboys, they eventually overtopped their assailants and grew to the stature of trees, which formed a very pleasing variety in contrast with the maples and spruces.

33. Wild Cherry and Plum. *Prunus.* (Species.)

The choke cherry (*Prunus virginiana*), the black cherry (*Prunus serotina*), the common wild red cherry (*Prunus pennsylvanica*), and the wild plum (*Prunus americana*), were all indigenous on the grounds, or early introduced, and flowered and fruited every year. A few specimens still remain. The wild red plum, still used for preserving, was an article of food with the old people of Hochelaga, as the stones are found in their kitchen-middens. It probably grew plentifully along the base of the mountain. The plants on the college grounds had apparently been sown by birds, and were principally interesting as harbingers of spring by their early blossomlng—their fruit being usually destroyed by the curculio.

34. THE LOCUST TREES. *Robinia pseudacacia* and *R. viscosa.*

Slips of these trees were obtained from friends at an early period of our planting, and throve well, especially the former, which, from its habit of sending up shoots from its roots, became almost a nuisance. The clammy acacia (*R. viscosa*) was more tender and liable to have the twigs winter killed, but it often bore abundantly its beautiful clusters of reddish flowers. A plant of the latter species still remains, but all those of the former had to give way to the new buildings.

35. THE CATALPA. *C. bignonioides.*

For several specimens of this beautiful and interesting tree we are indebted to the late Charles Gibb, and all are fortunately planted in portions of the grounds not as yet invaded by building. They require a sheltered position, and some specimens seem perfectly hardy, while others, perhaps less favorably situated, have the shoots winter-killed. None of the specimens have yet flowered, and, as their growth is not rapid, it may be several years before we can have the pleasure of seeing the beautiful blossoms. I have observed that this tree has in Toronto been planted along some of the streets. Whether it would stand here in such situations is uncertain: but it deserves attention in ornamental grounds.

36. THE DOGWOOD. *Cornus.* (Species.)

Of our different species of dogwood, that which seems most deserving of cultivation as an ornamental tree is *C. paniculata.* A fine tree-shaped specimen with very spreading branches is in the grounds, and is still vigorous though thirty years of age.

37. THE ELDERS. *Sambucus canadensis* and *S. racemosa.*

Both species are cultivated in the College grounds. The latter is perhaps the most important. It grows very vigorously, is the first shrub to put forth its leaves and its not very showy blossoms in spring, and when in fruit is gay with its bunches of scarlet berries. It tends to have a straggling habit of growth, but is easily pruned and kept in shape. Its early vegetation in spring entitles it to special consideration in our climate; and though it prefers somewhat rich ground, it will grow well on dry banks.

38. THE HIGH CRANBERRY. *Viburnum opulus.*

Two specimens of this plant presented by the late C. Dunkin, Esq., still exist in the grounds, and their fruit, remaining over winter, produces a pretty appearance and provides a meal to winter birds. The double variety known as the snowball is a common ornamental shrub everywhere, but the brilliant berries of the single variety entitle it to consideration as an ornamental plant, though its flowers are much less showy.

39. THE SHEEP-BERRY. *Viburnum lentago.*

This species, indigenous on the mountain, is the only other viburnum we have cultivated except the common snowball. It grows well and flowers and fruits freely, and is among other shrubs a pretty variety. In some parts of the country its berries are used as fruit, but are of little value.

40. The Woodbine or Five-Fingered Ivy. *Ampelopsis quinquefolia.*

This species grew freely among the thorn bushes and was used as a climbing plant as it generally is in Canada, with good effect. I owe to the kindness of my friend, the late Prof. Gray, some seedlings of the beautiful Japan species, *A. veichii.* This I have found too tender to grow in rich soil or in shady or exposed places, but in the dry soil and sunny exposures of the front of the college buildings it has held its own, though more or less killed back in winter, for about ten years. It is too tender for our climate, except in the most favourable soils and exposures.

41. The Staff-tree. *Celastrus scandens.*

This fine climber was abundant in the thorn thickets, and often bore quantities of its brilliant and permanent scarlet and orange fruit. It is now, however, confined to a single specimen trained over the front porch of the east wing, where it has continued unimpaired for the last twenty-five years, and puts forth is shoots and blossoms vigorously every spring, though it does not fruit. It is very well suited for this purpose, and I am surprised that it is not more frequently cultivated as an ornamental climber. When trained artificially, however, it often fails to fruit. It is not only a very beautiful climber, but has the merit of escaping the attacks of the minute insects so destructive to vines. I used to boast that it is altogether exempt from insect ravages; but only last spring I found some of the slender young shoots covered with the common black Aphis. It is an interesting example of the almost instinctive attraction of some climbing plants to supporting bodies. Its long red roots pass for a considerable distance underground, and whenever they come near to a post or tree stem, send up young plants though they may show no tendency to this elsewhere.

42. The Frost Grape. *Vitis cordifolia.*

This grew abundantly among the thorn bushes, often weighing them down with its masses of foliage and fruit. As already stated, it was used for training on dead trees, etc., but latterly it was much affected, and its beauty destroyed by the attacks of a minute vine-fretter (*Tettigonia*). Its fruit is useless except for the plentiful colouring matter which it contains.

43. THE JUDAS TREE. *Cercis canadensis.*

We owe specimens of this shrub to the late Mr. Gibb. It has, however, proved tender, even in a sheltered position, and has not flowered. It does not seem to be suited to our climate. Our largest specimen has been removed to the new botanical garden, where, perhaps, it may be more successful.

44. THE SUMACH. *Rhus typhina.*

This beautiful little tree is one of our best ornamental plants and will grow on poor stony soil. Its straggling habit of growth can be corrected by cutting down the tops of the young shoots annually for a few years. The female plant is much the best, being of more compact and vigorous growth and retaining its dense panicles of red fruit through the winter. In autumn the brilliant red leaves have a fine appearance. The fruit, though dry, is greedily eaten by some winter birds, and it is probably by the agency of these that the species is so plentifully disseminated over the lower part of the Mountain Park. Young plants trained separately on single stems and pruned as above directed, have a very fine appearance on exposed banks.

45. THE SHRUBBY HOLLYHOCK. *Hibiscus syriacus.*

I was much struck with the beauty of this plant as cultivated in the surburbs of Boston, and endeavoured to introduce it on the College grounds. The attempt was, however, unsuccessful. The tips were winter killed, and though I succeeded in having flowers for a few years, the plants ultimately perished.

46. The Angelica Tree or Shrubby Aralia. *Aralia spinosa.*

We owe this curious plant to Mr. Gibb. When growing vigourously and in good condition it is highly ornamental, but it is liable to have the terminal bud winter killed, and it has a bad habit of spreading freely from the root. It requires moist ground. Our best specimens have had to be removed, and some have been planted in the rear of the grounds near the Medical building.

47. Paulownia. *Paulownia imperialis.*

This tree produces magnificent leaves and is very ornamental, but unfortunately its large shoots are annually killed down. It has been on the ground for about twelve years and sends up vigorous shoots annually. It is deserving of cultivation even as a herbaceous plant, because of the beautiful foliage. Our best specimen has been destroyed but a smaller one still survives.

48. Shrubby Hydrangea. *Hydrangea arborescens.*

This beautiful, shrub presented by Mr. Gibb, has proved quite hardy and flowers profusely. Its large cymes of flowers are very showy in autumn, and if taken into the house can be dried and will remain fresh over winter. It has now been introduced into many private gardens. The best specimens I have seen are in the grounds of Mr. J. H. R. Molson.

49. The Horse Chestnut. *Æsculus hippocastanum.*

Specimens of this tree, presented by Mr. Young, have been growing for many years on the grounds and flower freely. I had hoped also to introduce the red variety, so much cultivated in England; but the specimens imported proved too tender to endure the winter, though Mr. Lunn, perhaps from some difference in soil or exposure, was more successful, and had vigorous specimens for many years.

50. The Spruces. *Abies.* (Species.)

We had originally no spruces on the grounds. The late Major Campbell of St. Hilaire was kind enough to send a car-load of young spruces to the College many years ago, principally of the black spruce, *A. nigra.* They were planted and grew well; but those in the vicinity of the cricket ground were all killed by the rough treatment they received. A group around the lawn tennis shelter still remains; but the best were planted on the east side of the grounds and have been destroyed. Mr. Gibb, at a later date, presented young plants of the Norway spruce. one of which remains. This species is finer in habit of growth than those of our country and perfectly hardy.

51. The Arbor Vitæ. *Thuya occidentalis.*

A few of these trees were planted in a clump in the central part of the ground in 1856 and still remain. I trust they will not require to be removed, as I am very desirous to obtain a record of the rate of growth of this tree, which seems to be extremely slow, a fact perhaps connected with the very durable character of the wood. Our specimens are only a few inches in diameter, while the elms and maples planted at the same time are a foot or more, and the spruces planted long after are twice their size.

52. The Larch. *Larix americana.* L.

Only a few specimens of the American larch were planted on the grounds, and I believe all have been destroyed. A fine specimen of the European larch still exists, but is too near to an intended roadway to be permitted to survive. The European larch is a finer and more compact tree than ours, and with more pendulous branches and larger and brighter coloured cones. It is perfectly hardy. The native larch has in many places been destroyed by the ravages of a caterpillar. I have not yet observed this to attack the English species.

53. THE JUNIPER. *Juniperus communis.*

I brought a specimen of this plant from Cape Elizabeth about 1865, and planted it in what seemed a favourable spot. It grew and has continued to live up to last year; but its growth is so slow that in twenty-five years it was a low bush, with a total diameter of only about three feet. I feared to attempt to transplant it, and had hoped to preserve it by placing guards around it, but in my temporary absence it was buried under a pile of stones and destroyed.

54. THE GINKGO TREE. *Ginkgo biloba.*

I was naturally desirous to have this tree on the grounds, as an example of a taxine tree with broad leaves, as the sole representative of its genus, and as a modern example of a type which in Cretaceous and Tertiary times was represented by several species in Canada. A specimen which I obtained many years ago from a nursery in the United States still stands, but it is too large to be transplanted with safety, and I fear is so near to a contemplated road embankment that it may be destroyed. A few smaller examples, presented by Mr. Gibb, have been transplanted to the new botanical garden.

Miscellaneous Shrubs.

It would be tedious to refer to a variety of other ornamental shrubs cultivated or experimented on. Among those successfully introduced are the golden currant, the flowering raspberry, the Western white flowering raspberry from Lake Superior (*Rubus nutkanus*), the silver-leaf (*Elæagnus argentea*),[1] the lilacs, of which we had at one time five or six varieties, the species of Philadelphus or "Syringa," the burning bush (*Euonymus*), the fringe-tree (*Chionanthus*), various species of *Spiræa*, etc. Many of these, as well as Canadian herbaceous plants, have been transferred to the new botanical garden.

[1] This species, usually considered a Western plant, is also found locally in Eastern Canada, as, for instance, on the banks of Metis River, and it grows very vigorously and would easily run wild at Montreal.

I have always regarded the sight of trees and other beautiful or impressive natural objects as an educating influence of no small value, and all the more needed in a country whose tradition is the destruction, not the culture of trees, and where, even from a utilitarian point of view, arboriculture should be encouraged far more than it has been; while the love of rural beauty, for its own sake, at present so lamentably deficient among us, would be an influence not only elevating but tending to the best kind of patriotism. For this reason I had hoped to leave behind me, in connection with McGill, a college park, which, if not large, should be attractive and instructive from its variety and the number of interesting trees contained in it, where our young men could learn to know and love the useful and ornamental trees of our country, and whence some of them might go forth to take up the pursuits so admirably carried out by our late lamented graduate and friend, Charles Gibb. This portion of our educational work has for the present been suspended, except in so far as it can be renewed on the Trafalgar property; but I hope that the slender and imperfect record of it above given may aid those who may have opportunity to continue it under better auspices, and may possibly tend to induce some large-minded benefactor to bestow on the University a sufficient tract of land for a botanical garden and arboretum, like those connected with some of the greater universities on this continent and abroad.

For the present we have secured, as a refuge for a portion of our collections, the use of a desirable property on the mountain, belonging to the Trafalgar Institute; but this is only temporary, and it is evident that to make adequate experiments on tree culture, and to perpetuate the evidence of our results, requires a permanent property, and this of some magnitude and with somewhat varied soils and exposures. Our botanical department, as now organized under Prof. Penhallow, would render this beneficial not only to students, but to the country at large.

NOTES ON THE FLORA OF CACOUNA, P. Q.[1]

August 9th—18th, 1891.

BY D. P. PENHALLOW.

In the flora of Cacouna and the adjacent districts of the Lower St. Lawrence, the botanist finds many features of interest, both in its extent and special character. One of the most prominent facts which first commands attention, is the brilliancy of the flowers, and the great profusion of many species which are nearly or quite at their northern limits of distribution. The presence of distinctly boreal species like *Arctostaphylos uva-ursi*, *Vaccinium vitis-idæa*, *Empetrum nigrum* and *Pinus banksiana*, and the predominance of such plants as alder, birches, *Linnæa borealis*, *Chiogenes serpyllifolia* and *Ledum latifolium*, together with a profusion of lichens and mosses, indicates a distinct approach to sub-arctic and arctic flora.

On the other hand, southern types are also met with, but many of them obviously near or at the extreme northern limits of their distribution. Such a combination of types lends a peculiar interest to the flora, which is also strengthened by the special physical characteristics of the region.

The geological formation of Cacouna and vicinity, is Lower Silurian. The various strata of sandstone, granitoid rock and shale are tilted up at an abrupt angle, and form a series of parallel ridges of variable height running north-east and south-west parallel with the general course of the river. These ridges rise to a height of 150–300 feet, and in one or two cases form isolated hills rising abruptly from the surrounding plain. Between them are large areas of alluvium which embrace both swamps and arable lands of fine quality.

The ridge following the shore line, and on which rests the Village of Cacouna, presents a very bold face towards

[1] Contribution from the Botanical Club of Canada.

the river, the cliff rising abruptly to a height of 50–100 feet, while somewhat farther back, the crest attains an altitude of 75–100 feet more. Towards the north, in the direction of Green River, the ridge gradually runs down to near the river level, while towards the south it also terminates at low level in a rocky point. For want of more exact identification, I shall refer to this locality as Cacouna Point. To the east of Cacouna ridge and rather nearer the Fraserville slope, but rising abruptly from the plain, is an isolated hill having a height of about 200 feet, and a northern and southern extension of about a mile. The western face is very bold and broken, while the eastern face slopes away somewhat gradually. This is known as Pilot Hill. Between the Cacouna ridge and the higher ridge at Fraserville, there is a ridge which rises abruptly from the surrounding plain, having its northern terminus near the Fraserville road, while its southern extremity projects well into the river at the landing. Between this point and the main shore at Fraserville is a deep bay, the shores of which are somewhat marshy. Again, between it and Cacouna Point, there is also a deep bay, the shores of which are very marshy almost up to the highway. This was found to be a locality rich in plants not found elsewhere. On the Fraserville side of this marsh, just under the bluff, are the ruins of a large stone house which will be referred to as the Old Stone House. Following the shore road past this point towards the landing, one is led through a succession of fields and finally through a beautiful wood, where is to be found an abundance of *Taxus* and more ferns than occur any where else in the vicinity. At the foot of all the shore bluffs are dense thickets, rich in species which do not find as congenial homes in other localities.

Cacouna Island is such only in name. It is in reality connected with the main land by a low neck which, at high water, is a few hundred feet wide, but at low water, expands to a broad tract of marshy land probably three-quarters of a mile or more wide. The island itself, is a mass of rock covered partly with thin soil, with bold shore cliffs rising to a height of 150 feet. The summit of the island is probably 300–350 feet high.

Such a configuration of the surface presents conditions which are in a high degree favorable to a diversified flora, while the latitude—47° N.—favors the presence of distinctly sub-arctic and arctic plants.

The river, which is here about twelve miles wide, offers a great barrier to the northern extension of southern forms. The temperature along the south-east shore, is manifestly higher than along the north-west shore, a fact which is indicated by the presence of persistent fogs in the vicinity of the latter, when the former is wholly free from them. It is, therefore, highly probable that on the northern shore the vegetation is more distinctly arctic, and that many species which occur on the south shore, may be wholly wanting there. Comparative studies in this direction would be of value.

The prevailing arborescent vegetation consists of the white (*Picea alba*) and black (*Picea nigra*) spruces, with occasional specimens of pitch (*Pinus resinosa*) and white (*Pinus strobus*) pines, larch (*Larix americana*) and white cedar (*Thuya occidentalis*). The sugar maple (*Acer saccharinum*) is common as a shade tree, and occasionally is sufficiently abundant to form sugar bush. *Populus tremuloides* is common everywhere, while the Lombardy poplar (*Populus dilatata*) is very common in all the villages as a shade tree. The Banksian pine (*Pinus banksiana*) is abundant on Cacouna Island, as also, is the Canadian yew (*Taxus canadensis*).

The very great variety of situations in which plants of the same species occur, is a matter of constant surprise. The bunch berry (*Cornus canadensis*) which, further south is almost wholly confined to low lands, is here found extending from low, moist woods and meadows up the slopes of the hills and even on the dry, rocky slopes of the higher ridges. *Linnæa borealis* is also found both in low, mossy ground with *Ledum latifolium*, and in moist woods, and also on dry, rocky ridges among the shrubby growth. *Crypripe-*

dium acaule was found most abundantly on the tops of dry ridges where it was protected by shrubby growth hardly more than eight feet high.

The blueberry (*Vaccinium pennsylvanium*) is very abundant throughout the eastern region. The mountain ash is also common, and is largely used for ornamental purposes. It grows as a low tree or large shrub hardly exceeding 20 feet in height, and on Cacouna Island it is wholly dwarf.

The time of year at which our observations were made was not favorable to the collection of a large number of species, nevertheless, the fact that within eight days, no less than 220 species were observed, exclusive of grasses, lichens, and mosses, shows that the flora of the district is a fairly rich one. The following enumeration of species with their localities, will obviate the necessity of further comment. It shows 49 families, 149 genera, and 212 species. The species which have been introduced and are now naturalised, are indicated by *

THALICTRUM POLYGAMUM, Michx. (Tall Meadow-Rue.)

Very common in thickets on Cacouna Island, in the same localities on the mainland and in moist lands generally. Flower.

RANUNCULUS CYMBALARIA, Pursh. (Seaside Crowfoot.)

This plant was found somewhat abundantly on the shore at Cacouna Island and in the same situations on the mainland. It was chiefly found growing in the soil between rocks. It was observed in the greatest abundance at Cacouua Point. No flower.

RANUNCULUS SCELERATUS, L. (Cursed Crowfoot.)

Common everywhere in ditches, especially towards Fraserville landing near the old stone house. Flower.

RANUNCULUS PENNSYLVANICUS, L. f. (Bristley Crowfoot.)

Found somewhat sparingly in the low ground of the intervale east of Cacouna, and more rarely in grain fields. Flower.

