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THE CANADIAN

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THE

CANADIAN RECORD

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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 *Tylodendron*, 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 2½ 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 Carbonifere, Pl. XXV, Fig. 4.

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

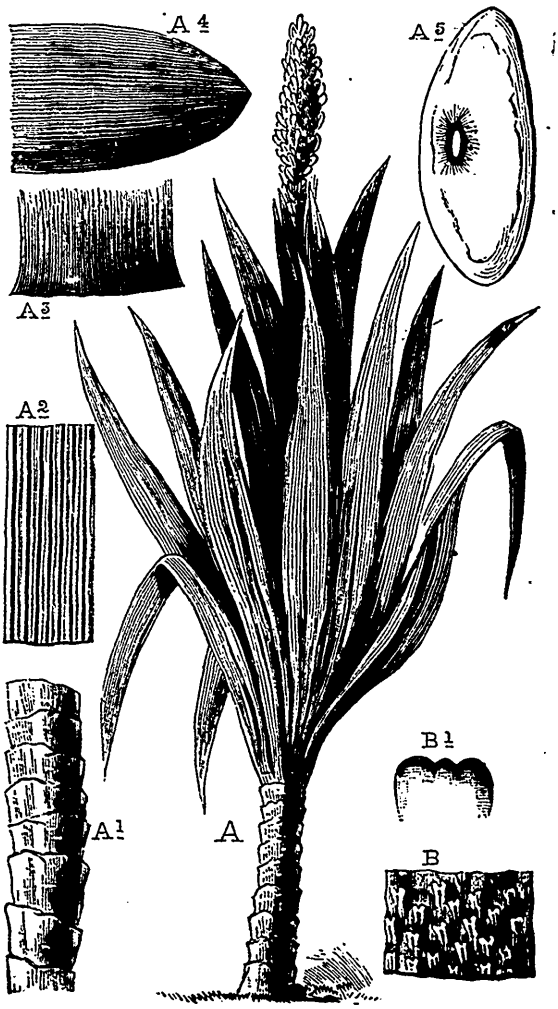

FIG. 2. Restoration of Cordaites borassifolia. (1) Stem, (2) leaf, (3, 4) base and point of leaf, (5) section of stem. B. Markings of Diplotegium, an allied type (from Acadian Geology.)

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 species 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 specimens 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.*)

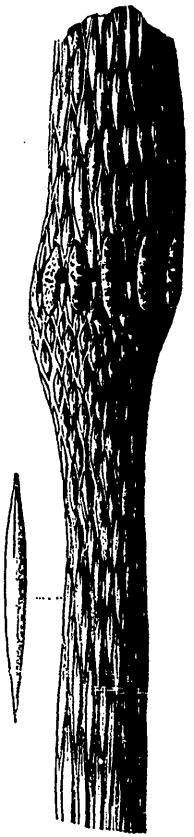

Fig. 3. Portion of stem of Tylodendron (from drawing by Mr. Bain.)

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.

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 dia-

phragms 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

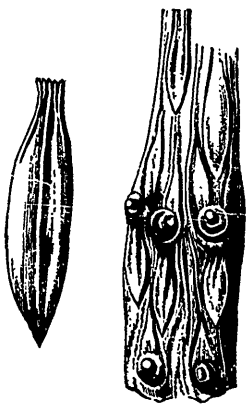

Fig. 4. Leaf-base and outer surface of Tylodendron with fruit scars. (Drawn by Mr. Bain.)

