THE CANADIAN RECORD OF SCIENCE

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RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF

THE NATURAL HISTORY SOCIETY OF MONTREAL

AND REPLACING

THE CANADIAN NATURALIST.

(VOL. IX. 1903-1916.)

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PUBLISHED BY THE NATURAL HISTORY SOCIETY.

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ON THE PETROGRAPHICAL RELATIONS OF THE LAURENTIAN LIMESTONES AND THE GRANITE IN THE TOWNSHIP OF GLAMORGAN, HALIBURTON COUNTY, ONTARIO.

By LOUIS CARYL GRATON, B.S.

CONTENTS.

GENERAL STATEMENT.

The region with which this paper deals lies in Central Ontario, near the southern margin of the great Northern Protaxis of the continent. It is situated in the south-western corner of sheet 118 of the Ontario series of maps being prepared by the Geological Survey of Canada, and comprises the western portion of the townships of Monmouth and Dudley, and nearly the whole of Glamorgan and Dysart; it thus occupies the centre of the southern half of Haliburton county, and is about 75 miles north of Lake Ontario.[1]

So much has recently been written concerning the Laurentian System in Canada, among others by Dr. Frank D. Adams,[2] Professor of Geology in McGill University, that only a brief summary need be given here.

The present view is that the Laurentian consists of an underlying series of gneisses and granites called the Fundamental Gneiss, much of which may be, and probably is, of igneous origin; and an overlying series, composed largely of gneisses of undoubtedly sedimentary origin, often differing in petrographical character from those underneath, associated with crystalline limestones and quartzites, and known as the Grenville series.

The geology of this general portion of the Archæan nucleus has been variously described,[3] but the particular area here being considered, as well as all that now included in sheet 118, had received extremely little attention, and in 1894 it was said to be, from a geological point of view, almost a *terra incognita*.[4] Since that time,

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1. I am indebted to Dr. Adams for all the facts concerning the geology of this area which are set forth in the present paper, also for the specimens which are here described and for advice and assistance in carrying out the work. The accompanying sketch map is reduced from his large scale field maps.

A detailed description of the whole district by Dr. Adams and Dr. Barlow will appear shortly in the form of a Report to the Director of the Geological Survey of Canada.

2. "On the Typical Laurentian Area of Canada," Jour. Geol., 1893, Vol. I., No. 4.

"Ueber das Norian oder Ober-Laurentian von Canada," Neues Jahrbuch für Mineralogie, etc., 1893, Beilage Band VIII.

"A Further Contribution to our Knowledge of the Laurentian," Am. Jour. sci., 1895., Vol. XLIX.

"The Geology of a Portion of the Laurentian Area," Geol. Surv. Can., Ann. Rep't., 1896, Vol. VIII., Part J.

3. Murray, A., Geol. Surv. Can., Rep't. of Progress, 1852-53.

MacFarlane, T., ibid., 1863-66.

Vennor, H. G., ibid., 1866-1869.

Vennor, H. G. ibid., 1870-77.

4. Adams, F. D., Geol. Surv. Can., Ann. Rep't., 1891-92-93, Vol. VI., Part J., p. 3.

a detailed geological examination of the area comprising sheet 118 has been begun and completed by Dr. Adams and Dr. A. E. Barlow.

The geology of that particular portion whose limits were given at the outset, and to which alone the following remarks refer, may be described as follows: The country is a hilly one, presenting the remarkable undulating or *roche moutonnée* surface so characteristic of the Laurentian; the depressions are usually filled with drift, and in the flats so formed are found innumerable lakes. Countless rounded bosses of bare rock protrude through the drift especially in those portions of the area occupied by several batholitic masses of granite or granitic gneiss, identical in appearance with the Fundamental Gneiss, which have penetrated and eaten into the white crystalline limestones which underlie the remaining portions of the area.