*Ranunculus acris, L. (Buttercups.)

Very common everywhere. Flower.

Caltha palustris, L. (Marsh Marigold.)

Only a few specimens of this plant were found in the wet land between Cacouna Point and the point at Fraserville landing. The leaves alone were found.

Coptis trifolia, Salisb. (Goldthread.)

This species occurs in abundance on mossy hummocks in the low lands bordering the road to Cacouna station. No flower.

Actæa spicata, L., var. rubra, Ait. (Red Baneberry.)

Very common everywhere in moist thickets and woodlands, being particularly abundant along the shore at the base of the bluff. On Cacouna Island it was found extending nearly to the summit. Fruit.

Actæa alba, Bigel. (White Baneberry.)

Very abundant and found in the same situations as the last, the sharply contrasting red and white berries of the two species forming a striking feature in the undergrowth. Fruit.

*Brassica sinapistrum, Boiss. (Charlock.)

This pest is here found in considerable abundance in all the grain-fields. Flower.

*Brassica nigra, Koch. (Black Mustard.)

Commonly found about dwellings and in waste places. Like the preceding, it has become well established. Flower.

*Capsella bursa-pastoris, Mœnch. (Shepherd's Purse.)

This introduced species is everywhere common on the mainland, and constitutes one of the most common roadside weeds. It seems, however, not to have extended to Cacouna Island. Flower and fruit.

Viola blanda, Willd. (Sweet White Violet.)

From the abundance of leaves found, this is evidently one of the most conspicuous of the spring flowers. It occurs everywhere in the lowlands.

VIOLA CANADENSIS, L. (Canada Violet.)

Only one specimen of this plant was found, and that on Cacouna Island, but although difficult to find at this season of the year, it is most probably one of the more conspicuous of the spring flowers throughout the open woods.

*SILENE CUCUBALUS, Wibel. (Bladder Campion.)

Very abundant along the roadsides and in fields, where it appears to constitute a troublesome weed. The usual height, as observed here, is from one to two feet. Flower.

ARENARIA LATERIFLORA, L. (Sandwort.)

A few plants of this species were observed near the shore of Cacouna Island, where it appears not to have fully established itself. On the mainland it is common all along the shore. Flower.

ARENARIA PEPLOIDES, L. (Sandwort.)

Very common on the sandy shore of Cacouna Point. Flower.

*STELLARIA GRAMINEA, L. Starwort.)

An introduced species of limited range here, being found only in cultivated fields at Cacouna Point. Flower.

SAGINA NODOSA, Fenzl. (Pearlwort.)

Very common in the sandy soil of the shore at Cacouna Point. No evidence of this species on the Island. Flower.

BUDA BOREALIS, Watson. (Sand-Spurrey.)

This plant grows in the same situations and has the same distribution as the preceding, the two being commonly mingled. Flower.

SPERGULA ARVENSIS, L. (Spurrey.)

A very common weed in grain-fields. Flower.

HYPERICUM MUTILUM, L. (St. John's-wort.)
A rather common plant in low ground. Chiefly in fruit, occasionally in flower.

ELODES CAMPANULATA, Pursh. (Marsh St. John's-wort.)
Common in the moss hummocks of low, boggy ground, chiefly in the intervale back of Cacouna. Fruit.

*LINUM USITATISSIMUM, L. (Flax.)
This introduced plant appears to be wholly confined to grain-fields, where it is quite prominent. It was not observed on Cacouna Island. Flower and fruit.

OXALIS CORNICULATA, L., var. STRICTA, Sav. (Wood Sorrel.)
A few plants of this species were observed on the slope of Pilot Hill, and though a more extended search might disclose a larger quantity, it is apparently not an abundant species here. Flower.

IMPATIENS FULVA, Nutt. (Jewel-Weed.)
Very common in low lands, especially in ditches and along narrow streams, as well as in moist thickets of the mainland and Island. Flower.

ACER PENNSYLVANICUM, L. (Striped Maple.)
This shrub was noted as occurring but sparingly, and the impression was gained that it is here near its highest northern limit. A few shrubs are to be found at the foot of the bluff along the shore, and a few more at the foot of the bold western foot of Pilot Hill. Fruit.

ACER SPICATUM, Lam. (Mountain Maple.)
A very common species in all the thickets along the shore, particularly along the foot of the bluff towards Fraserville landing. Fruit.

ACER SACCHARINUM, Wang. (Sugar Maple.)
A common tree, extensively used for shade. These three species of maple were not observed on Cacouna Island.

*TRIFOLIUM REPENS, L. (White Clover.)
Everywhere common in cultivated fields and by the road-side. Flower.

*Melilotus alba, Lam. (White Melilot.)

Somewhat common as a roadside weed and in gardens, where it is still cultivated for ornament. Flower.

Vicia cracca, L. (Vetch.)

Everywhere common along the roadside and in thickets. It is extremely abundant in grass lands, where it covers large areas, and has all the appearance of being cultivated. The rich, deep purple flowers are most striking. It is also found all along the shore and is common on Cacouna Island. Flower.

Lathyrus maritimus, Bigelow. (Beach Pea.)

A most abundant plant everywhere along the sandy shores and gravelly beaches. On Cacouna Island it extends up the rocky slopes near the shore to a height of forty or fifty feet. The flowers are very showy and form a conspicuous feature of the vegetation. Flower.

Prunus serotina, Ehrh. (Black Cherry.)

So far as observed this species occurs here only as a small tree, and was found chiefly in the thickets along shore at the foot of the bluff, where it is rather common. Fruit.

Spiræa salicifolia, L. (Meadow-sweet.)

Found somewhat sparingly in dry, rocky fields near Cacouna Point. Flower.

Rubus chamæmorus, L. (Cloud-berry.)

In a sphagnous swamp on the road toward Green Island, about two and one-half miles from Cacouna church, this plant was found in considerable abundance. It was not observed elsewhere. Leaves only.

Rubus triflorus, Richardson. (Dwarf Raspberry.)

Common in the rather dry fields, on sandy soil, at Cacouna Point. Fruit.

Rubus strigosus, Michx. (Wild Raspberry.)

Extremely abundant on Cacouna Island, also on Pilot Hill, and less conspicuously on the dry, rocky ridges. It is also very abundant in the woodlands of the intervales. The fruit of this plant, which is here gathered in great abundance, is in this locality remarkable for its size and flavor. Fruit.

GEUM RIVALE, L. (Purple Avens.)

Sparingly found in the marsh near Cacouna Point. Fruit.

FRAGARIA VIRGINIANA, Mill. (Strawberry.)

Very common everywhere in the fields, where it often covers extensive areas. Flowers and fruit.

FRAGARIA VESCA, L. (Strawberry.)

Rather common on the rocky ridges. Fruit.

POTENTILLA NORVEGICA, L. (Cinque-foil.)

Everywhere abundant in fields and along the roadsides, but not observed on Cacouna Island. Flower.

POTENTILLA PALUSTRIS, Scop. (Marsh Five-finger.)

Somewhat common in the marsh near Cacouna Point. Fruit.

POTENTILLA FRUTICOSA, L. (Shrubby Cinque-foil.)

Only one isolated patch of this plant, covering an area of about thirty feet square, was found in the low ground near the marsh at Cacouna Point. Fruit.

POTENTILLA TRIDENTATA, Ait. (Three-toothed Cinque-foil.)

An abundant species on Cacouna Island, where it grows in the crevices of ledges and between rocks, extending in great abundance quite to the summit. It was not observed anywhere on the mainland. Fruit, with occasional flowers.

POTENTILLA ANSERINA, L. (Silver-weed.)

A very common species on the gravelly shore of Cacouna Island and the mainland, where it covers large areas. It is also common on dry, rocky ridges and in moist fields everywhere. Flower.

Poterium canadense, Benth. & Hook. (Burnet.)

This plant is one of the most conspicuous features of the summer flora. Along the shore of Cacouna Island it is abundant. On the mainland it occurs in the intervales, where it often forms a dense growth for many square rods. One of the best locations for this plant is on the road to Fraserville, near the railroad crossing. Flower.

Rosa blanda, Ait. (Rose.)

Found somewhat sparingly, the only station being on rocky land at Cacouna Point. Only one clump, growing close to a ledge, was observed. Flower.

Pyrus americana, D. C. (Mountain Ash.)

Very common along the roadsides and in grounds about houses, where it has been utilized for ornamental purposes. It is abundant everywhere in thickets and on rocky slopes, where, however, it is always very small and badly attacked by fungus. It occurs somewhat sparingly on Cacouna Island, where it extends nearly to the summit, but always small and stunted. As found here the height ranges from 3° to 20°. Fruit.

Amelanchier canadensis, Torr. & Gray, var. botryapium, Torr. & Gray. (June-berry.)

Common on Cacouna Island, where it extends to the summit. On the mainland it is everywhere found on the rocky ridges, but nowhere is more than five feet high. Fruit.

Amelanchier oligocarpa, Roem. (June-berry.)

Common on the ridges along the shore. Both this and the previous species are very extensively attacked by fungus. Fruit.

Tiarella cordifolia, L. (False Mitre-wort.)

Observed only in the moist woods of Pilot Hill. Leaves only.

Ribes cynosbati, L. (Wild Gooseberry.)

An abundant species on the steep bluffs and along the rocky shore of both mainland and Island. Also very abundant at Cacouna Point. Fruit.

Ribes oxycanthoides, L. (Wild Gooseberry.)

This species is found near the beach on Cacouna Island, and abundantly in the thickets along the shore of the mainland, together with the preceding. Fruit.

Ribes prostratum, L'Her. (Fetid Currant.)

Very common in close thickets near the beach and also on Cacouna Island. Fruit.

*Sedum telephium, L. (Garden Orpine.)

Near the old stone house towards Fraserville landing there was found a patch of this plant covering several square yards. It has apparently escaped from an old garden formerly existing near by. Flower.

Epilobium angustifolium, L. (Fire-weed.)

Everywhere common along the roadsides, on gravelly beaches and in the low ground of the intervales, where it extends over large areas,—the brilliant flowers forming a blaze of color which catches the eye from a long distance. On Cacouna Island it is also abundant along the shore and extends well up the dry slopes towards the summit. Flower.

Epilobium coloratum, Michx. (Willow-herb.)

Very common in moist, low lands, along ditches and about the shore of Cacouna Island. Flower.

Epilobium palustre, L. (Willow-herb.)

Common on the upland ridges and on Cacouna Island. Flower.

Œnothera biennis, L. (Evening Primrose.)

Roadsides, somewhat common, and on Cacouna Island near the shore. Also common all along the shore of the mainland at the foot of the bluffs. Flower.

CIRCÆA LUTETIANA, L. (Enchanter's Nightshade.)

Very abundant in the thickets along the shore at the foot of the bluffs. Fruit.

LIGUSTICUM SCOTICUM, L. (Scotch Lovage.)

Very common all along the shore of the mainland and Island. Flower and fruit.

CŒLOPLURUM GMELINI, Ledeb.

Very common in the thickets along the shore of the mainland and Island, where it attains a height of five and six feet. Fruit.

OSMORRHIZA LONGISTYLIS, D. C. (Sweet Cicely.)

Common in thickets along the shore. Fruit.

SANICULA MARYLANDICA, L. (Black Snake-root.)

Found sparingly on Cacouna Island. Flower.

ARALIA HISPIDA, Vent. (Bristley Sarsaparilla.)

Found sparingly on dry, rocky ridges on Pilot Hill and on the rocks of the shore at Cacouna Point. Also a few specimens on Cacouna Island near the shore. Flower and fruit.

ARALIA NUDICAULIS, L. (Wild Sarsaparilla.)

Very common everywhere on the Island and mainland in moist, rocky thickets and on rocky slopes. Fruit.

CORNUS CANADENSIS, L. (Bunch Berry.)

Very abundant everywhere, presenting the greatest diversity of habitat. In the low grounds and moist woods of the intervales it is most common. It ascends the slopes of Pilot Hill and follows the wood growth to the summit of Cacouna ridge, where it is a common roadside plant, and it is even found in quantity on the dry, rocky ridges of greater elevation. In the latter situations the plants are rather small and the berries not numerous nor well formed. The favorite habitat, as farther south, is in the rich, moist woods of the rocky slopes, where the berries are large, rich in color, and the bunches very full and compact. Occasionally a flower.

Cornus stolonifera, Michx. (Red-osier Dogwood.)

Very common everywhere along roadsides and on rocky ridges. Abundant also on Cacouna Island. Fruit.

This shrub thrives well in a variety of situations, is easily cultivated, and if well cut back for a time forms a shapely plant. It improves very materially when transplanted to the more congenial conditions of cultivation, and is well worthy of introduction as an ornamental shrub.

Sambucus racemosa, L. (Elder.)

Common along the roadsides and in thickets at the base of the shore cliffs of mainland. Found but sparingly on Cacouna Island. Fruit.

Viburnum acerifolium, L. (Arrow-wood.)

In rocky woods somewhat common, especially along the base of the shore cliffs. It was not found on Cacouna Island. Fruit.

Viburnum pubescens, Pursh. (Downy Arrow-wood.)

Found very sparingly on dry, rocky ridges. Fruit.

Macoun assigns the eastern limit of this species to Western Quebec, but the specimens found by me make it certain that this range must be extended somewhat.

Viburnum nudum, L.

Found sparingly on rather well drained rocky ridges. Fruit.

Viburnum lentago, L. (Sheep-berry.)

Several shrubs along the roadside near St. Arsennes. Fruit.

Linnæa borealis, Gronov. (Twin-flower.)

Very common on rocky, wooded slopes, in moist woods everywhere. On Cacouna Island it extends up the rocky slopes in the open thickets, nearly to the summit. Fruit.

LONICERA OBLONGIFOLIA (?), Muhl. (Dwarf Honeysuckle.)

A few specimens of this shrub were found on the low ground near the old stone house. No flower or fruit.

DIERVILLA TRIFIDA, Moench. (Bush Honeysuckle.)

Common on the higher rocky ridges and in thickets all along the shore. It apparently does not occur on the Island. Flower.

GALIUM CIRCÆZANS, Michx. (Wild Liquorice.)

Common in thickets. Not found on the Island. Flower.

GALIUM TRIFIDUM, L. (Small Bedstraw.)

Common in low grounds, especially along ditches and streams. Flower.

EUPATORIUM PURPUREUM, L. (Trnmpet Weed.)

Very common in the low lands of the intervales. Flower.

EUPATORIUM PERFOLIATUM, L. (Thoroughwort.)

Common in low lands of the intervales along streams and ditches. Not found on the Island. Flower.

SOLIDAGO CÆSIA, L. (Golden-rod.)

Common everywhere in woodlands and borders of thickets. Flower.

SOLIDAGO LATIFOLIA, L. (Golden-rod.)

Everywhere in open woodlands and along roadsides. Flower.

SOLIDAGO SEMPERVIRENS, L. (Golden-rod.)

A very abundant species in the marsh near Cacouna Point. Flower.

SOLIDAGO CANADENSIS, L. (Golden-rod.)

Very abundant everywhere. Flower.

SOLIDAGO LANCEOLATA, L. (Golden-rod.)

Very common in fields and by the roadside. Apparently not found on the Island. Flower.

ASTER MACROPHYLLUS, L. (Aster.)

Everywhere in moist woodlands of both the Island and mainland. Flower.

ASTER NOVÆ-ANGLIÆ L. (Aster.)

Abundant on the borders of moist thickets everywhere. The large spring flowers form a brilliant feature of the vegetation. Flower.

ASTER CORDIFOLIUS, L. (Aster.)

Abundant throughout open woodlands and on the rocky ridges. Flower.

ASTER UMBELLATUS, Mill. (Aster.)

Everywhere common. Flower.

ASTER ACUMINATUS, Michx. (Aster.)

The most common aster of this vicinity, being found everywhere in thickets and along rocky cliffs and ridges. Flower.

ERIGERON PHILADELPHICUS, L. (Common Fleabane.)

Found sparingly in fields. Not observed on Cacouna Island. Flower.

ANAPHALIS MARGARITACEA, Benth & Hook. (Everlasting.)

Common everywhere on the island and mainland. Flower.

GNAPHALIUM ULIGINOSUM, L. (Low Cudweed.)

Very common in the moist ground of the intervales. Flower.

AMBROSIA ARTEMISÆFOLIA, L. (Roman Wormwood.)

Very common in waste places. Flower.

BIDENS FRONDOSA, L. (Beggar-ticks.)

Found sparingly in low ground, especially in the ditches near the marsh. Flower.

BIDENS CHYSANTHEMOIDES, Michx. (Bur Marigold.)

Ditches, in the low land everywhere. Flower.

ACHILLEA MILLIFOLIUM, L. (Milfoil.)

Very common on the Island and mainland, especially along roadsides and in waste places. Flower.

*TANACETUM VULGARE, L. (Tansy.)

Found occasionally in fields and waste places. Flower.

*ARTEMISIA VULGARIS, L. (Wormwood.)

Very common along the roadsides and in waste places. One of the conspicuous weeds of the locality. Flower.

*ARCTIUM LAPPA, L. (Burdock.)

Common everywhere. A great pest. Flower.

*CNICUS ARVENSIS, Hoffm. (Canada Thistle.)

Very abundant everywhere, constituting a troublesome weed. Flower.

*LEONTODON AUTUMNALIS, L. (Fall Dandelion.)

Somewhat common on Cacouna Island near the beach. Flower.

HIERACIUM CANADENSE, Michx. (Hawkweed.)

Common in fields and borders of woods on Cacouna Point. Flower.

HIERACIUM SCABRUM, Michx. (Hawkseed.)

Fields, everywhere common, also on the Island. Flower.

PRENANTHUS RACEMOSA, Michx. (Rattlesnake-root.)

Abundant on the shore of Cacouna Island, 6′–18′ high; also along the shore of the mainland. Flower.

PRENANTHES ALBA, L. (White Lettuce.)

Very common in the moist, rich woods of the island and mainland. Flower.

*TARAXACUM OFFICINALE, Weber. (Dandelion.)

A most abundant weed everywhere. Flower.

LACTUCA LEUCOPHŒA, Gray. (Lettuce.)

Moist thickets along the shore, common. Not found on the island. Flower.

*SONCHUS OLERACEUS, L. (Sow-thistle.)

Common everywhere, roadsides, about dwellings and in fields. Also on Cacouna Island. Flower.

*SONCHUS ARVENSIS, L. (Sow-thistle.)

Very common in fields everywhere and near the shore on Cacouna Island. This plant is particularly abundant in grain-fields, where it covers large areas, to the great detriment of the crops. Flower.

CAMPANULA ROTUNDIFOLIA, L., var. ARCTICA, Lange. (Harebell.)

Abundant everywhere on bold cliffs and dry, rocky hills. Particularly abundant along the rocky shore. On Cacouna Island it is very abundant on the rocky slopes, extending nearly to the summit. Also common in dry, rocky fields. Flower.

VACCINIUM PENNSYLVANICUM. Lam. (Blueberry.)