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*,

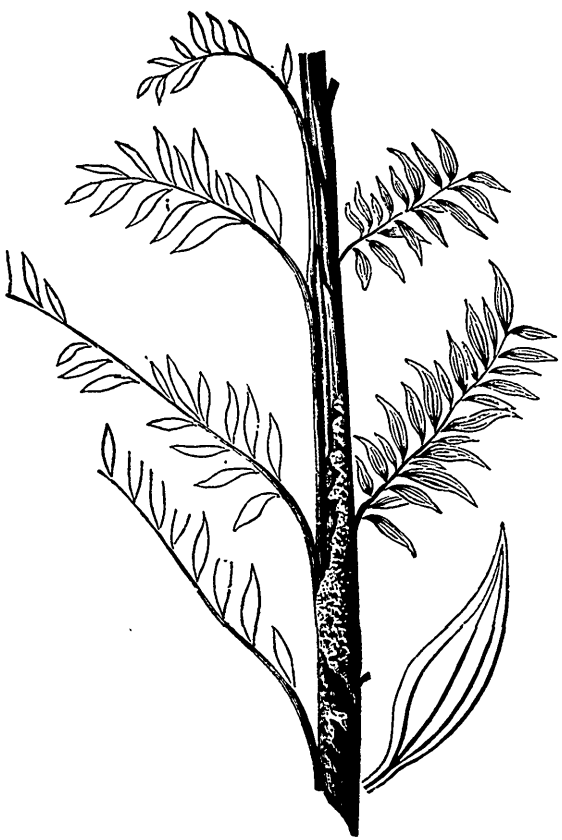

FIG. 5. Leafy branch of Tylodendron and leaf enlarged. (Drawn by Mr. Bain.)

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 *Nœggerathiœ*, 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 water-borne 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 scalariform 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 *Doleropliyllum* 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 sitú* 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 Ander-

son. 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 encamp-

ment, 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.

Aquilegia 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,

Circœa 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 localities.

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 cæsia, 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 vulgare, 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,
Picea alba, Link., } All very abundant in damp situations near streams.

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:

Lycopodiun 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, Messrs. P. S. Ross, E. B. Greenshields, W. Drysdale, Robert Mackay, Samuel 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 be-

fore. 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, ca..eful 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.