Dr. Adams has found in his recent studies in this area, the results of which will be published shortly, that in many localities at least, the Laurentian limestones, which are always much altered, were, at the contact of the Fundamental Gneiss, transformed into dark, basic rocks which still retained the banded structure of the limestone. He also ascertained that the Fundamental Gneiss contained many inclusions of dark, basic rocks, which near the contact were more angular in form, and away from the contact often assumed the form of dark elongated streaks in the Fundamental Gneiss. The field relations were such that it seemed practically certain that these fragments were portions of the basic contact rock, in a still more highly altered condition, which had floated away in the igneous mass during the process of intrusion.

It would appear then, either that new igneous material had been erupted through this limestone series, or that the underlying Fundamental Gneiss had been reheated sufficiently to fuse or to become plastic, and that the limestones had been invaded by it or had sunken down into it while in this plastic condition. Which one of these suppositions represents what has actually taken place is a difficult matter to determine. It might be that both are true in degree. Be that as it may, the action on the limestones would be practically the same, and certain it is that the great part of the intrusion is identical in character with truly intrusive igneous rock. There is still another possible explanation of the cause of these phenomena but it can only be referred to farther on.

Two specific problems now present themselves: the origin of the basic contact rocks, and the true character of the seeming inclusions. Specimens of the various rocks were collected by Dr. Adams, and some of them have been handed to the writer for investigation, in order that their mineralogical composition and character might be determined, and a comparison instituted between the several basic varieties themselves, and the limestones of which they are apparently the altered representatives.

Although the problems are distinct, several facts are encountered which render their exact and definite solution difficult. The rocks are not infrequently concealed by a mantle of drift, which is often thick; the contact itself is by no means sharp, but is instead, a brecciated zone of granite and of the invaded rocks in varying stages of alteration, and its demarcation and study would be a serious matter even if it were everywhere exposed; and fully as important as the two preceding facts, is the one that, due to the frequent similarity in appearance of rocks quite different in composition, and to the complexity of the relations generally, it is often almost impossible to realize fully, while in the field, the importance and significance of such facts as are observed—this can only be done later, when thin sections of the specimens can be examined.

The limestones are the same white or pinkish crystalline limestones or marbles everywhere characteristic of the Grenville Series, which have been described at length by Dr. T. Sterry Hunt [1] and various other writers. The source of the metamorphism which has produced this recrystallization — whether due to the heat from the igneous intrusions, to the dynamic action which has undoubtedly taken place, possibly accompanying these intrusions, or to other causes altogether different—is a subject which does not closely concern the present arguments. Away from the intrusions before described, the limestones are comparatively pure, though they sometimes contain bands of very dark hornblendic rocks or amphibolites, but approaching the igneous rocks, they are found to contain little rounded grains of pyroxene and other lime-rich minerals, and in many cases to pass into banded, basic rocks which warrant the field name of pyroxene gneiss. These become darker in color yet nearer the granite, and are still found to contain intercalated with them and with layers of limestone, bands of amphibolites, which have a harder or more granitic look than the pyroxene gneisses, but are otherwise quite similar in appearance. They are somewhat more sharply defined from the marbles than are the pyroxene gneisses, the transition from one to the other being often quite abrupt. The whole series is cut by dykes, veins, or stringers of the granite which anastomose through it in a remarkable way, and the resulting appearance is most complicated. Nearer still to the invading mass these bands become more and more broken and indefinite, the number and size of the granite dykes increase; and at last comes the state of affairs where the dark rocks occur as inclusions in the granite. In the south-western portion of the large central batholite shown in the accompanying map, these inclusions are very numerous indeed. They vary in size from a few

1. "Geology and Mineralogy of the Laurentian Limestones," Geol. Surv. Can., Rep't. of Progress, 1863-66, p. 181, *et seq.*

square inches to hundreds of yards, and have an appearance very similar to the rocks of the bands at the border, looking, however, still a little harder. Farther and farther away from the contact they lose much of their angular form and appear simply as dark, elongated streaks in the granite, which seems to be dissolving or absorbing them.

The granite of these intrusions, in its typical development, is red or pinkish, and somewhat foliated. Occurring all through it, however, are patches of a rock distinguished by a prevailing gray color. It cannot be stated with certainty that these gray gneisses are especially developed in the neighbourhood of the inclusions nor about the contact, though they certainly occur in those places as frequently as elsewhere.