A very common species on all the dry, rocky slopes and ridges. On Cacouna Island it is also very abundant, extending to the summit, where the fruit is several days later than on the mainland and along the shores of the island. Fruit.

One of the species supplying the blueberries of the market.

VACCINIUM CANADENSE, Kalm. (Blueberry.)

Low grounds, everywhere common, furnishing large, luscious berries in great abundance. The principal source of the market supply. Fruit.

VACCINIUM VITIS-IDÆA, L. (Mountain Cranberry.)

Somewhat common on the cliffs near the shore, but in these situations it seems to fruit sparingly. Abundant on the dry, rocky ridges and on Pilot Hill. Very abundant on Cacouna Island, extending to the summit over exposed ledges, where it fruits very freely. It is also found very sparingly in the low ground among alder tickets, with *Chiogenes*, but it does not fruit well in such situations. Fruit.

The berries of this plant are very attractive, and may be eaten, though their flavor is not sufficiently fine to be attractive.

Vaccinium oxycoccus, L. (Small Cranberry.)

Not very common. Found in sphagnous swamps on the road towards Green River. No flower or fruit.

Chiogenes serpyllifolia, Salisb. (Snow-berry.)

Very common in low grounds, sparingly on rocky ridges in dry woods. Not observed on the Island. Fruit.

The berries of this plant are not very abundant, and are generally more or less hidden by the surrounding vegetation, so that they are somewhat difficult to find. They are a brilliant white, however, and possess an aromatic flavor like wintergreen, on account of which properties they are highly esteemed in Newfoundland,[1] where it is a common practice to make a most delicate preserve of them. The fact that an entire day is often required to procure one quart of berries makes the preserve a very choice article.

Arctostaphylos uva-ursi, Spreng. (Bear-berry.)

Dry rocky ridges near the shore. Only a few plants found. Fruit.

Cassandra calyculata, Don. (Leather-leaf.)

Very common in low, wet ground. Fruit.

Empetrum nigrum, L. (Black Crowberry.)

A distinctly Arctic species which here flourishes in abundance on Pilot Hill, on the dry, rocky crests of the various ridges, about the shore near Cacouna Point and all over Cacouna Island. It fruits very freely. Fruit.

[1] "Garden and Forest," vol. i, p. 57.

Kalmia augustifolia, L. (Lamb-kill.)

This plant, which often proves such a serious element of danger to sheep, is here found in great abundance. It occurs in large quantity on rocky ridges, in low ground, and everywhere throughout the woody thickets of Cacouna Island, extending to the summit. Flower and fruit.

Ledum latifolium, Ait. (Labrador Tea.)

Everywhere common on rocky ridges and in lowlands of the intervales. On Cacouna Island it extends from base to summit. The leaves of this plant are dried and infused as a beverage under the name of Labrador tea, the practice being in full force in the Maritime Provinces at the present time. A sample of such tea recently sent me by Mr. G. U. Hay, of St. John, New Brunswick, shows that it consists of the leaves, dried naturally, and exhibiting all their ordinary characteristics, so that they are at once recognizable, together with many of the smaller branches, showing that no particular care is taken in the collection to have the tea consist of pure leaf.

Chimaphila umbellata, Nutt. (Pipsissewa.)

One specimen only, was found on Pilot Hill. Doubtless more would be found earlier in the season, but so conspicuous an absence of leaves at this time of year seems to point to it as being rather rare here. Flower.

Moneses grandiflora, Salisb. (One-flowered Pyrola.)

Evidently not abundant, probably out of season. Only a few plants found on Pilot Hill and near the summit of Cacouna Island. One flower. Fruit.

Pyrola chlorantha, Swartz. (Pyrola.)

A few specimens only, in the moist woods of Pilot Hill. Fruit.

Trientalis americana, Pursh. (Star-flower.)

Very common on the mainland and Island, chiefly in low ground and moist woods, but also extending up the rocky slopes to the summit of the ridges. Fruit, occasional flower.

LYSIMACHIA STRICTA, Ait. (Loosestrife.)

Common in low ground along streams and ditches. Not found on the Island. Flower.

GLAUX MARITIMA, L. (Sea Milkwort.)

Very abundant on sandy beaches and in the grass bordering the same. Where this plant grows in free sand, its vegetation is very rapid. It then forms dense patches many feet square, the plants growing to a height of 12′–18′. Under such circumstances flowers are rare, and the whole character of the plant is changed in a marked degree — more so than I have ever observed elsewbere. When growing in somewhat *turfy* sand, the plants are usually less than six inches in height, they do not form tufted patches, and the inflorescence is abundant. Flower.

GENTIANA AMARELLA, L. var. ACUTA, Hook, f. (Gentian.)

This is the only gentian found. It is very abundant along the shore towards Cacouna Point, and in the moist places between rocky ridges. It was not observed on the Island. Though not a showy species, it flowers profusely and forms an attractive plant. Flower.

HALENIA DEFLEXA, Grisebach. (Spurred Gentian.)

Very common in the low land of the intervale back of Cacouna, very rarely on upland ridges. It is also common on the Island. Flower.

MERTENSIA MARITIMA, Don. (Lungwort.)

This species is very common all along the gravelly shore, where it forms frequent patches two or three yards in area, and constitutes one of the most strikingly attractive features of the shore flora. Flower.

The description of this plant as given in Gray's

Manual, revised edition, p. 364, says that the corolla is *white*, and that it is found on the sea coast, Cape Cod to Maine and northward, *scarce*. This description appears to need modification in two respects. So far as we have been able to determine the flowers are here, all of a brilliant *blue*, white having been found in no instance, although special search was made. Then, also, the great abundance of this plant here would render the term *scarce* hardly justifiable.

*MYOSOTIS PALUSTRIS, Withering. (Forget-me-not.)

Very abundant in ditches and wet grounds everywhere. Not found on the Island. Flower.

CONVOLVULUS SEPIUM, L. var. AMERICANUM, Sims. (Hedge Bindweed).

In thickets near the shore of Cacouna Island, and everywhere along the shore of the mainland. Flower.

*LINARIA VULGARIS, Mill. (Butter and Eggs.)

Found sparingly along the roadsides and in fields of the intervales. Not found on the Island. Flower.

CHELONE GLABRA, L. (Turtle Head.)

Somewhat common in low lands along streams. Not found on the Island. Flower.

VERONICA AMERICANA, Schwienitz. (American Brooklime.)

Ditches by the roadside towards Green River. Common. Flower.

EUPHRASIA OFFICINALIS, L., var TARTARICA, Benth. (Eyebright.)

Extremely common in open fields and on rocky ridges everywhere and along the shore. Also found on Cacouna Island. Flower.

RHINANTHUS CRISTA-GALLI, L. (Yellow Rattle.)

Very common on the shore of the Island, and everywhere in thickets and fields of the intervales. Also along the shore near Cacouna Point. Flower.

MELAMPYVUM AMERICANUM, Michx. (Cow Wheat.)

Common everywhere on rocky ridges. On the Island extending to the summit. Also common throughout moist woodlands. Flower.

MENTHA CANADENSIS, L. (Wild Mint.)

Common everywhere in fields and borders of woods. Flower.

LYCOPUS SINUATUS, Ell. (Water Horehound.)

Common along ditches and streams of the intervales. Flower.

SCUTELLARIA GALERICULATA, L. (Mad-dog Skull-cap.)

Occasional in moist lands near ditches and streams. Not observed on the Island. Flower.

BRUNELLA VULGARIS, L. (Self-heal. Heal-All.)

Common everywhere, especially in cultivated fields. Flower.

PLANTAGO MAJOR, L. (Common Plantain.)

Very common everywhere along roadsides and in fields, but rather small. Flower.

PLANTAGO MARITIMA, L. (Beach Plantain.)

Very common on all the gravelly beaches and in crevices of rocky bluffs and hedges for some distance above the shore. Also on the island. Flower.

*CHENOPODIUM ALBUM, L. (Pigweed.)

Everywhere common in waste places. A most conspicuous weed. Flower.

CHENOPODILM RUBRUM, L. (Coast Blite.)

Rather common on the shore of Cacouna Island and abundant on shore of mainland. Flower.

ATRIPLEX PATULUM, L. (Orache.)

Common on all the beaches. Flower.

SALICORNIA MUCRONATA, Bigel. (Samphire.)

This species of samphire is very abundant in the marsh near Cacouna Point, and also in the more extensive marsh at the Island. Owing to the prevailing color which this plant attains with age, and its great abundance, these marshes have a very pronounced red color observable from long distances. Flower.

SALICORNIA HERBACEA, L. (Samphire.)

Very much less common than the preceding. A few specimens were found on the beach of Cacouna Island, more abundantly along the shore of Cacouna Point and on the borders of the marsh. Flower.

RUMEX SALICIFOLIUS, Weinmann. (White Dock.)

Very common all along the shore. Flower.

*RUMEX CRISPUS, L. (Curled Dock.)

On the Island near the beach. On the mainland, everywhere in fields and low ground and along roadsides. Flower.

*RUMEX ACETOSELLA, D. (Sheep Sorrel.)

One of the most common weeds in fields and waste places. Flower.

POLYGONUM AVICULARE, L. (Knotweed.)

Very common along waysides, about dwellings. and on the shore of the Island. Flower.

*POLYGONUM PERSICARIA. L. (Lady's Thumb.)

Very abundant in grain fields. Flower.

POLYGONUM ARIFOLIUM, L. (Halbert-leaved Tear-thumb.)

Common in grain-fields with the following. Flower.

POLYGONUM SAGITTATUM, L. (Arrow-leaved Tear-thumb.)

Common along brooks and ditches; everywhere in moist land. Flower.

*FAGOPYRUM ESCULENTUM, Mœnch. (Buckwheat.)

Extensively cultivated for the grain, and often escaped into waste places. Flower.

Comandra livida, Richardson. (Bastard Toad Flax.)

This plant was found in only one locality, on the dry, rocky ridge at Blueberry Hill, where it was fairly abundant. The bright red berries are most strikingly attractive. Fruit.

*Euphorbia helioscopia, L. (Spurge.)

Extremely common along roadsides, about dwellings, and in cultivated fields and pasture lands, where it often covers several acres. Not found on the Island. Flower.

*Urtica gracilis, Ait. (Nettle.)

Fields near the old stone house. Flower.

Myrica gale, L. (Sweet Gale.)

On Cacouna Island, common; and on the mainland in moist thickets, where it often forms large clumps. Fruit.

Betula lutea, Michx, f. (Yellow Birch.)

Very common in woodlands, but always small. Fruit.

Betula papyrifera, Marshall. (Paper or Canoe Birch.)

A common tree on the mainland and Island, but everywhere small. Fruit.

Alnus incana, Willd. (Speckled Alder.)

Everywhere abundant on rocky ridges and in low lands, where it forms dense thickets. On the Island, abundant to near the summit. Fruit.

Populus tremuloides, Michx. (Aspen Poplar.)

A common tree everywhere, replacing the spruces in clearings.

Populus balsamifera, L. (Balsam Poplar, Tacamahac.)

Very common about dwellings and by the roadside as a shade tree.

Populus dilatata. (Lombardy Poplar.)

A common shade tree in all the villages. 30° high.

PINUS STROBUS, L. (White Pine.)

A rare tree at Cacouna. Only one or two trees were found at the foot of Pilot Hill.

PINUS BANKSIANA, Lambert. (Northern Scrub Pine.)

This interesting tree is found only on Cacouna Island, where it extends in abundance from base to summit. 3°–12° high. Fruit.

PINUS RESINOSA, Ait. (Red Pine.)

Common on Pilot Hill. Not observed elsewhere. Fruit.

PICEA NIGRA, Link. (Black Spruce.)

Found with the next on the mainland and Island. They both mature at about the same height. Fruit.

PICEA ALBA, Link. (White Spruce.)

Common on all the hills and rocky ridges, constituting, with the preceding. the principal arborescent vegetation. Also abundant on the Island. Matures at 6°–20°. Fruit.

ABIES BALSAMEA, Miller. (Balsam Spruce.)

Occasionally found on rocky ridges with *Picea*, more abundantly on the Island. Apparently not very common. Frnit.

LARIX AMERICANA, Michx. (Larch. Tamarac. Hackmatack.)

Found very sparingly in low gronnd near Pilot Hill. Apparently not common here, and all young trees. Fruit.

THUYA OCCIDENTALIS, L. (Arbor vitæ. White Cedar.)

Sparingly distributed among the spruce growth on the mainland and Island. Everywhere small. Fruit.

JUNIPERUS COMMUNIS, L. (Juniper.)

Common on rocky slopes and ridges of both the Island and mainland. On the former it extends to the summit.

TAXUS CANADENSIS, Willd. (American Yew. Ground Hemlock.)

Somewhat abundant on Cacouna Island towards the summit. Also along the base of the cliffs near the Landing. Fruit.

MICROSTYLIS MONOPHYLLOS, Lindl. (Adder's Mouth.)

A few plants in the moist woods of Cacouna Island. Flower.

SPIRANTHES ROMANZOFFIANA, Cham. (Ladies Tresses.)

Found very abundantly in low ground anywhere; also sparingly on rocky slopes. Common in the moist woods of Cacouna Island. Flower.

HABENARIA PSYCODES, Gray. (Rein Orchis.)

Only one specimen was found in the moist thickets at Cacouna Point. Flower.

CYPRIPEDUM ACAULE. (Stemless Lady's Slipper.)

Common on dry, rocky ridges, on Pilot Hill and in the moist woods of Cacouna Island, where it was also found growing in the mossy soil of exposed rocks near the summit. The leaves only were to be found, but this is evidently one of the most abundant of the spring flowers.

CYPRIPEDIUM PUBESCENS, Willd. (Yellow Lady's Slipper.)

One specimen only, in fruit, was found in the moist woods of Pilot Hill.

IRIS VERSICOLOR, L. (Large Blue Flag.)

Very common in marsh lands near Cacouna Point, along ditches anywhere in the low lands and on Cacouna Island near the shore. Fruit.

This plant exhibits great diversity of habitat and aspect. Along the shore it commonly grows in the scanty soil, filling the crevices and hollows of rocks, and in such ceses it does not exceed 6′–8′ in height, the whole aspect of the plant being such as to lead one to suspect it to be a distinct species. On Cacouna

Island it grows high up the face of the cliffs where the moisture is very scanty. The absence of flowers in all cases, rendered a satisfactory determinatiou of this plant impossible.

Smilacina stellata, Desf. (False Solomon's Seal.)

Throughout moist, woody thickets of the Island and mainland, common. On the Island it extends to near the summit. Fruit.

Streptopus amplexifolius, D. C. (Twisted Stalk.)

Common in thickets along the base of rocky cliffs. Also on the Island in woody thickets. Fruit.

Clintonia borealis, Raf.

Very abundant everywhere in moist thickets. On the island extending high up towards the summit. Fruit.

Maianthemum canadense, Desf.

Very common in moist woods and low lands throughout the intervales. Fruit.

Veratrum viride, Ait. (American White Hellebore.)

Somewhat sparingly found in low lands of the intervales, along streams. Not found on the Island.

Triglochin palustris, L. (Arrow Grass.)

In moist places on rocky ridges near the shore Appar-parently not widely distributed. Not found on the Island. Fruit.

Triglochin maritima, L.

Grassy shores and along borders of the marsh at Cacouna Point. Common. Fruit.

Eriophorum polystachyon, L. (Cotton Grass.)

Somewhat common in the swampy lands of the intervales toward Pilot Hill. Fruit.

Spartina cynosuroides, Willd. (Fresh-water Cord Grass.)

In the wet ground near the old stone house. Flower.

SPARTINA STRICTA, Roth., var. ALTERNIFLORA, Gray. (Salt Marsh Grass.)

Very common along all the beaches. Flower.

SPARTINA POLYSTACHYA, Willd. (Salt Reed Grass.)

Common on beaches and in marsh lands above tide water. Flower.

PHALARIS ARUNDINACEA, L., var. PICTA. (Reed Canary Grass.)

A large patch near the old stone house. Fruit.

BROMUS CILIATUS, L. (Brome Grass.)

A few plants only near the beach on Cacouna Island. Flower.

LYCOPODIUM SELAGO, L.

One specimen only was found in the crevice of a bare ledge near the summit of Cacouna Island. Fruit.

LYCOPODIUM LUCIDULUM, Michx.

Sparingly found in the moist woods of Pilot Hill. Fruit.

LYCOPODIUM OBSCURUM, L.

Sparingly found in the moist woods of Pilot Hill. Fruit.

LYCOPODIUM CLAVATUM, L.

Common in the moist woods of Pilot Hill. Fruit.

LYCOPODIUM COMPLANATUM, L.

Common in the moist woods of Pilot Hill, together with the two preceding, and at Cacouna Point. Fruit.

POLYPODIUM VULGARE, L.

Very common on dry rocks, growing in the mossy crevices and hollows. The plant, as here found, is diminutive in size, rarely exceeding 2′–6′ in height. On the island it extends to the summit, and matures at 2′–3′ in height.

PTERIS AQUILINA, L. (Common Brake.)

Common everywhere in thickets. Very abundant on Cacouna Island, where it attains a height of 3°–4°.

ASPLENIUM FILIX-FŒMINA, Bernh.

One of the most common ferns. Found in moist thickets at base of rocky cliffs.

PHEGOPTERIS DRYOPTERIS, Fee.

Common on the rocky cliffs near the shore.

ASPIDIUM SPINULOSUM, Swartz.

In moist thickets of Cacouna Island and in moist woods of mainland.

ASPIDIUM GOLDIANUM, Hook.

In low grounds somewhat common.

ONOCLEA SENSIBILIS, L. (Sensitive Fern.)

Common in the low lands everywhere along streams. Not found on the Island.

OSMUNDA CINNAMOMEA, L. (Cinnamon Fern.)

Common in low grounds, especially near the marsh.

BOTRYCHIUM TERNATUM, Swartz, var. OBLIQUUM, Gray.

Only one plant found near the beach on Cacouna Island. Fruit.

EQUISETUM ARVENSE, L. (Horse-tail.)

Low grounds, common. Sterile stems only.

EQUISETUM LIMOSUM, L. (Horse-tail.)

In wet grounds along ditches on the road to Cacouna station. Fruit.

EQUISETUM SYLVATICUM, L. (Horse-tail.)

Along ditches and in low grounds, common. Not found on the Island.

NOTE ON LEPTOPLASTUS.

BY G. F. MATTHEW, M.A., F.R.S.C.

In the number of this journal for October, 1889, the author communicated a short paper on the "Occurrence of Leptoplastus in Acadian Cambrian Rocks," and referred two species of trilobites to that genus.