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.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDE IN TENTHS. Mean.	Max.	Min.	Per cent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	56.93	61.1	53.0	8.1	29.4642	29.543	29 393	.150	4293	92.3	54.7	S.W.	15 5	8.5	10	4	00	0 42	....	0.42	1	
2	46.03	54.4	35	18.9	29.7908	30.042	29 479	.563	.2482	76.8	39.0	W.	21.2	8.2	10	0	00	0 07	....	0 07	2	
3	38.82	42.4	32.0	10.4	29.9888	30.068	29.868	.200	.2132	90.0	35 8	S.	7.5	8.3	10	0	01	0.39	....	0.39	3	
4	40.37	42.8	37.7	5.1	30.0917	30.242	29 846	.396	.2322	92.5	38.3	N. W.	8.2	10 0	10	10	00	0.24	...	0.24	4	
5	38.93	41.9	36.5	5.4	30 1415	30.220	30 084	.136	.1888	79.7	33 0	N.	9.4	10.0	10	10	00	....	.	....	5	
SUNDAY..... 6	. ...	45.1	37.5	7 6	.....	.....	.....	....	.....	....	....	N.E.	13.7	....	..	..	00	0.79	...	0 79	6	.....SUNDAY
7	39.95	42.7	38.5	4.2	29 8868	30.017	29.796	.221	.2315	93 7	38.2	N. W.	15.7	10.0	10	10	00	0.33	....	0 33	7	
8	37.38	40.0	35.5	4.5	29.8135	29.840	29.788	.052	.1908	85.3	33.2	S.W.	20.3	10 0	10	10	00	0.08	...	0 08	8	
9	44.77	53.2	35.9	17.3	29.7352	29.766	29.696	.070	.2115	71.7	35.7	S.W.	19.3	6.8	10	0	80	0.04	....	0.04	9	
10	40.45	45.0	35.1	9.9	29.8578	29.918	29.768	.150	.1728	69.0	31.0	W.	11.4	6.7	10	0	44	....	..		10	
11	41.63	47.7	36.4	11.3	29.9467	29 994	29.909	.085	.1790	67.8	31 7	W.	8.1	8.0	10	0	79	...	....	....	11	
12	39.47	45.0	35.6	9.4	30.0965	30.174	30.036	.138	1630	67.3	29.7	N.W.	7.3	3.5	10	0	54	....	....	....	12	
SUNDAY. 13	.....	48.1	32.2	15.9	.....	.....	.....	....	.....	...	....	N.E.	19.9	...	..	.	95	.	....	....	13	.....SUNDAY
14	42.30	49.9	33.7	16.2	30.2042	30.285	30.135	.150	.1915	71.5	33 3	N.E.	15.9	0.0	0	0	97	..	....	...	14	
15	44.32	52.8	36.7	16.1	30.1727	30.231	30 119	.112	.1787	61.2	31.5	N.	14.0	0.0	0	0	98	...	....	..	15	
16	43.95	51.4	36.2	15.2	30.1922	30.265	30.116	.149	.1678	59.3	30.2	....	8.4	0.5	2	0	97	....	....	....	16	
17	48.13	55.6	39.6	16.0	29.9413	30 063	29.857	.206	.2328	68.7	37.8	S.W.	16 4	5.5	10	0	12	....	....	....	17	
18	43.20	48.2	38.6	9.6	29.9857	30.044	29.888	.156	.1782	71.7	31.3	W.	12.4	7.3	10	3	23	Inapp.		0.00	18	
19	43.50	49.3	37.7	11.6	29.9905	30.125	29.739	.386	.1942	69.3	33.7	S.E.	9.7	6.8	10	0	25	...	....	.....	19	
SUNDAY.....20	.....	53.9	31.8	22.1	.....	.....	...	... .	... .	...	...	W.	16.3	....	.	.	77	....	....	....	20	.....SUNDAY
21	33.47	40.9	27.6	13.3	30.2495	30.306	30.103	.203	.1215	65.0	22.5	N.E.	4.3	3.8	10	0	70	...	.	....	21	
22	34.40	41.5	28.5	13.0	30.3545	30.463	30.309	.154	.1262	63.2	22.8	S.W.	10.6	6 7	10	0	17	...	....	....	22	
23	27.70	33.2	21.8	11.4	30.5400	30.605	30.480	.125	.0988	65.3	17.8	N.W.	9.6	0.0	0	0	98	...	....	....	23	
24	33.28	42.9	22.8	20.1	30.2975	30 436	30.135	.301	.1053	57.5	19.3	S.E.	8.7	0.5	1	0	92	....	. .	....	24	
25	39.02	46.3	30.7	15.6	29 9863	30.075	29.929	.146	.1428	60.7	26.2	S.E.	15.0	8.2	10	0	12	....	. .	....	25	
26	41.13	46.3	35.5	10.8	30.0037	30.045	29.946	.099	.1678	64.8	30 0	N.E.	4.2	10 0	10	10	00	....	. .	....	26	
SUNDAY.. 27	.....	43.8	38.1	5.7	.....	.....	.....	....	.....	...	..	N.E.	16.3	....	.	..	00	0.47	..	0.47	27	....SUNDAY
28	38.13	42.1	33.2	8.9	29.8497	29.990	29.744	.246	.2152	93 3	36.3	N.E.	43.1	10.0	10	10	00	0.47	0.8	0.55	28	
29	35.73	38.3	32 9	5.4	30.1187	30.177	30.017	.160	.1770	84 3	31.5	N.E.	31.1	9.5	10	7	00	0.04	....	0.04	29	
30	35.12	41.1	30.6	10.5	30.1915	30.228	30.171	.057	.1602	78.8	28.8	N.W.	8 3	3 5	10	0	45	....		....	30	
31	35.85	41.1	29.7	11.4	30.1452	30.193	30.093	.100	.1785	84.8	31 5	E.	4.6	8.0	10	0	20	....	....	...	31	
....Means.	40.15	46.06	34.42	11.64	30.0384	.....	.....	.182	.1888	74.3	32 0	....	13.75	6.31	.		36.6	3.34	0.8	3 42	Sums	
¶5 yrs. means for & including this mo.	45.00	52.02	38.24	13.77	30.0091	.....	.....	.212	.2399	76.0	....	.....	....	6 45			¶41.2	3.42	1 7	3.59	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.....	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 56 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 28 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.

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.				*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	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	2.5	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, 12,025.
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.

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.				*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.					
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	−2.5	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	1·3	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	10	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	9	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.

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.					* Barometer.				Mean pressure of vapour. †	Mean relative humidity. ‡	Mean dew point.	Wind.		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.
	Mean.	¶ Deviation from 15 year means.	Max.	Min.	Mean daily range.	Mean.	Max.	Min.	Mean daily range.				Resultant direction.	Mean velocity in miles per hour										
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	61.5	43.6	0.30	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	.196	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	29.483	.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	29.3 5	.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 April 15th. 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 47,960, Auroras were observed on 16 nights. Fogs on 42 days. Hoar-frost on 80 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.