That this contact is one of intrusion seems certain.[1] There is also evidence to show that practically all the rocks of this series have been subjected to pressure, motion, and deformation. The absence of any distinctly cataclastic structure in the rocks about the contact indicates that such deformation has not taken place to any extent since the rocks have recrystallized; but the prevalent foliation, the presence of muscovite and microcline, as well as of numerous cracks and strain shadows in the various minerals, and the absence of any fine-grained zone in the igneous rock near the contact, all point to the conclusion that the intrusion took place deep in the earth's crust when movements were in progress, and when, in consequence, the limestones were at a high temperature.

In the case of more brittle rocks, even under the conditions just mentioned, this invasion and movement would doubtless have caused a shattering and fracturing, which would now be evidenced by numerous faults and by a more or less cataclastic structure in the rocks about the contact of the intrusion. But these limestones, softened,

1. cf. Adams, F. D., and Barlow, A. E., "On the Origin and Relations of the Grenville and Hastings series in the Canadian Laurentian," Am. Jour. Sci., 1897, Vol. III p. 176.

doubtless, by the heat from the mass below, and under the burden of the rocks above,[1] have, instead, *flowed*, so that they accommodated themselves to the rather irregular form of the invading mass, and now, everywhere, their strike is seen to be the result of this intrusion and parallel to its boundary.

This subject of the flow of marble and limestone has been most carefully and convincingly dealt with experimentally by Dr. Adams. [2] Some of the structures so produced artificially in Carara marble have been compared by him with structures exhibited by the limestones of this very district and found to be identical.[3]

It is not alone to the limestones, however, that this peculiarity of strike belongs. The foliation of the amphibolites and gneisses forming the contact zone correspond to the strike of the limestone and the form of the intrusion; while even the rocks of this mass itself are foliated and banded, and both foliation and banding are parallel to its boundary. Cases which appear entirely analogous to this, as regards the matter of uniformity of strike and foliation, have been observed in the Rainy Lake region [4] and in the district about the Lake of the Woods,[5] where the so-called Fundamental Gneiss penetrates the Huronian.

In their endeavours to trace back as far as possible the geological history of the earth as recorded by the stratified deposits in its crust, the early workers—possibly deceived by the outward resemblance of these intrusive rocks to undoubted clastic rocks present in later geological formations, which were known to have undergone extensive

1. Heim, A., "Geologie der Hochalpen zwichen Reuss und Rhein," Beitrage zur Geol. Karte der Schweiz, Vol. XXV., Bern, 1891.

2. Adams, F. D., and Nicolson, J. T., "An Experimental Investigation into the Flow of Marble," Phil. Trans. Roy. Soc. London, 1901, Series A, Vol. 195, pp. 363-401. See also Van Hise, C. R., "Metamorphism of Rocks and Rock Flowage," Bull. Geol. Soc. Am., 1898, Vol. IX., pp. 295-313, 318-326.

3. Loc. cit., pp. 389-390.

4. Lawson, A. C., Geol. Surv. Can., Ann. Rep't., 1888, Vol. III., Part F.

5. Ibid., 1885, Vol. I., Part CC.

deformation and alteration—considered that the foliation and banding in them were evidence of original stratification. And with the facilities for investigation then at their command, this is not surprising.

With increased knowledge, resulting from due consideration of the effects produced by great dynamic action, from detailed mapping in the field, and perhaps more than anything else, from the application of the microscope to the study of petrography, and the consequent recognition of the exact composition and structure of many of these rocks, this old idea has been completely superseded. And in recent years, work by Lossen, Lehmann, Daubrée, Nauman, Reusch, Schmidt, Milch, Teal, Heim, G. H. Williams, and others has proved beyond doubt that foliation may be produced in massive plutonic rocks as a result of pressure before the rock has wholly solidified; and Lawson[1] has drawn attention to the fact that "the various foliated crystalline rocks usually classified as Laurentian were largely plutonic rocks which have crystallized slowly, probably under an extremely gradual diminution of temperature, from a thickly viscid, coherent, or tough hydrothermal magma."[2] The foliation was explained as a result of "differential pressure which, by causing a yielding or deformation, induced a flow in the mass."