Since then, on studying the geological range of a trilobite which occurs with these two, he was led to see that there was a discordance between the range of the two species (supposing them to be Leptoplasti), and that of the third one—*Agnostus pisiformis*, L. In Sweden this species belongs to the base of the Olenus-bearing strata; but a variety (*socialis*, Tullberg) is found in the middle of the Olenus beds, and an allied species, *A. cyclopyge*, Tull., as high as the layers containing *Parabolina spinulosa.*

The range of this species of Agnostus (*A. pisiformis*) and its relatives in Sweden is thus *below* the horizon of Leptoplastus. Moreover, the Acadian form of *Agnostus pisiformis*, by its narrower pygidial rachis and other features, appears to be a somewhat more primitive form than the type of the species found so many years ago in Sweden, and therefore possibly older.

The locality in the Kennebecasis valley where these three trilobites were found was for this reason re-examined, and additional parts of the species were found. The additional material did not bear out the reference of the two species to Leptoplastus. Soon after a species of trilobite found in the St. John Basin, undoubtedly of the genus Leptoplastus, removed any doubt there might have been that these species were wrongly referred.

Angelin says of the movable cheek of Leptoplastus that it is compressed. This is true of the two Acadian species in question, but he evidently meant compressed all around; in these Acadian trilobites, however, the cheeks are compressed on the front and back only, and at the genal angle run out into a rather long spine; this was fouud to be incompatible with the reference of these species to Leptoplastus.

There are reasons for including the Acadian species in Anomocare. The attitude of the genal spines, directed backward and outward, like the barbs of an arrow, the large pygidium, with narrow, many-jointed rachis, and the broad border-fold to the cheek and pygidium are not characters of Leptoplastus (except that a large, bordered pygidium is found in one species of Leptoplastus—*L. stenotus*) but they are common in Anomocare. We would therefore transfer the two species from the Kennebecasis valley to *Anomocare* as the nearest genus.

Leptoplastus latus. N. sp.

1. Centre-piece of the head-shield. Mag. $\frac{2}{1}$.
2. Movable cheek. Mag. $\frac{2}{1}$.
3. Part of thorax, with pygidium attached. Mag. $\frac{2}{1}$.

The new species of Leptoplastus found in the St. John Basin is remarkable for its wide head; with the movable cheek the head is nearly four times as wide as long; the pygidium, as in two out of the three Leptoplasti described by Angelin, is small; and the thorax is compact and rigid, more like Ctenopyge than the Oleni; the free cheeks are round and tumid as in the Sphærophthalmi, and the eyes are set unusually far back on the head as in the species *Sphærophthalmus alatus.*

This species is more fully described in the volume of "Transactions of the Royal Society of Canada" now in press.

sch

ldspar R

Tabulation of the Igneous Rocks Based Upon the System of Professor H. Rosenbusch

By Frank D. Adams.

		Alkali Feldspar Rocks. (Orthoclase, Microcline, Anorthoclase, Albite.) With Mica, Amphibole or Pyroxene.		Alkali Feldspar-Nepheline (or Leucite) Rocks. With Mica, Amphibole or Pyroxene.	Leucite Rocks.		Nepheline Rocks.		Melilite Rocks.	Lime Soda Feldspar-Nepheline (or Leucite) Rocks.		Lime Soda Feldspar Rocks. With Hornblende or Mica.		Lime Soda Feldspar Rocks. With Augite, Diallage or Hypersthene.		Rocks containing no Feldspathic Constituent. (Free from Alkalies.)	
		With Quartz.	Without Quartz.		Without Olivine.	With Olivine.	Without Olivine.	With Olivine.		Without Olivine.	With Olivine.	With Quartz.	Without Quartz.	Without Olivine	With Olivine.	**Pyroxene Rocks.**	**Olivine Rocks.**
Abyssal (Plutonic) Rocks.	**Hypidiomorphic Granular Structure.**	**Granite.** Muscovite Biotite Granite or (Granite proper.) Biotite Granite (Granitite) Augite Granitite Hornblende Granite Riebeckite Granite.	**Syenite.** Mica Syenite Augite Syenite. Hornblende Syenite.	**Eleolite Syenite.** **Leucite Syenite.**				Ijolite		**Theralite.**		**Quartz Diorite.** Quartz Mica Diorite. Quartz Hornblende Diorite. Quartz Augite Diorite.	**Diorite** Mica Diorite. Hornblende Diorite. Augite Diorite	**Gabbro** and **Norite.**	**Olivine Gabbro** and **Olivine Norite.**	**Pyroxenite.** Diallagite. Bronzitite. Hypersthenite. Websterite (Enstatite and Diallage). Hornblendite (Augite and Hornblende).	**Peridotite.** Picrite (with Augite) Amphibole (with Hornblende). Wehrlite (with Diallage). Harzburgite (Saxonite) with Bronzite Lherzolite (with Diallage and Bronzite) Dunite (with Chromite)
Dyke Rocks.	**Panidiomorphic or Porphyritic Structure.** Granitic.	Pegmatite. Aplite Quartz Tinguaite.	Bostonite.	Tinguaite. Leucite Tinguaite.								Malchite					
	Granite Porphyritic.	Granite Porphyry.	Syenite Porphyry.	Eleolite Syenite Porphyry. Leucite Syenite Porphyry.							* These rocks contain very little Feldspar or Nepheline, but have an unindividualized base which would probably crystallize out as Feldspar and Nepheline if the crystallization was sufficiently far advanced. Some of them may be more nearly allied to the Nepheline Rocks.	Diorite Porphyrite					
	Lamprophyritic.		Minette. Vogesite.						Alnoite	Fourchite.*	Monchiquite.*	Kersantite. Camptonite.					
Effusive (Volcanic) Rocks.	**Porphyritic Structure.** Older.	**Quartz Porphyry.**	**Quartzless Porphyry.** Keratophyre.									**Quartz Porphyrite.** Quartz Mica Porphyrite. Quartz Hornblende Porphyrite.	**Porphyrite.** Mica Porphyrite. Hornblende Porphyrite. Enstatite Porphyrite.	**Diabase.** Leucophyre. Quartz Diabase. Proterobase. Enstatite Diabase. Sahlite Diabase. Spilite **Augite Porphyrite.** Augite Porphyrite (proper). Diabase Porphyrite.	**Olivine Diabase.** **Melaphyre.**		**Picrite Porphyrite.**
	Younger.	**Liparite** or **Rhyolite.** **Pantellerite.**	**Trachyte.**	**Phonolite.** Leucitophyre **Leucite Phonolite.**	**Leucitite.**	**Leucite Basalt.** **Augitite** and **Limburgite** (in part.)	**Nephelinite.**	**Nepheline Basalt.**	**Melilite Basalt.**	**Tephrite.** Nepheline Tephrite. Leucite Tephrite.	**Basanite.** Nepheline Basanite. Leucite Basanite.	**Dacite.** Quartz Propylite.	**Andesite.** Mica Andesite. Hornblende Andesite. Hypersthene Andesite. Augite Andesite Propylite	**Basalt.** Hypersthene Basalt. Hornblende Basalt. Quartz Basalt. **Augitite** and **Limburgite** (in part.)	**Olivine Basalt.**		

Notes to Accompany a Tabulation of the Igneous Rocks based on the System of Prof. H. Rosenbusch.

By Frank D. Adams, Lecturer in Geology, McGill University.

Of all the plans proposed from time to time by various authors for the classification of the Igneous Rocks, that by Prof. Rosenbusch of Heidelberg is the one which has met with the greatest favour, and is now adopted by almost all petrographers throughout the world.

The classification proposed in the first edition of this author's "Mikroskopische Physiographie der Massigen Gesteine," published in 1877, was altered in some essential particulars in his second edition of the work published in 1887, while the great advances in petrographical knowledge since that date have led to the adoption of still further modifications in the classification adopted for the unique collection of rocks which he has brought together in the museum of the Geological Institute of the University of Heidleberg.

Having drawn up a table incorporating the latest results in this field in a condensed form, for the use of my students at McGill College, I have ventured, at the request of a number of American petrographers whom I consulted while constructing it, to publish it with a few words of explanation, in the "Canadian Record of Science," that it might be available for the use of students elsewhere. It is based upon and in a general way resembles a table published by Prof. Rosenbusch in 1882, in the "Neues Jahrbuch für Mineralogie, &c."

There has recently been a tendency among petrographers to consider rocks rather from a chemical than from a mineralogical standpoint, as geological units having a certain chemical composition rather than as aggregates of certain mineral species. This is in part owing to the fact that magmas of diverse composition may crystallize out in very similar mineral aggregates, thus for instance, a modern volcanic rock composed of Sanidine and ordinary Augite, will have quite a different chemical composition from one containing large amounts of Anorthoclase and Acmite, although both, being compounds of an alkali feldspar and pyroxene, would be Trachytes if classified according to mineralogical composition. In the same way we have in the Augite Syenites a series of rocks presenting great diversities in chemical composition as well as in petrographical relationship. At present, however, a purely chemical classification presents many difficulties. A knowledge of the exact chemical composition of many rocks is wanting, while for practical purposes it would be impossible to adopt any method of classification which requires a complete chemical analysis of a rock before its name and proper position could be ascertained. Mineralogical composition and structure must still be important factors in any scheme which is to be generally adopted.

In the accompanying table, however, a classification according to chemical composition has in a general way been secured. On the left we have rocks rich in alkalies, principally potassa. Going toward the right in the table we have, first, rocks in which this alkali is largely replaced by soda (the Leucite rocks, however, forming an exception) then those in which this alkali is associated with progressively larger proportions of lime, while on the extreme right are rocks which are free from all alkalies, but in which lime, magnesia and oxide of iron are present in large amount. Speaking generally, moreover, it may be said that the rocks decrease in acidity from left to right, the principal exception being the small group of Nepheline, Leucite and Melilite rocks.

In order to bring out these chemical relationships as clearly as possible and place the several groups of rocks in positions where their affinities are more clearly shown, I have, at Prof. Rosenbusch's suggestion, given to several groups of rocks positions other than those which they occupied in his former table, or in the last edition of his book. The Nepheline, Leucite and Melilite rocks, for example, instead of being classed with the Peridotites, to which they are not related, under the general heading of "Rocks containing no Feldspar," have been placed immediately after the Orthoclase Nepheline (or Leucite) rocks and before the Plagioclase Nepheline (or Leucite) rocks. In this way all the rocks containing Nepheline and Leucite are kept together in the table, instead of being separated as before by the Diorites and Gabbros, which are much more nearly related to the Pyroxenites and Peridotites which now succeed them.

In the Heidelberg collection, moreover, the Diabases have been placed among the Volcanic rocks instead of with the Plutonic rocks. The anomalous position of these rocks when classed as Plutonic rocks—shown by the frequent occurrence in them of amygdaloidal structure, their stratigraphical position as flows and their association with tufa—was always evident, their character, as well as their structure, show that they should be classed among the old Volcanic rocks.

The Tinguaites, as well as some of the Acmite Trachytes and the Alnoites in this collection, have also been placed among the Dyke rocks.

Since the publication of the second edition of the "Massigen Gesteine," moreover, a number of massive igneous pyroxenic rocks occurring in different localities have been accurately studied by several petrographers.[1]

This has necessitated the enlargement of the table and the separation of the Pyroxene rocks from the Olivine rocks with which they were formerly classed. These have accordingly been erected into a new group—the Pyroxenites—a name first applied by Dr. Sterry Hunt, in 1862 (see Geology of Canada, 1863, p. 667, etc.), to certain eruptive rocks from Rougemont, Montarville and Mount Royal, members of a series of old volcanic cores situated in the

[1] Hatch—Quart. Jour. Geol. Soc., May, 1889.
Teall—British Petrography, pp. 71 and 84.
Hutton—Roy. Soc. New South Wales, August, 1889.
Williams—American Geologist, July, 1890.

Province of Quebec. He also, however, applied the name to certain more or less massive rocks associated with the limestones of the Laurentian system, and of which the eruptive origin is not by any means certain.

Some gaps in the classification have lately been filled by the discovery of new rocks, these have been placed in their respective places in the table. Among them may be mentioned Malchite, a rock among the Diorites corresponding to Aplite, which will be described shortly by Prof. Osann in one of the Reports of the Geological Survey of Baden. Also the rock described by Ramsay from Finland, under the name of Iolite. This latter is a coarsely crystalline rock composed of eleolite, hornblende and aegerine, which thus corresponds to Nepheline Basalt in the Plutonic series but which also contains garnet.

Two other very interesting rocks which have lately been described are Fourchite [1] and Monchiquite. [2] These have an unindividualized base, in which are embedded phenocrysts of augite, with amphibole or biotite. In Monchiquite, olivine is also present. They therefore contain no "feldspathic constituent," and might on that account seem more properly to be considered as the Dyke rocks of the Pryoxenite and Peridotite series. Having, however, quite a different composition from these rocks, and being in no way related to them, they have been classed as the Lamprophyric dyke rocks of the Theralite series, where they properly belong, since, judging from the chemical composition, it is probable that the base would have crystalized as plagioclase and nepheline had the rock become completely crystallized.

It will be seen, then, that in the accompanying table the Igneous rocks are first classified in three horizontal columns, according to their structure or the depth at which they have solidified, as Abyssal (Plutonic) Rocks, Dyke

[1] J. Francis Williams—"The Igneous Rocks of Arkansas," Annual Report of the Geological Survey of Arkansas for 1890, vol. ii.

[2] M. Hunter and H. Rosenbusch—"Uber Monchiquite, ein Camptonitisches Ganggestein aus der Gefolgschaft der Elaeolithsyenite," Tschermak's Min. und Pet. Mitth. xi, 1890.

Rocks and Effusive (Volcanic) Rocks. The structures characteristic of each of these groups is stated. They are then classified in eight vertical columns, according to their mineralogical and chemical composition, into rocks having as an essential constituent an Alkali Feldspar; an Alkali Feldspar with Nepheline or Leucite; Nepheline Rocks; Leucite Rocks; Melilite Rocks; Rocks composed essentially of Nepheline or Leucite and Plagioclase; Plagioclase (or Soda Lime Feldspar) Rocks; and lastly, Rocks containing no Feldspathic Constituent.

These rocks are then subdivided according to the bisilicates and micas which they contain, while further subdivisions are made in the case of the more acid rocks by the presence or absence of quartz, and in the case of the basic rocks by the presence or absence of olivine.

The part of Prof. Rosenbusch's scheme of classification which has met with the most adverse criticism is the group of the Dyke Rocks. It seems rational to suppose, however, that since in an extinct volcano we have a crack, pipe or dyke, at the lower end of which we have typical Plutonic rock, and at the upper end typical Volcanic rock, and since these two rocks differ widely in structure, that we might have in the intervening position a rock or rocks with a peculiar structure of their own. Prof. Rosenbusch believes, after the study of a great series of dykes, that these rocks have certain distinct structures of their own, and that although in some cases rocks exhibiting these structures occur as facies of Abyssal or Effusive rocks, as, for instance, about the borders of Plutonic masses, yet as independent geological units rocks possessing these structures never occur except in the form of dykes. These rocks which he believes cannot properly be referred to either of the other classes, he has placed together by themselves as Dyke Rocks. In some cases, as in the Aplites and the Minettes, they have pronounced and easily recognized characters, in others the characters approximate more nearly to those of the Plutonic or Volcanic rocks. Following Prof. Rosenbuch, these Dyke Rocks have been divided into three series—the Granitic, the Granite-Porphyritic, and the Lamprophyritic Dyke rocks. These three series have been arranged in horizontal rows—separated merely by spacing, not by lines.

The division of the Volcanic rocks into older and newer is still retained, although but little stress is laid upon it, hence in the table these two divisions are separated by an *interrupted* line. In many cases rocks of these two classes cannot be distinguished from one another, but in other cases they present differences (generally due to partial alteration) by which they are characterized. As geologists have been accustomed to give special names to rocks possessing these special characters, the distinction may for the present at least be retained as convenient. Thus although Liparite may be identical in all essential respects with Quartz Porphyry, geologists are not yet prepared to abandon either term. Both rocks have certain characters which renders a special name advantageous, although these characters have little or no value for purposes of classification.

In constructing such a table it becomes very difficult to decide just how much detail in classification should be included and how much left out. If too little is put in, the table is of no value to any but those desiring the most elementary knowledge of the subject, while too much detail renders the table too complicated and cumbersome. I have therefore made it a general rule to omit in the subordinate classification names based merely on structural differences, *e.g.*, Nevadite, Granophyre, etc., and to employ only those based on the actual differences of composition. One or two exceptions have been made in the case of rocks which seemed of especial importance. In this way, many names which would serve only to confuse the student are omitted, while most of those of real importance are retained. The attempt has also been made by employing several kinds of type to bring out prominently the chief subdivisions and more important rocks, and to classify the others in a general way according to their importance. In a few cases also, where a rock is merely a variety of those immediately preceding it (*e.g.*, Augite Granite), or where a series of names coming under a more general heading do not make up a complete sub-classification, but merely indicate a series of independent varieties (as in the case of Diabase), the type has been shifted out of line to draw attention to the fact.

In conclusion I desire to acknowledge the assistance which I received in constructing this table from Prof. Rosenbusch, who has devoted much time and thought to it. Most of what there is of value in it originated with him. It must, however, as Prof. Rosenbusch remarks, still be regarded as of value rather for determinative purposes, and not as a thoroughly satisfactory scheme of classification, which is a thing to be looked for in the future. It is hoped, however, that it may be one further step toward this goal.

I also desire to acknowledge my indebtedness to Prof. Geo. H. Williams of Johns Hopkins University, as well as to the late Dr. J. Francis Williams of Cornell University, who have kindly aided me by several valuable suggestions.

A Note on the Collection of Sediments in Potable Waters.

By R. F. Ruttan, B.A., M.D.

A point of considerable importance, but one frequently overlooked by the analyst, is the microscopic examination of the sedimentary matter occurring in drinking water. This is generally described as "slight" "heavy" etc., and little or no serious effort made to determine its general nature. One explanation of this common omission is that, as a rule, the quantity of sedimentary matter in a potable water is very small and consequently very difficult to collect for examination in a satisfactory way.

The methods usually employed for collecting and estimating the traces of suspended solids present in most potable waters are all open to objections. They are inefficient or difficult of application. Probably one of the best, certainly the one most frequently used, is to allow the vessel in which the water was collected—say a Winchester quart—to stand some hours undisturbed and then to syphon off the super natant clear water leaving about half an inch between the short end of the syphon and the sediment. This residual water is then well shaken up and with the suspended matter poured into a conical glass capable of holding about 200 or 250 c.c. After again allowing it to stand a few hours, the sediment may be drawn up by a pipette and examined.

Apart from the time and attention required by this method, it has another objectionable feature; the current produced by the syphon in action invariably separates a considerable portion of the lighter and more floculent part of the deposit and carries it away.

The accompanying diagram[1] illustrates the simple contrivance the writer has had constructed for collecting and estimating water sediments in connection with the analysis of the Montreal water supply now being made.

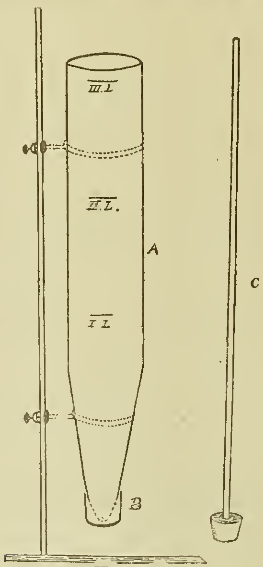


Fig. 3.

[1] This apparatus is manufactured by Max Kæhler and Martini, Berlin.

The apparatus consists of a tube about 60 ctm. long and 10 ctm. in diameter. The tube is cylindrical for about three fourths of the length, for its remainder the sides gradually converge until the lower opening is less than 5 ctm. in diameter. On this smaller end is carefully ground a glass cap which is conical internally, and externally has a flat bottom to enable it to stand like a cup.

In addition to the tube and cap there is a glass rod firmly inbedded at one end in a rubber stopper (*c*) that exactly fits the lower opening of the tube from the inside.

The tube will hold about 3 litres but is graduated to contain 1 and 2 litres in case of a limited supply or a very heavy sediment.

To use the apparatus the cap is carefully adjusted, the samples thoroughly shaken and the tube filled to the containing mark. It is then covered and suspended quite perpendicularly in the rings of a large Bunsen stand. If the tube be properly constructed all but a mere trace of sediment will have gathered into the cup at the bottom within a few hours. It has been my custom to examine these tubes at the end of four or five hours, and if there is any visible deposit on the sides to give a gentle rotatory motion to the water and again leave them undisturbed for several hours when, as a rule, not a trace of sedimentary matter will be found out of the cup at the bottom.

To obtain the sediment the stopper is introduced quietly from above by means of the rod, and the cup is at once detached without losing any water or disturbing the sediment.

There is thus obtained the sediment of three litres of water in about 50 cubic centimeters ready for microscopic examination or quantitative estimation. By means of a tared filter the sediment can be filtered off, dried and weighed in a few hours.

Note.—Some time after this apparatus was shown at the Natural History Society, my attention was called at Ottawa to a tube of similar design invented by Dr. Wynter Blyth, and figured by him in his Hand-book on Foods. Dr. Blyth's tube is quite small, and the slope very much greater, the cup not larger than $\frac{1}{2}$ of an inch in diameter, the opening at the bottom of the tube is closed by a ground glass plug which being ground in offers a rough surface on which the particles of sediment would certainly lodge. The design, however, is in either respect quite similar to the one described above.

Short Notes on some Canadian Minerals.[1]

By W. F. Ferrier, B.A.Sc., F.G.S., Geological Survey of Canada.

(Communicated by permission of the Director.)

It is the intention of the writer in the following short notes to place on record a few new localities of some Canadian minerals, and also to call attention to the interesting forms in which, in several instances, they occur at these and other localities already known.

1. Native Arsenic.

A year ago a specimen was received from Mr. Charles Brent, Mining Engineer, of Port Arthur, Ont., which contained this mineral in some quantity.

The locality is given as Edwards Island, Thunder Bay District, Lake Superior, nine miles east of Silver Islet, and the ore, of which the arsenic forms a part, is said to have yielded in selected samples as high as 130 oz. silver to the ton, the average being abont 75 oz.

The arsenic occurs, in the specimen examined, in small reniform masses, tarnished to a dark-grey color and imbedded in a white cleavable calcite which forms small patches in a dark-grey, fine-grained, crystalline limestone.

It greatly resembles in appearance that found at Joachimsthal, in Bohemia.

Blende, galenite, pyrite, and chalcopyrite were observed as associated minerals, and native silver is also said to occur rather plentifully with it.

The Silver Islet Consolidated Mining and Land Co. during

[1] One of the species described, the Molybdenite, is from Labrador.

the past year did considerable development work on the property with a view to working the ores for silver, but nothing is being done at present.

Only one other recorded occurrence of this interesting species in Canada has come under the writer's notice, viz: that from the Fraser River, British Columbia.[1]

2. Molybdenite.

Some time ago a specimen of this mineral, collected by Mr. J. D. Frossard, Mining Engineer, Montreal, in Labrador, was placed in my hands by Mr. B. T. A. Bell of the "Canadian Mining Review."

It is interesting as a contribution to our knowledge of the minerals of that little known land. It occurs in broad foliated plates and nodules in a light colored, rather coarsely crystalline granitic rock which at first sight closely resembles a crystalline limestone, or dolomite, but is almost wholly composed of quartz and felspar.

3. Sphalerite or Blende.

During the past summer several good specimens of this sulphide of zinc were collected by the writer from the quartz veins in the townships of Risborough and Marlow, Beauce Co., Quebec, described by Dr. Ells in his report on that region.[2]

Some very fine crystals were observed, but it was found impossible to obtain perfect specimens of them, as they are exceedingly fragile and imbedded in a very hard and compact quartz.

Twinned octahedra up to an inch in diameter occur, having the planes very smooth and angles sharply defined.

The best specimens were obtained from the "Armstrong" vein, mentioned in Dr. Ell's report.

4. Pyrite.

Crystals of this well-known mineral lately found by Mr.

[1] Ann. Report Geol. Surv. Can. 1886, Part T, p. 9.
" " " " " 1887-88, Part R, pp. 106, 161.

[2] Ann. Report Geol. Surv. Can. 1886, Part J, p. 59.
" " " " " 1888-89, Part. K, p. 77.

H. M. Ami at Perkins Mills, Templeton, Ottawa Co., Quebec, though not of very large size, (about $\frac{1}{2}$ in. diameter) are remarkable for their perfection, and brilliancy of lustre.

They exhibit the faces of the cube and octahedron (∞ 0,0) the former being more extensively developed than the latter.

5. Martite.

Mr. A. M. Campbell of Perth, Ont., sent me some octahedral crystals from the Dalhousie Iron Mine, on lot 1, range 4 of the township of Dalhousie, Lanark Co., Ontario.

They proved, on examination, to consist of magnetite, partially, and in a few cases, completely, altered to hematite, though still retaining the sharp outlines of the original octahedrons of magnetite.

The crystals in which the alteration is complete may properly be referred to Martite, defined by Breithaupt as sesquioxide of iron occurring under an isometric form.

The completely altered crystals are not magnetic or only very feebly so.

Some of them are an inch and more in diameter.

Specimens which have been exposed to the weather are externally of a bright brick-red color.

6. Kermesite.

Occurs in small radiating tufts of capillary crystals on stibnite from Rawdon, Hants Co., Nova Scotia, and exhibits all the ordinary characters of the species.

It results no doubt from the alteration of the stibnite.

Mr. C. W. Willimott first called my attention some time ago to its occurrence at this locality.

7. Quartz.

Of this familiar mineral some good crystals have lately been brought to light. Mr. A. P. Low, during the past summer found transparent crystals in a red pegmatite at Lac aux Iles, Portneuf Co., Quebec, which shew the com-

PLATE II.

QUARTZ CRYSTAL, WITH CURVED FACES (CONCAVE.)

BOUCHETTE TOWNSHIP, OTTAWA CO., QUE.

bination a = ∞ P, b=P, c = 2 P 2, the 2 P 2 faces being remarkably well developed. (See Fig. 4.)

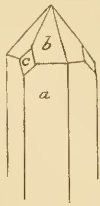


Fig. 4. Quartz Crystal—Lac aux Iles, Portneuf Co., P. Q.

Mr. John Stewart, of Ottawa, has also presented me with some interesting crystals of smoky quartz, from lot 44, range 6, Bouchette township, Ottawa Co., Quebec.

In these both prismatic and pyramidal faces are *concave*, giving the crystal the peculiar appearance shown in Plate II, which is reproduced from a drawing kindly made for me by Mr. L. M. Lambe, the artist of the Survey.

When a straight edge is laid across one of the prism faces ($\frac{1}{3}$ in. wide), the deflection of the face from its normal position, at a point half way across it, is seen to be about $\frac{1}{20}$ of an inch, the curvature being quite symmetrical.

Similar crystals have been found in Orange County, New York State.

8. Spinel.

Beautiful, brilliant, jet-black octahedrons of spinel were lately found by Mr. John Stewart, in Aylwin township, Ottawa county, Quebec, imbedded in a crystalline limestone.

Perfect crystals in my possession measure $\frac{3}{4}$ in. in diameter, and some of them exhibit the combination of octahedron and dodecahedron (o.∞ o).

A complete alteration of the mineral to some species of mica has been observed in a few instances.

9. Anhydrite and Gypsum.

Mr. H. Lundbohm of the Geological Survey of Sweden, who has recently been in Canada studying the mode of occurrence of our apatite, placed in my hands for determination some very interesting specimens of these minerals, collected by him at the "100 ton pit," McLaren's Phosphate Mine, lot 4, concession 8, North Burgess, Lanark Co., Ont.

They present all the ordinary physical characters of these species.

The anhydrite is in cleavable masses of a light purple or lilac color, and shews alteration to a snowy white gypsum, being in places, traversed by a network of little cracks filled by that mineral, a process of alteration apparently analogous to that of the serpentinization of olivine. Sometimes the alteration has taken place only in the direction of the cleavage planes, giving rise to a most beautiful banded structure, anhydrite and gypsum arranged in alternate layers.

Some good sized masses of fine-grained white gypsum occur with the anhydrite, probably derived from its alteration.

Both the anhydrite and gypsum occur in crystalline limestone, associated with apatite, and their presence in the Laurantian limestones is of special interest, opening up, as it does, many interesting questions regarding the origin of these limestones.

Hitherto the sulphates of lime seem to have been overlooked in enumerating the minerals of the Laurentian.

It is purposed to make a careful study of the mode of occurrence of these sulphates in the Laurentian limestones, and to publish any interesting facts which may be ascertained regarding it.

Ottawa, Nov. 24, 1891.

David Milne Home.

L.L.D. F.R.S.E. F.G.S. &c.

David Milne, afterwards David Milne Home, was born January 22nd, 1805, and died, full of years and honours, on September 19th, 1890. His father was a captain in the Royal Navy, a distinguished officer, afterwards Admiral Sir David Milne, and David was the eldest son, and from his youth a thoughtful boy and diligent student. On completing his University course at Edinburgh, he entered on the study of Law, and for some years practised successfully in Edinburgh, holding for a time the honourable post of Advocate depute. After his marriage to Miss Home and the death of his father, he retired from legal business and devoted himself to country life, in which he bore himself as the highest type of an educated Scottish country gentleman.

Deeply religious and an elder of the Presbyterian church, he took an active part in the stirring church movements of his time, and in many other departments of Christian work, as the Bible Society, the Sunday School Union, and the Scottish Christian Knowledge Society. He was a zealous educationist and agriculturist, and keenly alive to the importance of science in agriculture, and was active in county business. He was early attracted to the study of geology, and made its pursuit the main recreation of his life; devoting himself more particularly to the local geology and archæology of the South of Scotland, and to the questions relating to the boulder-clay and other glacial deposits. He was the chairman and organiser of the Boulder Committee of the Geological Society of Scotland, and his reports on that subject are widely known and valued. As a student of Pleistocene geology he was eminently rational and conservative, and advocated moderate views as to the Glacial period in opposition to the extreme glacialists.

At the time of his death he was the President of the Edinburgh Geological Society, and Vice-president of the Royal Society of Edinburgh. He was a chief promoter of the Ben Nevis Meteorological Observatory, and of the Marine Station at Granton, and was President of the Berwickshire Field Club. The writer of this notice had an opportunity, by his invitation, to attend one of the excursions of this club, and at the same time to enjoy the hospitality of the President and his family at his seat of Milne Graden in Berwickshire, and to visit with him some interesting "Kaims" and other superficial deposits. The above is a very slight sketch of Mr. Milne Home's multiplied labours and public engagements. He was the author of many reports, public addresses, and memoirs on a great variety of geological, archæological, and other scientific subjects; and from his position and personal character exercised a large influence in favour of science and education in Scotland.

The few facts above stated are gleaned from the well-written biographical sketch from the pen of his accomplished daughter, Miss Grace Milne Home;[1] in which will also be found interesting notices of the geology of Berwickshire, and letters from eminent geologists and other scientific men, with whom Mr. Milne Home was in correspondence.

J. W. D.

Addenda to Sir W. Dawson's Paper on the Trees Growing on the Grounds of McGill University.

In the discussion I was reminded that I had omitted two of our most useful and beautiful shrubs, the Mahonia, *Berberis aquifolium*, and its ally, *B. vulgaris*, both of which may be said to have been naturalized on the College grounds and spread themselves at their own discretion. The former in particular is interesting as our best substitute for Holly, which in its foliage it much resembles. It is an evergreen, but its leaves are liable to be killed in winter if not covered with snow. When planted in a low and sheltered place, likely to be well covered with snow in winter, it spreads freely and its leaves preserve their greenness, so that it may be gathered at Christmas; and it will come out bright and uninjured from under the snow in spring. With a few of the berries of the tree cranberry, which remain red and perfect all winter, it may be made to do duty very well for the traditional holly of the mother country.

It was also noticed in the discussion that the growth of trees in this climate is very rapid. A young man who plants well selected trees may, before he is middle aged, have large and useful plantations; and belts of forest trees,

[1] Douglas, Edinburgh, 1891.

if judiciously planted, besides their other uses, are invaluable for shelter and for protecting fruit trees.

Young seedling trees are the best, as they soon gain on older trees which have been removed, and are more beautiful and shapely. Many of our best forest trees are quite easily propagated from the seed, and abundance of healthy seedlings can often be collected under old trees.

Much is to be said, both on the score of economy and beauty, in favor of hedges instead of fences; and if the native thorns are to be used, the best will probably be *C. tomentosa*, the pear or apple haw, from its vigorous growth and compact habit. Some varieties of this species also produce a large and edible fruit.

A pleasant feature connected with such trees as the Sumach, the Rowan tree and the Tree-cranberry, is that they attract winter birds, and thus enliven the shrubbery at a time when living things are least abundant in our woods and grounds.

The planting and culture of trees, and the disposal of them for utility and adornment were referred to by several speakers in the discussion, and it is hoped may form the subject of a separate paper by some member having the requisite experience and scientific knowledge.

Proceedings of the Natural History Society.

The regular monthly meeting was held on Monday evening October 26th., Mr. J. H. Joseph, Vice-President, in the Chair. The minutes of the annual meeting were read and approved, also minutes of the council meetings of May 21st and Oct. 19th.

Letters from Dr. Harrington and Mr. Frank D. Adams were read, resigning the offices of President and Secretary respectively.

It was moved by Mr. J. Stevenson Brown, seconded by Mr. J. A. U. Beaudry, that " in accepting the resignation of Dr. Harrington the society regrets that he cannot act as President for another year. The Society also takes this opportunity of thanking Dr. Harrington, not only for the efficient manner in which he has discharged his duties as President, but also for the work he has done for the Society in the past and for the interest he still continues to show in its welfare."

It was resolved to suspend the by-law on balloting and on motion of the Hon. Edward Murphy, seconded by Major L. A. H. Latour, the Very Rev. Dean Carmichael was elected President.

It was then moved by Mr. Geo. Sumner, seconded by Mr. J. A. U. Beaudry, that Dr. Harrington be elected Vice-President. Carried.

Mr. J. Stevenson Brown then moved, seconded by Mr. J. A. U. Beaudry, that the recommendation of the Council accepting the resignation of Mr. Frank D. Adams as Recording Secretary and the appointing of Mr. R. W. McLachlan in his place, and Mr. Frank D. Adams as member of the Council be adopted. Carried.

A letter from the Citizens' Royal Society Committee, was read, offering the Society a cheque for $300.00 and the books and vouchers of the committee, on condition that the Society should undertake to settle any accounts that may still remain unpaid. On motion the offer was accepted.

The Curator reported the following additions to the museum :—Woodchuck, black variety, from Mr. Griffin ; Brown Thrasher, from E. D. Wintle ; Wood Thrush and Yellow legs, from F. B. Caulfield ; Nest of the longbilled Marsh Wren, from E. D. Wintle ; A Land Crab found in a bunch of bananas. A Lamellibranchiate fossil from the Hudson River formation, Georgetown, Ont., from C. A. Walker ; Red Shoulder Hawk (nestling), from Mr. Abbott ; Rattle Snake skin with rattles attached, from H. J. Tiffin ; a collection of insects, from Albert Holden ; Natural products from the Islands of Jamaica and St. Vincent, from John Fulton ; Specimens of Asbestos and Phosphates, East Templeton, from A. M. Perkins, and a cocoon of silk worm and silk from Mr. Griffin. The thanks of the Society was ordered to be sent to the donors.

The usual exchanges were reported by the Librarian.

Messrs. F. X. Langelier and W. E. Boustead were elected ordinary members.

Mr. F. B. Caulfield then read a paper entitled "A few Notes on Additions to our Museum." It was moved by Mr. J. Stevenson Brown, seconded by Mr. J. A. U. Beaudry that the thanks of the Society be tendered to Mr. Caulfield for his interesting paper.

The meeting then adjourned.

Proceedings of the Microscopical Society.

The Annual meeting of the Montreal Microscopical Society was held in the Library of the Natural History Society on Monday evening Nov. 9th.

The Secretary Treasurer reported that the membership had trebled during the year, the attendance at the meetings had largely increased, no members were in arrears, the Society was free from debt and had a cash balance on hand. It was suggested in his report that the aim of the Society be more clearly defined and that the members should consider some enlarged scheme of practical work.

During the past season papers had been read on the following subjects:—

Nov. 10th "Illumination as applied to the Microscope"
J. Stevenson Brown, Esq.

Dec. 8th "Facts connected with keeping an Aquarium"
Dean Carmichael.

Jan. 12th "Practical hints on the Microtome"
Wyatt G. Johnson, M.D.

Feb. 9th "Histology of the eye of the Owl and Lobster"
J. W. Stirling, M.D.

Mch. 9th "The Microscope and Bacteriology"
J. A. Beaudry, M.D.

April 13th "The Polariscope as applied to the separation of Starches"
G. P. Girdwood, M.D.

May 11th "The Bacteria in Montreal drinking water"
Wyatt G. Johnson, M.D.

The election of officers resulted in the re-election of J. Stevenson Brown, President; Hon. Senator Murphy, Vice-President; Leslie J. Skelton, Hon.-Secretary.

It having been decided by the committee on rules to divide the office of Secretary-Treasurer, Mr. J. S. Shearer was unanimously elected Hon.-Treasurer.

The President read his annual address and took for his subject "The Duty of Science." At its conclusion, a vote of thanks was tendered him and also to the officers of the Society for their efforts on its behalf during the year just closed.

The papers for the coming season have all been arranged for in advance and are:—

Oct. 20th "The Bacillus of Diphtheria" illustrated with apparatus for investigation and culture,

J. B. McConnell, Esq., M.D.

Nov. 9th. The President's annual address, (and Election of officers),

J. Stevenson Brown, Esq.

Dec. 14th "The use of the Microscope in the study of Fossils,"

Sir Wm. Dawson, L.L.D., F.R.S., F.G.S., &c.

Jan. 11th "Polarised Light, its usefulness in indicating structure," with lantern illustrations,

Prof. John Cox, M.A.