From these considerations it is evident that much valuable information may be obtained by adding to the results of stratigraphic methods, those of a careful microscopic examination of thin sections of the various rocks; and that has been the aim in the following division.

PETROGRAPHY.

In the pages which follow, certain terms used to describe structure may admit of a somewhat different meaning than the one given to them here; in order to avoid any

1. Opera cit.
2. Barlow, A. E., Geol. Surv. Can., Ann. Rep't., 1897, Vol. X., Part I, p. 51.

ambiguity or uncertainty, they are defined at this point in the exact sense in which they are used here. *Foliation* is a "laminated structure, produced in a rock by the parallel arrangement of certain or all of its constituent minerals"; *banding* is the alternation in the form of bands, of gneisses differing more or less in composition or structure, which gneisses may or may not be foliated as well; *granitic* is the typical structure of granite, characterized by a general lack of crystalline form and a more or less complete interlocking on the part of the mineral grains; *granular* is the structure common to granites which have been somewhat deformed and have in consequence lost much of this interlocking of the grains; *granulitic* structure causes a thin section of a rock possessing it to appear as a mosaic of roughly equidimensional grains, usually of small size—it is typical of recrystallized rocks which have been subjected to movement during the process of solidification, but it may be produced by the deformation and crushing of already solidified granitoid rock-masses.

The rocks of this area, with the exception of the true limestones, present a similarity in one respect, namely, they are all foliated; in general, also, they are banded. Otherwise, however, as has already been mentioned, they present a wide variation in character, ranging in composition and likewise in properties from acid granites to basic amphibolites.

Perhaps one of the most noticeable features in the petrography of the more acid types is the occurrence of plagioclase feldspar, often in great preponderance over the orthoclase; a rock which is to all appearances a granite when examined macroscopically, being possibly of a pink color; and highly quartzose, is found under the microscope to be really a quartz diorite. This phenomenon, known as the "plagioclase phase" of granite, is not of unusual occurrence in this class of rocks.[1]

It has been found a matter of convenience, sustained by the nature of the rocks themselves, to class the rocks of which specimens have been examined into four groups, and these have been named conditionally: (1) Gneissic Granites, (2) Gray Gneisses, (3) Altered Limestones, and (4) Inclusions in the Gneissic Granites. In the following descriptions, however, each rock has been named according to the generally accepted nomenclature depending on mineralogical composition and structure, and thus there are Quartz Diorite gneisses, Scapolite Amphibolites, etc. Since all the specimens are exceptionally typical of the rocks they represent, and as each represents a somewhat different rock, it has been thought advisable to give a rather detailed description of each specimen, in order to bring out more clearly the relations of the several rocks to one another. The order followed has been made to correspond as nearly as possible to the degree of the metamorphism which the rocks have undergone, since it was thought that this would give a better idea of the gradations from one specimen to the next, and as it has the advantage of being briefer than any other arrangement could be.

GNEISSIC GRANITES.

These rocks, which are generally of a reddish color, make up the great bulk of, and characterize the batholitic intrusions. It is they, supposedly, which during the activity of the igneous forces, have metamorphosed the limestones about their contact.

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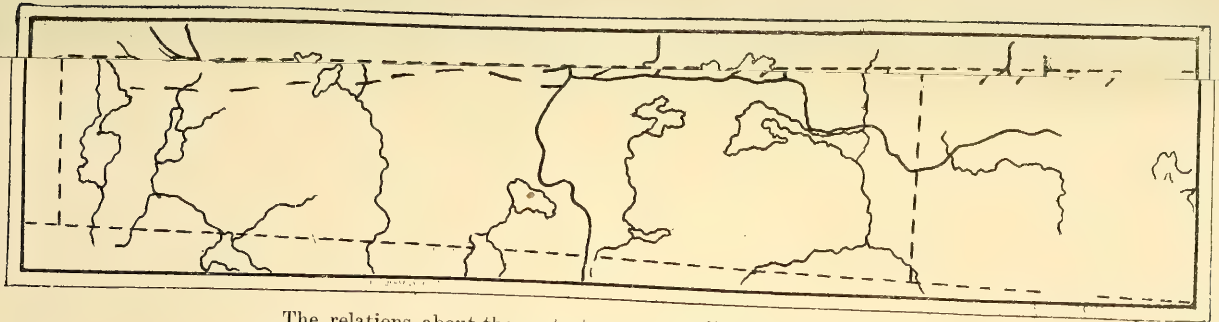
1. McInnes, H., "Geology of Seine River, etc.," Geol. Surv. Can., Ann. Rep't., 1897, Vol. X, Part H, p. 16.