Feb. 8th "Crystalline forms modified by impurity,"

Jos. Bemrose, Esq., F.G.S.

Mar. 14th "The House Spider,"

Rev. W. J. Smyth, M.A., B.Sc., Ph.D.

April 11th "The American Tent Caterpillar:"

A. F. Winn, Esq.

May 9th "Use of the Microscope in the identification of burnt documents,"

G. P. Girdwood, Esq., M.D., M.R.C.S., (Eng.)

Those wishing to join the Society can do so either as ordinary or associate members by addressing the Secretary, Leslie J. Skelton, 138 Metcalfe St., Montreal.

Ordinary members must be possessed of an acromatic microscope. Associate members can attend the meetings but cannot take any active part in the proceedings.

INDEX.

1891.

C. H. McLEOD, *Superintendent.*

[cut]	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
4	71	....	....	....	1
0	03	...	....	....	2
0	00	....	5.7	0.74	3
2	00	....	Inapp.	0.00	4
SUNDA.	69	....	....	....	5 ....SUNDAY
0	97	. . .	....	....	6
9	03	....	....	....	7
0	90	....	....	....	8
0	97	...	....	...	9
0	73	....	....	....	10
0	00	0.50	....	0.50	11
SUNDA.	00	0.63	....	0.63	12 ... . SUNDAY
6	08	Inapp.	....	0.00	13
0	00	0.07	....	0.07	14
0	00	0.57	....	0.57	15
0	13	0.05	.	0.05	16
0	70	....	....	....	17
0	03	0.45	....	0.45	18
SUNDA	01	0.07	....	0.07	19 ....SUNDAY
0	99	....	....	....	20
0	97	....	....	....	21
7	44	Inapp.	....	0.00	22
1	00	0.04	....	0.04	23
0	70	.....	Inapp.	0.00	24
2	07	....	1.4	0.14	25
SUNDA	66	....	....	....	26 .... .SUNDAY
0	89	......	....	...	27
1	13	Inapp.	Inapp.	0.00	28
0	71	Inapp.	Inapp.	0.00	29
0	92	....	....	. .	30
......	41.5	2.38	7.1	3.26	Sums ....
17 yrs. includi	¶52.0	1.64	25.0	2.30	17 years means for and including this month.

Directi
Miles .
Durati
Mean v
Grea
Grea
the 3rd

giving a range of 1.097 inches. Maximum relative humidity was 99 on the 15th. Minimum relative humidity was 29 on the 29th.

Rain fell on 12 days.
Snow fell on 6 days.
Rain or snow fell on 16 days.
Rain and snow fell on 2 days.
Auroras were observed on 3 nights.
Lunar corona on 1 night.
Fog on 1 day.
Solar halo on 1 day,

ABSTRACT FOR THE MONTH OF APRIL, 1891.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	* BAROMETER. Mean.	§ Max.	§ Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	36.42	44.5	25 8	18.7	30.0643	30.108	30.025	.083	.1423	66.5	26.2	N.E.	7.9	8.8	10	4	71	....	....	....	1
2	41.27	48.5	37.4	11.1	29.8753	30.000(?)	29 764	.236	.1468	57 0	27.0	S.E.	16.3	10.0	10	10	03	...	....	....	2
3	32.77	38.8	30.2	8.6	29.5513	29.764	29.441	.323	.1627	87.7	29.5	N.	26.8	10.0	10	10	00	....	5.7	0.74	3
4	32.32	35.5	25.6	9.9	29.5908	29.710	29.490	.220	.1302	70.5	23.7	N.W.	17.6	8.7	10	2	00	....	Inapp.	0.00	4
SUNDAY........ 5	......	31.8	21.8	10.0	.. ....	......	......	....	.....	....	....	S.W.	21.5	....	..	..	69	....	....	....	5 ....SUNDAY
6	32.12	38.1	24.7	13.4	29.8217	29.868	29.784	.084	.1077	60.7	20.0	S.W.	12.7	3.5	10	9	97	. .	....	....	6
7	31 03	34.1	27.7	6 4	29.8507	29.955	29.801	.154	.1085	62.5	20.2	W.	10.5	9 8	10	9	03	....	....	....	7
8	32 05	38.3	24.1	14.2	30.1615	30.282	30.038	.244	.1068	59.3	19.7	W.	13.1	5.0	10	0	90	....	....	....	8
9	39.12	48 5	30.2	18.3	30.4408	30.484	30.350	.134	.1357	57.0	25.2	W.	0 8	0.5	3	0	97	...	....	...	9
10	42.33	53.5	28.6	24.9	30 4317	30.538	30.311	.227	.1395	53.5	25.7	S.E.	6.5	7.2	10	0	73	....	....	....	10
11	41.07	44.1	36.6	7.5	30.0797	30.265	29.902	363	.2383	92.2	38.8	S.E.	20.2	10.0	10	10	00	0.50	....	0.50	11
SUNDAY 12	......	44.8	35.7	9.1	....	......	.....	....	.....	....		S.W.	20.2	.	..	.	.00	0.63	....	0.63	12 .. .. SUNDAY
13	44.58	50.0	38.1	11.9	29 9325	20.999	29 874	.125	.2312	79.0	38.2	S.W.	23 0	9.3	10	6	08	Inapp.	....	0.00	13
14	43.67	50.0	37 6	12.4	30.0638	30.127	29.917	.210	.2178	75 2	36.0	N.E.	18.6	10.0	10	10	00	0.07	....	0.07	14
15	34.42	38.8	32 4	6.4	30 0512	30.056	30.017	.069	1853	93.2	32.7	N.E.	18.3	10.0	10	10	00	0.57	....	0.57	15
16	41.97	50.0	33.5	16 5	30.1537	30.206	30.096	.110	.2277	85.3	37.5	S.W.	12.9	8.3	10	0	13	0.05		0.05	16
17	50.75	60.1	36.6	23.5	30.1487	30.250	30.017	.233	.2445	66.7	39.3	S.W.	14.6	4.2	10	0	73	...	....	....	17
18	53.88	58.5	47.4	11.1	29.8312	29.971	29.729	.242	.3017	86.0	49.5	S.W.	15.1	8.3	10	0	03	0.45	....	0 45	18
SUNDAY........19	.....	54 7	45.6	9.1	....	......	......	....	... .	....	....	S.W.	16.8	...	..		01	0.07	....	0.07	19 ....SUNDAY
20	47.10	54.0	40.6	13.4	30.2085	30.264	30.066	.198	.1925	59.5	33.5	N.W.	13.7	0.5	3	0	99	....	....	....	20
21	52.17	63 0	36.5	26.5	30.2047	30.332	30.031	.301	.2070	53.5	35.3	S.W.	10.9	2.3	10	0	97	....	....	....	21
22	56.83	70.0	46.5	23.5	29.6602	29.864	29.498	.366	.3317	71 7	47.3	S.W.	13 9	9 0	10	7	44	Inapp.	....	0.00	22
23	39 22	47.5	34.5	13.0	29.5367	29.664	29.456	.208	.2112	85.8	35.2	N.	17 9	8.5	10	1	00	0.04	....	0.04	23
24	39 37	50.3	30 7	19.6	29.6222	29.697	29.536	.161	.1287	54.8	23.8	N.W.	20.3	5.0	10	0	70	.....	Inapp.	0.00	24
25	36 57	42.3	29.0	13.3	29.7130	29.863	29.595	.268	.1387	66 0	27.7	N.W.	19.3	9.0	10	2	07	....	1.4	0.14	25
SUNDAY........26	......	56.0	36.6	19.4	... .	......	. ....	....	.....	....	....	N.W.	15 9	....	..	.	66	....	....	....	26 .... .SUNDAY
27	60.12	72.0	47.5	24.5	29.7328	29.913	29.560	.353	.2467	46.8	39 3	S.W.	20.9	1.8	10	0	89	......	....	...	27
28	42.32	60 5	31.6	28.9	29.7322	29.865	29.575	.290	.1675	60.7	29.7	W.	30.3	7 7	10	1	13	Inapp.	Inapp.	0.00	28
29	40.73	51.5	27.7	23.8	29.8117	29.884	29.752	.132	.1155	47.0	21.5	W.	22.2	6.8	10	0	71	Inapp.	Inapp.	0.00	29
30	52.65	65.0	40.9	24.1	29.6442	29.769	29.541	.228	.2158	52.8	35.5	S.E.	8.0	2.8	9	0	92	....	....	.	30
............Means	42.19	57.49	39.30	18.19	29.9198	......	......	.214	.1862	67.3	31 5	....	16.22	6.81	..	..	41.5	2.38	7.1	3.26	Sums ....
17 yrs. means for & including this mo.	39.76	48.26	32.18	16.07	29.9411	......	......	.202	.1693	66.7	....	....	....	5.90	..	..	¶52.0	1.64	25.0	2.30	17 years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
Miles....	1394	1001	44	1091	493	4411	1917	1289	
Duration in hrs..	76	62	8	73	36	241	121	78	25
Mean velocity....	18.3	16.2	5.5	14 9	13.7	18.3	15.8	16.5	

Greatest mileage in one hour was 59 on the 3rd.

Greatest velocity in gusts, 72 miles per hour on the 3rd.

Resultant mileage, 4635.
Resultant direction, S. 72° W.
Total mileage, 11,683.

* Barometer readings reduced to sea-level and temperature of 32° Far.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Ten years only.

The greatest heat was 72.0 on the 27th; the greatest cold was 21.8 on the 5th, giving a range of temperature of 50.2 degrees. Warmest day was the 27th. Coldest day was the 5th. Highest barometer reading was 30.538 on the 10th; lowest barometer was 29.441 on the 3rd, giving a range of 1.097 inches. Maximum relative humidity was 99 on the 15th. Minimum relative humidity was 29 on the 29th.

Rain fell on 12 days.

Snow fell on 6 days.

Rain or snow fell on 16 days.

Rain and snow fell on 2 days.

Auroras were observed on 3 nights.

Lunar corona on 1 night.

Fog on 1 day.

Solar halo on 1 day.

MAY, 1891.

vel, 187 feet. C. H. McLEOD, *Superintendent.*

Sky Clouded in Tenths. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1.5	9	0	84	....	....	....	1
5.0	10	0	94	...	....	...	2
....	..	..	31	0.32	....	0.32	3 ....SUNDAY
6.3	10	0	50	0.05	....	0.05	4
8.3	10	0	17	0.01	Inapp.	0.01	5
7.8	10	2	27	0.05	....	0.05	6
7.0	10	0	81	....	....	....	7
8.5	10	4	44	Inapp.	....	0.00	8
9.8	10	9	02	0.10	....	0.10	9
	..	..	33	Inapp.	....	0.00	10 .... SUNDAY
8.3	10	0	00	0.03	....	0.03	11
1.7	7	0	94	....	....	....	12
1.8	6	0	91	....	....	....	13
1.2	9	0	74	....		....	14
2.7	7	0	84		....	...	15
10.0	10	10	00	0.66	...	0.66	16
....	..	..	82	....	....	....	17 ....SUNDAY
5.7	10	0	53	0.05	....	0.05	18
3.3	10	0	85	....	....	....	19
9.0	10	4	47	.....	....		20
8.7	10	6	20	0.22	....	0.22	21
6.5	10	1	51	...	....	....	22
0.0	0	0	95	....	....	....	23
....	..	..	90	....	....	....	24 .... SUNDAY
8.3	10	4	68	....	....	....	25
5.8	10	0	35	0.22	....	0.22	26
2.5	10	0	92	....	..	....	27
10.0	10	10	52	....	....	....	28
8.3	10	5	50	....	....	....	29
7.7	10	0	16	.....	....	....	30
....	..	..	72	....	....	....	31 .... SUNDAY
5 99	..	..	55.3	1.71	0.00	1.71	Sums ....
6.28	..	..	¶52.0	2.91	0.10	2.92	17 years means for and including this month.

o sea-level and

f mercury.
being 100.

n the 16th; the 5th, giving a egrees. Warm- ay was the 5th. s 30.312 on the 608 on the 1st,

giving a range of 0.704 inches. Maximum relative humidity was 99 on the 9th. Minimum relative humidity was 25 on the 13th.

Rain fell on 12 days.

Snow fell on 1 day.

Rain or snow fell on 12 days.

Rain and snow fell on 1 day.

Hoar frost on 2 days.

Fog on 2 days.

ABSTRACT FOR THE MONTH OF MAY, 1891.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	* BAROMETER. Mean.	§ Max.	§ Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	52.62	66.3	41 5	24.8	29.7148	29.860	29 608	.252	.2130	56.2	36.2	S.W.	17.0	1.5	9	0	84	....	....	....	1
2	53.82	63 4	42.7	20.7	29.9167	29.972	29.877	.095	.2065	51.3	35.3	S.W.	14.7	5.0	10	0	94	...	....	..	2
SUNDAY.. 3	......	57.0	39.6	17.4	.. ....	......	......	...	.....	....	....	W.	15.2	....	..	..	31	0.32	....	0.32	3 ....SUNDAY
4	39.47	48.0	33.6	14.4	29.8458	29.977	29.777	.200	.1508	62.7	27.3	S.W.	28.2	6.3	10	0	50	0.05	....	0.05	4
5	36.02	42 0	31.7	10.3	29.8370	29.884	29.794	.090	.1482	69 8	27.0	S.W.	21.5	8.3	10	0	17	0.01	Inapp.	0.01	5
7	40.85	48.2	33.5	14.7	29.9202	30.032	29.878	.154	.1625	63.0	28.8	N.W.	15.9	7.8	10	2	27	0.05	....	0.05	6
6	47.18	56.4	37.1	19 3	30.0482	30.120	29.992	.128	.1400	44.2	25.7	W.	16.5	7.0	10	0	81	....	....	....	7
8	51.73	62.8	42.0	20.8	29.8637	29.999	29.763	.236	.2355	62.5	38.2	S.W.	17.3	8.5	10	4	44	Inapp.	....	0.00	8
9	52.50	61 0	48.5	12.5	29.8067	29.841	29.790	.051	.3467	87.8	47 2	S.E.	7.5	9.8	10	9	02	0.10	....	0.10	9
SUNDAY . 10	......	80.0	46.5	33.5	......	......	......	....	.....	....		S.W.	26.9		..	..	33	Inapp.	....	0.00	10 . SUNDAY
11	47 05	58.9	43 0	15.9	29.9610	30.032	29.891	.141	.2257	69.8	37.3	N.W.	13.2	8.3	10	0	00	0.03	....	0.03	11
12	53.67	65 9	39.9	26.0	30.0988	30.149	30.068	.081	.2302	58 2	38.0	S.W.	6.0	1.7	7	0	94	....	....	....	12
13	57.33	69.1	44.6	24.5	30 0243	30.094	29.967	127	.2275	50.8	37.7	S.W.	10.3	1.8	6	0	91	....	....	....	13
14	53.22	62.0	47.3	14.7	30.0880	30.131	29.976	.155	.1978	49.5	34.0	....	12.0	1.2	9	0	74	....		....	14
15	58.40	72.2	41.5	30.7	29 9773	30.130	29.855	.275	2432	48.8	38.5	S.E.	12.0	2.7	7	0	84		....	...	15
16	47.85	58.7	36.8	21 9	29.8388	29.913	29.711 ?	.202	.2755	81.5	42.0	W.	15.6	10.0	10	10	00	0.66	...	0.66	16
SUNDAY. .. 17	.....	52.1	34.7	17.4	....	......	..	....	.. .	....	....	W.	20.3	....	..		82	....	....	....	17 ....SUNDAY
18	42.63	51.0	38.5	12.5	29.8212	30.044	29.692	.352	.1727	63.5	30.0	W.	24 7	5.7	10	0	53	0.05	....	0.05	18
19	47.92	57 0	36.1	20.9	30.1900	30.242	30.115	.127	.1593	47.5	23.5	S.W.	12.1	3.3	10	0	85	....	....	....	19
20	61.07	75.8	43.3	32.5	30.2718	30.312	30.229	.083	.3508	65.0	48.7	S.	13.0	9.0	10	4	47	.....	....		20
21	66.38	74.3	59.8	14.5	30.0825	30.248	29.922	.326	5252	81.3	60.3	S.	15.2	8.7	10	6	20	0.22	....	0.22	21
22	54.17	66.0	39.5	26.5	29.9777	30.109	29.887	.222	.2700	60.2	40.0	N.	17 5	6.5	10	1	51	...	....	....	22
23	46 10	56.8	33.7	23.1	30.1425	30.207	30.092	.115	.1723	55 7	30.7	....	9 5	0.0	0	0	95	....	....	....	23
SUNDAY.... ...24	......	69.2	39.8	29.4	. .	......	......	....	.....	....	....	S.W.	10.2	....	..	.	90	....	....	....	24 .... .SUNDAY
25	62.33	71.0	54.0	17.0	29.9152	29.965	29.868	.097	.3258	59.5	47.0	S.W.	15.9	8.3	10	4	68	....	....	....	25
26	47 55	58.0	41 6	16.4	30.0295	30.168	29.977	.191	.2540	76.3	40.2	N.	14.8	5.8	10	0	35	0.22	....	0.22	26
27	50.58	59.4	38.6	20.8	30.2028	30.297	30.129	168	.1830	49.3	32.0	S.W.	11.3	2.5	10	0	92	....	..	....	27
28	59.02	71 0	48.4	22.6	30.1207	30.171	30.066	.105	.2825	56.2	42.8	S.W.	13 0	10.0	10	10	52	....	....	....	28
29	65.65	79.8	50.7	29.1	29.9878	30.089	29.918	171	.3867	63.0	51.7	S.	7.4	8.3	10	5	50	....	....	....	29
30	65.93	74.0	56.3	17.7	29.9137	29.940	27.881	.059	.4480	71.0	55.8	....	7 4	7.7	10	0	16	.....	....	....	30
SUNDAY........31	......	75.1	51.6	23.5	....	......	......	....	.....	....	....	N.E.	8.9	....	..	..	72	....	....	....	31 .... SUNDAY
....Means	52.36	63.30	42.46	20.84	29.9845	. ..	......	162	.2513	61.72	38 5	....	14.7	5 99	..	..	55.3	1.71	0.00	1.71	Sums ....
17 yrs. means for & including this mo.	54.45	63.68	45.43	18.25	29.9372	....	......	.163	2831	65.20	....	....	.	6.28	..	..	¶52.0	2.91	0.10	2.92	17 years means for and including this month.

ANALYSIS OF WIND RECORD

Direction....	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
Miles	1198	364	91	578	1419	4548	1941	803	
Duration in hrs ..	84	44	21	65	103	252	114	55	1
Mean velocity....	14.3	8.3	4.3	8 9	13.1	18.0	17.0	14.6	

Greatest mileage in one hour was 48 on the 4th.
Greatest velocity in gusts, 66 miles per hour on the 1st.

Resultant mileage, 5820.
Resultant direction, S. 58.5 W.
Total mileage, 10,942.

* Barometer readings reduced to sea-level and temperature of 32° Far.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Ten years only.

The greatest heat was 80.0 on the 10th; the greatest cold was 31.7 on the 5th, giving a range of temperature of 48.3 degrees. Warmest day was the 21st. Coldest day was the 5th. Highest barometer reading was 30.312 on the 20th; lowest barometer was 29.608 on the 1st, giving a range of 0.704 inches. Maximum relative humidity was 99 on the 9th. Minimum relative humidity was 25 on the 13th.

Rain fell on 12 days.
Snow fell on 1 day.
Rain or snow fell on 12 days.
Rain and snow fell on 1 day.
Hoar frost on 2 days.
Fog on 2 days.

NE, 1891.

187 feet. C. H. McLEOD, *Superintendent.*

Clouded Tenths. Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
10	2	61	....	....	....	1
10	0	30	....	....	...	2
10	4	17	0.14	....	0.14	3
10	0	82	....	....	....	4
10	0	70	....	....	....	5
9	0	90	....	....	....	6
..	..	88	....	....	....	7 ....SUNDAY
10	2	76	....	....	....	8
10	4	52	....	....	....	9
10	1	63	......	....	....	10
10	1	46	0.83	....	0.83	11
10	0	80	0.01	....	0.01	12
10	0	92	....	...	....	13
..	..	61	....	....	....	14 ....SUNDAY
10	1	37	.....	....	.. .	15
10	0	69	0.40	....	0.40	16
10	7	31	0.04	....	0.04	17
10	2	85	....	....	....	18
10	1	64	...	....	....	19
10	5	12	....	....	....	20
..	..	09	0.01	....	0.01	21 ....SUNDAY
10	10	00	0.18	....	0.18	22
10	3	26	0.14	....	0.14	23
10	0	36	....	....	....	22
8	0	79	....	....	....	25
10	1	76	....	...	...	26
9	0	81	....	....	....	27
..	..	90	....	....	....	28 .... .SUNDAY
10	0	88	....	....	....	29
10	0	62	....	....	....	30
..	..	58.4	1.75	....	1.75	Sums ....
..	..	55.5	3.08	....	....	17 years means for and including this month.

level and

ury.
.00.

6th; the
giving a
Warm-
the 3rd.
on the
the 1st,

giving a range of 0.626 inches. Maximum relative humidity was 96 on the 22nd. Minimum relative humidity was 25 on the 7th.

Rain fell on 8 days.

Thunder storms on the 11th and 16th.

ABSTRACT FOR THE MONTH OF JUNE, 1891.

Meteorological Observations McGill College Observatory, Montreal Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				* BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	§ Max.	§ Min.	Range.				General direction.	Mean velocity in miles perhour	Mean.	Max.	Min.					
1	71.38	82.1	58.1	24.0	29.7042	29.789	29.620	.169	.4542	60.0	56.3	S.W.	20.5	7.7	10	2	61	....	....	....	1
2	56 27	65.0	51.4	13.6	29.9347	29.980	29.865	.115	.2917	64.3	44.2	N.	11.6	4.3	10	0	30	....	....	...	2
3	47.08	55.1	40.4	14.7	30.1048	30.133	30.057	.076	.2132	67.8	35.7	N.E.	24.3	8.8	10	4	17	0.14	....	0.14	3
4	51.30	60.9	41.5	19.4	30.1505	30.188	30.118	.070	.1890	51.0	33.0	N.E.	14.0	1.7	10	0	82	....	....	....	4
5	53.72	64.0	43.3	20.7	30.1832	30.246	30.130	.116	.1943	48.2	33.8	W.	14.1	2.3	10	0	70	....	....	....	5
6	59.05	70.0	44.5	25.5	30.1363	30.221	30.068	.153	.2092	42.2	35.8	W.	9.8	2.0	9	0	90	....	....	....	6
SUNDAY 7	.....	75.6	49.4	26.2	....	......	......	....	.....	....	....	S.W.	11.0	....	..	..	68	....	....	....	7 ....SUNDAY
8	68.17	82.2	54.9	27.3	30.0605	30.131	30.000	.131	.2947	44.0	44.5	S.W.	17.4	5.3	10	2	76	....	....	....	8
9	67.50	80.3	57.0	23.3	30.0178	30.077	29.973	.104	.3383	50.5	47.8	S.W.	18.3	8 0	10	4	52	....	....	....	9
10	72.08	84.8	60.4	24.4	29.9505	30.019	29.889	.130	.4665	59.3	56.5	S.W.	15.6	6.8	10	1	63	......	....	....	10
11	71.95	86.9	64.3	22.6	29.8742	29.945	29.815	.130	.5847	76.2	63.3	S.W.	16.3	8.0	10	1	46	0.83	....	0.83	11
12	68.95	77.0	62.3	14.7	29.9108	30.013	29.858	.155	.4580	65.3	56.3	S.W.	20.1	5.8	10	0	80	0.01	....	0.01	12
13	69.32	78.7	55.4	23.3	30.0490	30.111	29.994	.117	.3995	54.7	52.8	S.W.	14.5	3.0	10	0	92	....	..	....	13
SUNDAY 14	.....	82.0	61.3	20.7	....	......	. ....	....	.....	....	. ..	S.W.	23.5	....	..	..	61	....	....	....	14 ....SUNDAY
15	74.63	86.7	64.2	22.5	29.8280	29.879	29.787	.092	.4647	54.5	56.8	S.W.	23.9	7.2	10	1	37	.....	....	.. .	15
16	74.58	90.0	67.5	22.5	29.7413	29.795	29.680	.115	.5948	69.0	63.5	S.W.	20.7	6.3	10	0	69	0.40	....	0.40	16
17	64.78	70.3	58.3	12.0	29 8668	29.893	29.843	.050	.3882	63.7	51.8	N.E.	17.9	9.8	10	7	31	0.04	....	0.04	17
18	63.38	74.5	54.4	20.1	29 8263	29.885	29.770	.115	.3812	67.0	51.3	E.	11.1	7.5	10	2	85	....	....	....	18
19	65.03	74 6	55.2	19.4	29.7627	29.785	29.734	.051	.4318	70.5	54.5	S.E.	10 0	8.0	10	1	64	...	....	....	19
20	67.53	74.8	59.3	15.5	29.8303	29.844	29.813	.031	.5198	77.2	59.8	S.E.	8.0	9.3	10	5	12	....	....	....	20
SUNDAY........21	.....	79.9	66.4	13.5	.. ....	......	......	....	.....	....	....	S.E.	6.7	....	..	..	09	0.01	....	0.01	21 ....SUNDAY
22	69.10	74.7	66.6	8.1	29.7330	29.794	29.678	.116	.6403	90.3	66.0	S.E.	9 8	10.0	10	10	00	0.18	....	0.18	22
23	65.97	74.1	56.5	17.6	29.7125	29.863	29.646	.217	.5248	81.2	59.8	S.W.	20.4	8.8	10	3	26	0.14	....	0.14	23
24	59.53	68.2	53.6	14 6	29.9690	29.989	29.925	.064	.3852	75.8	51 8	W.	9.1	5.2	10	0	36	....	....	....	22
25	69.62	81.0	53.5	27.5	29.9015	30.020	29.791	.229	.5028	70.0	58.8	S.	6 3	1.8	8	0	79	....	....	....	25
26	66.17	77.5	53.7	23.8	29.9128	30.049	29.829	.220	.4098	62.3	52.3	N.	16.7	5.8	10	1	76	....	...	...	26
27	62.23	73.9	50.6	23.3	29.9973	30.050	29.959	.091	.3007	54.8	44.8	N.	15.3	2.2	9	0	81	....	....	....	27
SUNDAY........28	.....	78.5	55.3	23.2	....	......	......	....	.....	....	....	N.	17.3	....	..	..	90	....	....	....	28 .... SUNDAY
29	67.40	76.4	59.1	17.3	29.8413	29.871	29.814	.057	.4250	63.5	54.3	N.E.	13.9	3.5	10	0	88	....	....	....	29
30	67.60	75.8	57.8	18.0	29.8995	29.927	29.871	.056	.4718	70.7	57.2	N.E.	11.9	3.2	10	0	62	....	....	....	30
....Means	65.17	75.85	55.87	19.98	29.9192	.....	......	.114	.4052	63.6	51.6	....	15.0	5.86	..	..	58.4	1.75	....	1.75	Sums ....
17 yrs. means for & including this mo.	64.50	73.26	55.92	17.34	29.8991	.....	......	.153	.4215	68.6	....	....	....	5.71	..	..	55.5	3.08	....	....	17 years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
Miles............	1953	1605	187	748	361	4697	892	358	
Duration in hrs..	106	115	24	79	46	257	59	33	1
Mean velocity....	18.4	12.2	7.8	9.5	7.85	18.3	15.1	10.8	

Greatest mileage in one hour was 34 on the 26th.
Resultant mileage, 2760.
Resultant direction, S. 72.°5 W.
Total mileage, 10,801.

* Barometer readings reduced to sea-level and temperature of 32° Far.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Ten years only.

The greatest heat was 90.0 on the 16th; the greatest cold was 40.4 on the 3rd, giving a range of temperature of 49.6 degrees. Warmest day was the 15th. Coldest day was the 3rd. Highest barometer reading was 30.246 on the 5th; lowest barometer was 29.620 on the 1st, giving a range of 0.626 inches. Maximum relative humidity was 96 on the 22nd. Minimum relative humidity was 25 on the 7th.

Rain fell on 8 days.

Thunder storms on the 11th and 16th.

JLY, 1891.

, 187 feet. C. H. McLEOD, *Superintendent.*

Y CLOUDED N TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
.8	10	0	78	0.13	....	0.13	1
.0	10	10	00	0.41	....	0.41	2
.0	10	1	40	0.19	....	0.19	3
.0	10	10	03	0.55	....	0.55	4
..	..	..	00	0.22	....	0.22	5 ....SUNDAY
.5	10	0	00	0.06	....	0.06	6
.5	10	0	82	0.10	....	0.10	7
.0	10	5	75	0.23	....	0.23	8
2	3	0	100	....	....	....	9
.0	0	0	97	....	....	....	10
.5	2	0	96	....	....	....	11
..	..	..	74	....	....	....	12 ....SUNDAY
.7	10	0	80	....	....	....	13
.3	10	7	43	0.06	....	0.06	14
.8	10	2	39	0.14	....	0.14	15
.7	10	0	15	....	....	....	16
.3	2	0	97	....	....	......	17
.2	10	3	34	0.25	....	0.25	18
..	..	..	60	0.34	....	0.34	19 ....SUNDAY
.8	10	3	37	....	....	....	20
.3	8	0	97	....	....	....	21
.5	10	0	76	....	....	....	22
.6	10	2	10	0.13	....	0 13	23
.0	10	4	35	0.50	....	0.50	22
.2	10	0	16	0.01	....	0.01	25
							26
..	..	..	49	0.10	...	0.10	27
.8	9	0	94	....	....	....	
.8	10	0	53	0.26	....	0.26	28 .... .SUNDAY
.5	9	0	67	0.01	....	0.01	29
.0	10	0	18	1.10	....	1.10	30
.3	9	0	73	0.01	....	0.01	31
71	..	..	52.9	4.80	....	4.80	Sums ....
46	..	.	¶58.5	4.19	....	4.19	17 yrs. means for and including this month

ı-level and

rcury.
; 100.

13th ; the giving a s. Warm- ıs the 31st. 57 on the n the 4th,

giving a range of 0.789 inches. Maximum relative humidity was 97 on 4 days. Minimum relative humidity was 33 on the 9th.

Rain fell on 20 days.

Thunder storms on six days, and lightning without thunder on two days.

ABSTRACT FOR THE MONTH OF JULY, 1891.

Meteorological Observations McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				* BAROMETER.				† Mean pressure of vapour	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	§ Max.	§ Min.	Range.				General direction.	Mean velocity in miles per hour	Mean.	Max.	Min.					
1	69.55	83.3	56.5	26.8	29.9600	29.989	29.919	.070	.5165	74.1	59.7	S.E.	12.0	5.8	10	0	78	0.13	....	0.13	1
2	64.70	68.0	61.3	6.7	29.9782	30.013	29.927	.086	.5623	92.0	62.3	S.	9.3	10.0	10	10	00	0.41	....	0.41	2
3	66.08	77.9	59.3	18.6	29.7963	29.928	29.712	.216	5280	83.8	60.5	S.	9.8	8.0	10	1	40	0.19	....	0.19	3
4	61.82	68.1	58.5	9.6	29.6163	29.702	29.568	.134	.4867	88.0	58.2	S.	10.0	10.0	10	10	03	0.55	....	0.55	4
SUNDAY..........5	.....	62.6	55.3	7.3	....	......	......	....	.....	....	.	S.	16.1	....	..	..	00	0.22	....	0.22	5 ....SUNDAY
6	57.53	64.8	51.5	13.3	29.7678	29.860	29.652	.208	.3552	75.0	49.5	S.W.	18.7	7.5	10	0	00	0.06	....	0.06	6
7	59.95	68.0	50.0	18.0	29.8402	29.906	29.767	.139	.3545	69.8	49.5	W.	13.5	6.5	10	0	82	0.10	....	0.10	7
8	60 95	70.8	51.0	19.8	29.8507	29.981	29.785	.196	.3970	74.7	52.7	W.	12.4	7.0	10	5	75	0.23	....	0.23	8
9	67.03	76.0	56.1	19.9	30.0778	30.109	30.041	.068	.3222	51.5	47.7	N.	11.3	1 2	3	0	100	....	....	....	9
10	70.50	80.6	55.6	25.0	30.1945	30.232	30.151	.081	.4075	55.2	53.3	S.W.	11.0	0.0	0	0	97	....	....	....	10
11	72.97	83.5	57.9	25.6	30.1523	30.230	30.074	.156	.4600	56.7	56.5	S.W.	14.6	0.5	2	0	96	....	....	....	11
SUNDAY 12	.....	83.0	64.8	18.2	....	......	. ....	....	.....	....	....	S.W.	18.0	....	..	..	74	....	....	....	12 ....SUNDAY
13	77.22	86.8	68.5	18.3	29.9407	30.028	29.877	.151	.5847	63.2	63.6	S.W.	20 0	3.7	10	0	80	....	....	....	13
14	75 42	85.6	69.7	15.9	29.8365	29.884	29.809	.075	.6305	72.5	65.5	S.W.	18.6	9.3	10	7	43	0.06	....	0.06	14
15	72.25	78.0	65.9	12.1	29.7345	29.804	29.676	.128	.5642	72.5	62.0	S.	17.7	7.8	10	2	39	0.14	....	0.14	15
16	66 77	73.0	62.3	10.7	29.8710	29.962	29.799	.163	.4720	72.0	57.3	S.W.	17.6	6.7	10	0	15	....	....	....	16
17	71.55	83.0	61.3	21.7	30 0130	30.046	29.986	.060	. .5020	64.8	58.7	S.W.	12.0	0.3	2	0	97	....	....	......	17
18	70.42	81.3	62.0	19.3	29.8643	30.017	29.694	.323	.4477	63.0	55.7	S.E.	14.8	8.2	10	3	34	0.25	....	0.25	18
SUNDAY.........19	.....	75.3	60.3	15.0	.. ....	......	......	....	.....	....	....	S.W.	14.6	....	..	..	60	0.34	....	0.34	19 ....SUNDAY
20	64.85	72.1	57.5	14.6	30.1225	30.171	30.038	.133	.3978	65.2	52.5	S.W.	11.5	7.8	10	3	37	....	....	....	20
21	64.83	74.4	55.4	19.0	30.2963	30.326	30.230	.096	.3482	57.5	49.0	N.	7.3	2.3	8	0	97	....	....	....	21
22	68.55	79.8	53.2	26.6	30.2575	30.357	30 143	.214	.3998	59.3	52.3	S.E.	7 9	3.5	10	0	76	....	....	....	22
23	69.17	74.0	65.3	8.7	30.0768	30.149	29.990	.159	.5730	80.5	63.0	S.	15.3	8.6	10	2	10	0.13	....	0 13	23
24	67.38	79.1	61.3	17 8	29.8835	29.976	29.810	.166	.5747	86.3	62.8	S.W.	10.2	9.0	10	4	35	0.50	....	0.50	22
25	61.05	68.0	57.0	11.0	29.8897	29.902	29.866	.036	.4032	74.5	53.0	N.W.	6 2	6.2	10	0	16	0.01	....	0.01	25 26
SUNDAY.........26	.....	67.6	54.5	13.1	....	......	......	....	.....	....	....	S.W.	12.7	....	..	..	49	0.10	...	0.10	27
27	59 32	68.0	50.4	17.6	29.9117	29.956	29.886	.070	.3225	63.5	47.2	S.W.	9.8	4.8	9	0	94	....	....	....	
28	62.85	72.8	52.5	20.3	29.8893	29.909	29.861	.048	.4110	71.2	53.3	S.W.	11.7	3.8	10	0	53	0.26	....	0.26	28 .... .SUNDAY
29	67.17	72.8	56.0	16.8	29.9122	29.957	29.874	.083	.4745	72.8	57.5	S.E.	8.2	3.5	9	0	67	0.01	....	0.01	29
30	64.00	72.0	54.4	17.6	29.7855	29.870	29.702	.168	.4783	81.2	57.7	S.E.	16.8	8.0	10	0	18	1.10	....	1.10	30
31	57.00	70.0	45.6	24.4	29.8631	29.917	29.787	.130	.3390	73.5	48.1	S.W.	14.7	4.3	9	0	73	0.01	....	0.01	31
....Means	66.33	74.8	57.8	17.0	29.9401	.....	......	.131	.4564	70.9	55.9	S.34.° W.	13.0	5.71	..	..	52.9	4.80	....	4.80	Sums ....
17 yrs. means for & including this mo.	68.83	77.2	60.8	16.4	29.8874	.....	......	.139	.4979	70.8	....	....	....	5.46	..	.	¶58.5	4.19	....	4.19	17 yrs. means for and including this month

ANALYSIS OF WIND RECORD.

Direction.......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
Miles............	290	172	44	1103	2002	4672	1122	299
Duration in hrs..	26	20	7	88	158	320	91	31
Mean velocity....	11.2	8.6	6.3	12.5	12.7	14.6	12.3	9.6

Greatest mileage in one hour was 28 on the 15th.
Greatest velocity in gusts 32 miles per hour on the 15th.
Resultant mileage, 6590.
Resultant direction, S. 34.° W.
Total mileage, 9704.

* Barometer readings reduced to sea-level and temperature of 32° Far.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 10 years only.

The greatest heat was 86.8 on the 13th; the greatest cold was 45.6 on the 31st, giving a range of temperature of 41.2 degrees. Warmest day was the 13th. Coldest day was the 31st. Highest barometer reading was 30.357 on the 22nd; lowest barometer was 29.568 on the 4th, giving a range of 0.789 inches. Maximum relative humidity was 97 on 4 days. Minimum relative humidity was 33 on the 9th.