Smyth, C. H., jr., "Crystalline Limestones and Associated Rocks of the North-Western Adirondack Region," Bull. Geol. Soc. Am., 1894, Vol. VI., pp. 266-267.

Kemp, J. F. and Hollick, A., "The Granite at Mount Adam and Eve, Warwick, Orange Co., N. Y., and its Contact Phenomena," Annals N. Y. Acad. Sci., 1894, Vol. VII., p. 641.

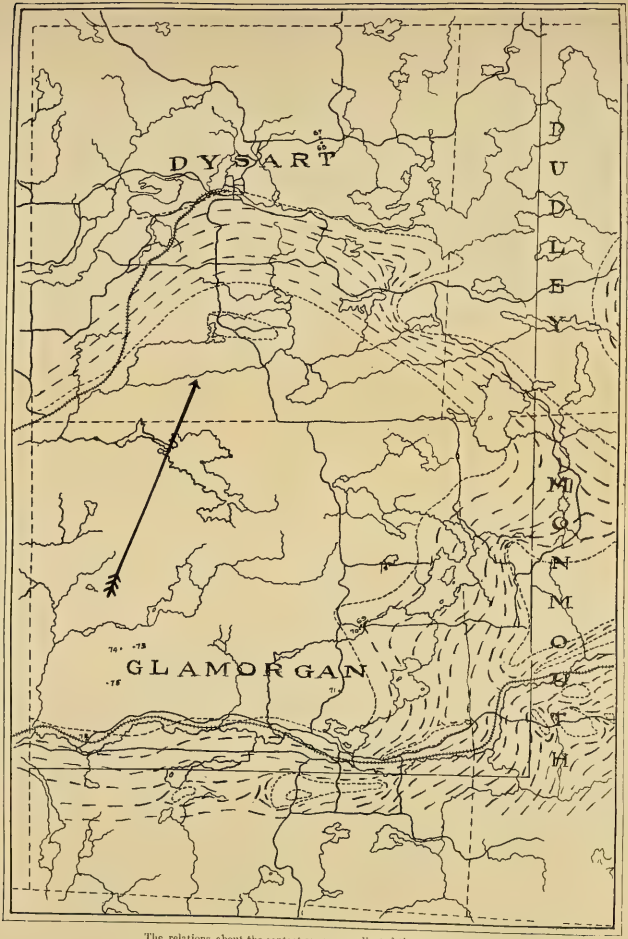


The relations about the contact are so complicated that on a map of this scale only the broad distinction between granite and limestone can be made.

Within the inner rectangle the geology is practically complete, and the only rocks occurring are granite and limestone. White represents granite, and the dashes represent limestone and its strike.

The small figures indicate the points from which specimens were taken ; 67 represents thin section 1267, 70 represents section 1270, etc.

The scale is miles to the inch.



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The scale is miles to the inch.

Foliated Granite, Township of Glamorgan, Range IX., Lot 9. (Section 1273.)

This rock is pinkish and usually fine-grained, with occasional good sized individuals of feldspar. It has a banded structure which is quite distinct, the darker constituents occurring almost entirely in fairly continuous, narrow ribbons, to which, moreover, the arrangement of the grains is parallel; this indicates a foliated structure also. The more acid bands have a greater width—an inch or more—and in them also, the dark constituents, wherever they do occur, are arranged with their long axes parallel to the banding.

Under the microscope it is seen to consist essentially of quartz, plagioclase, microcline, with some orthoclase, and biotite. Muscovite, numerous grains of magnetite, sometimes enclosing pyrite, and a few little crystals of zircon and of apatite also occur.

The quartz is in clear glassy grains, both large and small, and of irregular form. It is often cracked, and in other individuals shows well marked undulose extinction or strain-shadows. The orthoclase, which is somewhat turbid, is recognized by its being twinned according to the Carlsbad law, though this twinning is not always seen. It frequently shows slight strain-shadows, and it is without doubt from a straining of the orthoclase that the microcline has been derived. This seems especially probable, for in this rock both these minerals are pink in color. The microcline is comparatively fresh, and is distinguished by its characteristic cross-hatched appearance in polarized light. The plagioclase is generally in large individuals, and frequently turbid; it is oligoclase Both the orthoclase and the plagioclase occasionally show cleavage. The biotite is not present in large amount. It is in narrow, lath-shaped individuals, brown, with sometimes a greenish tinge, and quite strongly pleochroic; cleavage well shown. The muscovite, which also often shows distinct cleavage, is clear and colorless, and occurs in irregularly shaped masses near the feldspars or the biotite, though it does not appear to have been derived from the latter; occasionally it presents the fibrous or plumose structure of sericite. What points most strongly to its origin is its occurrence in the feldspars in detached particles, which, however, are parts of large individuals, giving simultaneous extinction and hence being similarly oriented. They are really skeleton crystals which have been formed at the expense of the feldspar. Similar phenomena have been noticed in granites from the Pelly River, British Columbia,[1] and in the Stanstead [2] granite in Quebec. Both these granites resemble in other ways the one under consideration; both have been subjected to intense pressure while deep in the earth's crust, and in the latter case, the orthoclase has been converted into microcline just as in this one. The muscovite seems to have been produced by the same forces which caused these other changes, and indicates a first stage of dynamic metamorphism, short of complete recrystallization.[3] The magnetite is frequently altered about the edges to limonite, which has infiltrated along the cleavage-planes of the feldspars. The zircon is in small, well-defined prismatic crystals, terminated by a combination of pyramidal forms which gives an almost rounded appearance. It has a broad, black boundary, denoting high refractive index, and very high double refraction, polarizing in pale blue tints. The apatite is also in well-formed crystals, of hexagonal outline, low index of refraction, and low double refraction, giving bluish gray in polarized light.

The structure of the rock is granular and allotriomorphic.

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1. Adams, F. D., "On Some Granites from British Columbia, etc." Can. Rec. Sci., 1891, Vol. IV., pp. 352-354.
2. Adams, F. D., "Description of a Series of Thin Sections of Typical Rocks," Montreal, 1896, pp. 5-6.
3. cf. Harker, A., "Petrology for Students," Cambridge, Eng., 2nd ed., 1897, p. 309.

GRAY GNEISSES.

These rocks occur in patches throughout the granite mass, and are often found near the basic, highly calcareous contact rocks or inclusions. They more closely resemble the granites, however, and are distinguised from it by their gray color.

Quartz Diorite Gneiss, Township of Dysart, Lot 24, between Ranges IX. and X. (Section 1268).

This is a fine-grained, gray, and very quartzose gneiss, of uneven and interrupted foliation. The acid constituents are nearly white.

When examined microscopically, its essential constituents are seen to be quartz, plagioclase, biotite, and hornblende. Orthoclase, a very few grains of microcline, magnetite, pyrite, apatite, and a few small crystals of zircon embedded in the quartz make up the accessory constituents.

The quartz is very abundant, in grains of varying size, some of which show uneven extinction; the larger grains are much elongated in the plane of the foliation of the rock, in fact, they largely determine the direction of the foliation. Some are clear, but others are clouded with inclusions, which, however, are so minute that little can be determined concerning them, even with a high power. They are doubtless inclusions of some basic material, for considerable of the quartz separated from Thoulet's solution in which an amethyst crystal of specific gravity 2.651 just floated. The plagioclase is present in large amount, as large angular grains, fairly fresh and clear; cleavage can often be seen. It shows beautiful albite twinning, in broad and narrow bands, and is sometimes also twinned according to the Pericline law. It is probably andesine, since it gives an extinction angle of 15° and has a specific gravity of about 2.65. The ferro-magnesian constituents are not nearly so abundant as the more acid ones. The biotite is dark brown, and shows good cleavage. It is strongly pleochroic, and the absorbtion is $\mathfrak{a} > \mathfrak{c}$. Extinction is parallel. The grains are of medium size, and allotriomorphic, showing a tendency to skeleton structure, and thus interlocking with other minerals. Hornblende occurs somewhat more abundantly, in deep, yellowish-green individuals; cleavage excellent. Extinction in the clinopinacoidal sections is inclined, giving a maximum extinction angle of 33°, which indicates a basic composition. The pleochroism is very pronounced, as follows:—