Rain fell on 20 days.

Thunder storms on six days, and lightning without thunder on two days.

91.

Met H. McLEOD, *Superintendent.*

Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	0.03	....	0.03	1
	....	....	....	2 ....SUNDAY
	....	....	....	3
	....	....	....	4
	...	....	....	5
	....	....	....	6
	....	....	..	7
	....	....	....	8
	....	....	....	9 .... SUNDAY
	0.02	....	0.02	10
	0.11	....	0.11	11
	0.04	....	0.04	12
	0.04	..	0.04	13
	0.13	....	0.13	14
	0.04	....	0.04	15
	....	....	....	16 ....SUNDAY
	....	....	....	17
	1.03	....	1.03	18
	....	....	....	19
	....	....	....	20
	1.20	....	1 20	21
	....	....	....	22
	0.04	....	0.04	23 .... .SUNDAY
	0 74	....	0.74	24
	0 26	....	0.26	25
	....	...	....	26
	0.02	....	0.02	27
	....	....	....	28
	....	....	.. .	29
	....	....	....	30 ....SUNDAY
	0.00	....	0.00	31
4	3.70	....	3.70	Sums ....
9	3.19	....	3.19	17 yrs. means for and including this month

DAY.

1
SUNDAY.........2
3
4
5
6
7
8
SUNDAY 9
10
11
12
13
14
15
SUNDAY. 16
17
18
19
20
21
22
SUNDAY........23
24
25
26
27
28
29
SUNDAY....... 30
31

....Means

17 yrs. means for & including this mo.

Direction......

Miles ....

Duration in hrs ..

Mean velocity....

Greatest mileag
Greatest velocity
25th.

h; lowest barometer was 29.469 on the 21st, ing a range of 0.814 inches. Maximum relative midity was 98 on the 24th. Minimum relative midity was 39 on the 11th.
ain fell on 14 days.

ABSTRACT FOR THE MONTH OF AUGUST, 1891.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				* BAROMETER.				† Mean pressure of vapour	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	§ Max.	§ Min.	Range.				General direction.	Mean velocity in miles per hour	Mean.	Max.	Min.					
1	60.06	73.7	54.6	19.1	29.6653	29.760	29.568	.192	.3988	76.3	52.3	S.W.	18.6	6.7	10	0	33	0.03	....	0.03	1
SUNDAY.........2	.....	74.3	51.4	22.9	....	......	......	....	.....	....	.	W.	16.8	....	..	..	94	....	....	....	2 ....SUNDAY
3	67.05	80.8	57.5	23.3	29.9760	30.045	29.907	.138	.3808	58.6	51.5	W.	8.4	3.0	8	0	96	....	....	....	3
4	66.50	82.5	55.5	27.0	30.1012	30.123	30.078	.045	.4368	69.3	55.0	S.E.	6.7	4.5	9	0	74	....	....	....	4
5	68.42	83.8	57.7	26.1	30.1095	30.155	30.074	.081	.4837	71.8	57.8	S.	5.3	1.0	3	0	83	...	....	....	5
6	72 48	82.7	57.2	25.5	30.0673	30.125	30.016	.109	.5155	65.2	59.7	S.W.	7.0	2.5	6	0	91	....	....	....	6
7	69 75	77.8	64.3	13.5	29.9500	29.993	29.904	.089	.5305	72.8	60.3	S.W.	16.3	6.5	10	0	58	.....	....	..	7
8	67.95	78.0	59.3	18 7	29.9692	30.016	29.941	.075	.4310	64.2	54.8	N.	7.3	1.8	8	0	94	....	....	....	8
SUNDAY 9	.....	78.1	58.5	19.6	....	......	. ....	....	.....	....	....	S.E.	9.5	.	..	.	17	....	....	....	9 ... . SUNDAY
10	75.95	84.1	68.2	15.9	29 8652	29.931	29.775	.156	.5640	63.7	62 2	S.W.	17.8	0.8	4	0	95	0.02	....	0.02	10
11	75 88	90.2	60 7	29 5	29.8473	29.957	29.750	.207	.5773	66.7	62.8	S.W.	14 1	3.3	10	0	77	0.11	....	0.11	11
12	70.62	77.2	64.2	13.0	29.8105	29.898	29.748	.150	.5697	78.5	63.3	S.W.	13.7	8.3	10	1	19	0.04	....	0.04	12
13	65.50	74.8	57.4	17.4	29.9852	30 018	29.946	.072	.3967	64.8	52 3	N.	6.8	3.8	10	0	90	0.04	..	0.04	13
14	65.27	73.8	56.4	17.4	30 0175	30.046	30.001	.045	.4667	76.2	57.2	S.W.	5.2	7.0	10	2	78	0.13	....	0.13	14
15	65 00	70.0	59.9	10.1	29.9853	30.020	29.956	.064	.5110	83.3	59.7	E.	5.5	6.7	10	0	13	0.04	....	0.04	15
SUNDAY. 16	.....	76.5	59.0	17.5	.. ....	......	......	....	.....	....	....	S.W.	3.0	....	..	..	42	....	....	....	16 ....SUNDAY
17	69.93	78.8	60.8	18.0	29.9773	30.053	29 910	.043	.4720	65.3	57.5	S.W.	10 0	2.5	5	0	97	....	....	....	17
18	66.22	74 5	62.1	12.4	29.8665	29.944	29.814	.130	.5082	78.7	58.7	S.W.	8.7	7.3	10	0	40	1.03	....	1.03	18
19	60.23	67.4	53.6	13 8	30.0277	30 079	30.005	.074	.3313	64.5	47.7	N.E.	11.1	2.5	10	0	98	....	....	....	19
20	68.17	81.6	50 6	31.0	29 8125	29.980	29.649	.331	.4975	72 7	58.5	S.	11.7	1.3	3	0	92	....	....	....	20
21	69.62	72.4	68.3	4.1	29.5330	29.615	29.469	.146	.6302	86.8	65.3	S.	13.8	10.0	10	10	00	1.20	....	1 20	21
22	70.58	78.0	61.0	17.0	29.7530	29.073	29.644	.229	5023	66.7	58.5	S.W.	11.2	4.2	10	0	75	....	....	....	22
SUNDAY.........23	.....	71.9	58.2	13.7	. ....	......	......	...	.....	....	....	N.	18.3	....	..		02	0 04	....	0.04	23 .... SUNDAY
24	59.52	64.0	56.7	7.3	29.8945	29.935	29.845	.090	.4840	95.0	58.ⁿ	N.E.	14.5	10.0	10	10	01	0 74	....	0.74	24
25	65.45	71.5	58.5	13.0	30.0820	30.224	29.915	.309	.4192	66.2	53.5	S.W.	19.9	4.3	10	0	81	0 26	....	0.26	25
26	64.32	73.8	53.2	20.6	30.2010	30.283	30.141	.142	4177	69.8	53.8	S.W.	6.6	5.5	9	0	82	....	...	....	26
27	65 03	73.4	58.0	15.4	30.0112	30.118	29.902	.216	.5488	89.0	61.3	S.E.	3.8	7.0	10	0	21	0.02	....	0.02	27
28	65.62	74.2	58.3	15.9	29.7782	29.825	29.737	.088	.4817	75 7	57.0	S.W.	17.1	9.8	10	9	27	....	....	....	28
29	57.55	65.3	50.6	14.7	30.0232	30.158	29.879	.279	.3317	70.7	47.7	S.W.	17.0	6.7	10	0	59	....	....	.. .	29
SUNDAY....... 30	.....	69.5	50 6	18.9	....	......	......	....	.....	....	....	E.	5.9	....	..	..	60	....	....	....	30 ....SUNDAY
31	60 23	63.7	57.8	5.9	30.1878	30.208	30.172	.036	.4427	85.2	55.5	E.	4.5	10.0	10	10	22	0.00	....	0.00	31
....Means	66.65	75.4	58.3	17.4	29.9422	......	......	.136	.4750	73.0	57 0	S. 44½° W.	10.8	5.3	..	..	¶58.4	3.70	....	3.70	Sums ....
17 yrs. means for & including this mo.	66.94	75.2	58.8	16.4	29.9410	.....	......	.133	.4809	72.4	....	... .	....	5 3	..	.	59.9	3.19	....	3.19	17 yrs. means for and including this month

ANALYSIS OF WIND RECORD.

Direction......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
Miles........	761	868	305	381	1176	3448	905	223
Duration in hrs..	79	68	60	56	110	255	78	21
Mean velocity....	9.6	12.8	5.1	6.8	10.7	13.5	11.6	10.6

Greatest mileage in one hour was 32 on the 28th. Greatest velocity in gusts 36 miles er hour on the 25th.

Resultant mileage, 3401. Resultant direction, S. 44° 30′ W. Total mileage, 8067.

* Barometer readings reduced to sea-level and temperature of 32° Far.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 10 years only.

The greatest heat was 90.2 on the 11th; the greatest cold was 50.6 on the 20th, 29th and 30th, giving a range of temp. of 39.6 degrees. Warmest day was the 10th. Coldest day was the 29th. Highest barometer reading was 30.283 on the 26th; lowest barometer was 29.469 on the 21st, giving a range of 0.814 inches. Maximum relative humidity was 98 on the 24th. Minimum relative humidity was 39 on the 11th.

Rain fell on 14 days.

;MBER, 1891.

level, 187 feet. C. H. McLEOD, *Superintendent.*

n ty es ur	Sky Clouded In Tenths. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	7.0	10	0	19	0.18	....	0.18	1
	3.7	10	0	64	....	....	....	2
	2.3	9	0	83	....	....	....	3
	7.0	10	0	37	0.21	....	0.21	4
	8.8	10	5	16	0.22	....	0.22	5
	....	..	..	32	0.09	....	0.09	6 ....SUNDAY
	8.0	10	3	61	....	....	....	7
	4.7	10	0	79	....	....	....	8
	7.0	10	3	53	Inap.	....	Inap.	9
	2.0	8	0	84	0.01	....	0.01	10
	5.8	10	0	75	....	....	....	11
	0.7	2	0	86	....	....	....	12
	....	..	..	32	0.01	....	0.01	13 ....SUNDAY
	8.3	10	0	08	....	....	....	14
	5.0	10	0	64	Inap.	....	Inap.	15
	3.7	10	0	89	Inap.	....	Inap.	16
	6.3	10	2	41	Inap.	....	Inap.	17
	6.3	10	0	52	0.11	....	0.11	18
	0.2	1	0	97	....	....	....	19
	....	..	..	94	....	....	....	20 ....SUNDAY
	7.8	10	4	54	Inap.	....	Inap.	21
	5.0	10	0	45	....	....	....	22
	5.7	10	0	56	....	....	....	23
	0.7	2	0	83	....	....	....	24
	0.5	2	0	89	Inap.	....	Inap.	25
	8.0	10	0	94	....	...	....	26
	....	..	..	85	....	....	....	27 .... .SUNDAY
	1.7	10	0	76	....	....	....	28
	3.3	10	0	37	0.20	....	0.20	29
	1.2	4	0	96	....	....	.. .	30
	....	..	..	. ..	....	....	....	31
	4.4	8.4	0.7	62.7	1.03	....	1.03	Sums ....
	6.4	..	.	¶54.94	3.21	....	3.21	Years means for and including this month.

to sea-level and

f mercury.
being 100.

the 25th ; the
, giving a range
est day was the
Highest barom-
30th ; lowest

barometer was 29.732 on the 29th, giving a range of 0.741 inches. Maximum relative humidity was on the . Minimum relative humidity was on the

Rain fell on 14 days.
Snow fell on days.
Rain or Snow fell on 14 days.
Auroras were observed on 3 nights.
Hour frost on days.
Lunar hals on 2 nights.
Lunar corona on the
Fog on 5 days.

ABSTRACT FOR THE MONTH SEPTEMBER, 1891.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER.				* BAROMETER.				† Mean pressure of vapour	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	§ Max.	§ Min.	Range.				General direction.	Mean velocity in miles perhour	Mean.	Max.	Min.					
1	61.82	69.7	56.9	12.8	30.1098	30.180	30.056	.124	.4730	85.8	57.5	E.	3.1	7.0	10	0	19	0.18	....	0.18	1
2	62.43	72.7	54.0	18.7	30.0643	30.110	30.023	.087	.4670	83.8	57.2	W.	7.7	3.7	10	0	64	....	....	....	2
3	69.25	79.1	59.2	19.9	29.9922	30.053	29.932	.121	.5068	72.0	59.5	S.E.	14.0	2.3	9	0	83	....	....	....	3
4	63.35	70.5	52.7	17.8	30.0920	30.287	29.932	.355	.4730	80.2	56.5	W.	13.9	7.0	10	0	37	0.21	....	0.21	4
5	55.77	62.1	47.4	14.7	30.2502	30.338	30.142	.196	3613	80.8	49.7	N.	9.7	8.8	10	5	16	0.22	....	0.22	5
SUNDAY........6	.....	74.3	57.6	16.7	....	......	......	....	.....	....	....	S.E.	14.2	....	..	..	32	0.09	....	0.09	6 ....SUNDAY
7	60.82	68.5	56.8	11.7	29.8877	29.955	29.819	.136	.4147	78.3	53.8	W.	10.9	8.0	10	3	61	....	....	....	7
8	55.48	62.0	51.6	10.4	30.0803	30.159	29.999	.160	.2987	69.3	44.8	N.W.	9.6	4.7	10	0	79	...	....	....	8
9	58.10	67.2	48.1	19.1	30.1565	30.206	30.092	.114	.3415	70.8	48.2	W.	12.5	7.0	10	3	53	Inap.	....	Inap.	9
10	63.07	71.5	56.5	15.0	30.2840	30.306	30.253	.053	.4023	69.8	54.2	W.	16.6	2.0	8	0	84	0.01	....	0.01	10
11	64.13	73.1	57.2	15.9	30.2623	30.319	30.212	.107	.4312	73.2	54.7	S.W.	14.2	5.8	10	0	75	....	....	....	11
12	64.83	75.6	55.0	20.6	30.0868	30.207	29.952	.255	.4263	70.7	54.7	S.E.	10.0	0.7	2	0	86	....	....	....	12
SUNDAY 13	.....	71.5	59.1	12.4	....	......	.....	....	.....	....	....	W.	12.8	....	..	..	32	0.01	....	0.01	13 ....SUNDAY
14	55.53	61.6	46.7	14.9	29.8913	29.988	29.796	.192	.3297	73.7	47.3	W.	11.2	8.3	10	0	08	....	....	....	14
15	51.40	58.9	43.1	15.8	29.9838	30.033	29.921	.112	.2708	71.7	42.5	N.W.	3.6	5.0	10	0	64	Inap.	....	Inap.	15
16	55.78	65.4	46.0	19.4	30.1548	30.235	30.037	.198	.3198	72.2	46.7	W.	8.6	3.7	10	0	89	Inap.	....	Inap.	16
17	61.40	71.7	51.4	20.3	30.1708	30.285	30.042	.243	.4262	78.8	54.2	S.	6.1	6.3	10	2	41	Inap.	....	Inap.	17
18	69.23	82.0	62.7	19.3	29.8807	29.989	29 765	.224	.5588	77.5	61.8	S.W.	24.6	6.3	10	0	52	0.11	....	0.11	18
19	59.80	66.8	51.4	15.4	30.1842	30.216	30.097	.119	.3273	64.0	47.2	N.	9.8	0.2	1	0	97	....	....	....	19
SUNDAY........20	.....	70.5	48.4	22.1	.. ....	......	......	....	.....	....	....	S.W.	9.3	....	..	..	94	....	....	....	20 ....SUNDAY
21	63.35	74.8	54.0	20.8	30.0687	30.168	30.017	.151	.4550	78.0	56.2	S.	10.3	7.8	10	4	54	Inap.	....	Inap.	21
22	60.42	68.4	51.1	17.3	30.1190	30.207	30.048	.159	.4712	88.8	57.0	N.E.	9.1	5.0	10	0	45	....	....	....	22
23	68.32	74.8	64.2	10.6	30.0497	30.084	29.964	.120	.5693	82.5	62.5	N.E.	5.8	5.7	10	0	56	....	....	....	23
24	70.73	80.7	58.4	22.3	30.0403	30.096	29.994	.102	.5803	78.5	63.2	N.W.	16.2	0.7	2	0	83	....	....	....	24
25	74.65	83.5	68.1	15.4	29.9173	29.999	29.815	.174	.5853	69.0	63.3	S.W.	29.0	0.5	2	0	89	Inap.	....	Inap.	25
26	64.12	71.3	59.2	12.1	30.1653	30.196	30.095	.101	4107	69.5	53.3	N.	6.4	2.0	10	0	94	....	...	....	26
SUNDAY........27	.....	74.6	52.0	22.6	....	......	......	....	.....	....	....	S.	4.3	....	..	..	85	....	....	....	27 .... .SUNDAY
28	70.33	81.1	60.9	20.2	30.0845	30.166	29.998	.168	.5803	79.0	63.0	S.	8.5	1.7	10	0	76	....	....	....	28
29	64.58	75.1	53.5	21.6	29.8937	30.065	29.732	.333	.4302	67.8	53.3	S.W.	23.5	3.3	10	0	37	0.20	....	0.20	29
30	50.83	58.7	42.5	16.2	30.3907	30.473	30.237	.236	.2308	62.2	38.2	N.W.	12.9	1.2	4	0	96	....	....	.. .	30
31	.....	....	......	....	....	......	......	....	.....	....	....	....	....	....	..	..	. ..	....	....	....	31
....Means	62.29	71.26	54.14	17.12	30.0870	.....	......	.167	.4285	74.9	53.9	W. 19° S.	11.6	4.4	8.4	0.7	62.7	1.03	....	1.03	Sums ....
Years means for & including this mo.	58.73	66.74	50.97	15.78	30.0155	.....	......	.178	.3836	75.1	....	....	....	6.4	..	.	¶54.94	3.21	....	3.21	Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles	663	329	39	837	819	2036	2793	853	
Duration in hrs ..	65	32	14	70	87	128	217	90	17
Mean velocity....	10.2	10.3	2.8	12.0	9.4	15.9	12.9	9.5	

Greatest mileage in one hour was on the th. Greatest velocity in gusts miles er hour on the th.

Resultant mileage, 4175. Resultant direction, W. 19° S. Total mileage, 8369.

* Barometer readings reduced to sea-level and temperature of 32° Far.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 10 years only.

The greatest heat was 83.5 on the 25th; the greatest cold was 42.5 on the 30th, giving a range of temp. of 41.0 degrees. Warmest day was the Coldest day was the Highest barometer reading was 30.473 on the 30th; lowest barometer was 29.732 on the 29th, giving a range of 0.741 inches. Maximum relative humidity was on the . Minimum relative humidity was on the

Rain fell on 14 days.
Snow fell on days.
Rain or Snow fell on 14 days.
Auroras were observed on 3 nights.
Hoar frost on days.
Lunar hals on 2 nights.
Lunar corona on the
Fog on 5 days.