$\mathfrak{a}$ = pale yellow,
$\mathfrak{b}$ = yellowish green,
$\mathfrak{c}$ = deep green.

Or to state it in the "absorption scheme,"

$$\mathfrak{c} > \mathfrak{b} > \mathfrak{a}.$$

A comparatively small number of fairly fresh grains of an untwinned feldspar of low specific gravity, about 2.56, are probably orthoclase. The apatite is in small distorted crystals of hexagonal outline. Magnetite occurs in irregular grains of varying size, alone, and also inclosing grains of pyrite. The former shows a characteristic steel-blue color and metallic lustre in reflected light, and under the same conditions the pyrite looks brass-yellow. The magnetite is sometimes altered at the edge to hematite, which, in reflected light, appears red.

The structure of the rock is granular, inclining, where individuals of the basic constituents adjoin, to a mosaic structure, and pointing to a partial recrystallization.

Quartz Diorite Gneiss, Township of Glamorgan, Corner of Lots 25 and 26, Ranges VII. and VIII. (Section 1271.)

This is a fine grained, rather light reddish gray gneiss, with foliation not very distinct.

Examined microscopically, it is seen to have as essential constituents quartz, plagioclase, microcline, and biotite. A very few grains of an untwinned feldspar, probably orthoclase, a little iron ore, probably hematite, and a few small, well-formed crystals of apatite, usually embedded in the quartz, are accessory constituents.

The quartz is abundant; it is clear and glassy, and often shows distinct strain-shadows. Microcline is present in considerable amount and presents its typical cross-hatching in polarized light, it is quite clear and fresh. The plagioclase also is abundant; it is twinned in broad and narrow bands, and often shows a slight turbidity, probably due to kaolinization, along certain lines which doubtless represent cleavage planes; some, however, is perfectly clear. It is oligoclase, having a specific gravity under 2.64, and an extinction angle of 10°. A considerable amount of biotite is present, in grains of very irregular outline. It is very deep brown, strongly pleochroic, and shows good cleavage, with extinction parallel.

The structure of the rock is typically granular.

Quartz Diorite Gneiss, Township of Glamorgan, Range VIII., southern part of Lot 7. (Section 1275).

This is a fine-grained, gray gneiss, rather distinctly foliated, the foliation being especially well brought out on the weathered surface.

Under the microscope it is found to consist essentially of quartz, orthoclase, plagioclase, biotite, and hornblende; individuals of microcline are not uncommon. As accessory constituents it holds numerous grains of sphene, a grain or two of black iron ore, and a few poorly developed crystals of apatite.

The quartz is in large and small irregular grains, clear, but often showing undulatory extinction. The orthoclase is untwinned, shows cleavage, with which extinction is frequently parallel, and though generally fresh, is sometimes decomposed along the cleavage lines. The plagioclase, which is oligoclase, is abundant. It shows Albite and Pericline twinning, cleavage is often seen, and the extinction is inclined; it tends to be turbid along the cleavages. Biotite occurs in considerable amount, in irregular individuals; it is brown and strongly pleochroic. Hornblende occurs in about equal amount, generally in irregular individuals of medium size, but some show a tendency toward rough crystallographic outline. It is very deep green and intensely pleochroic; the scheme of absorbtion is $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$. In the zone of $\infty P \infty$ and $\infty P \acute{\infty}$, the maximum extinction angle observed was 22°. The sphene is in irregular grains, much cracked. It has a high refractive index, giving a dark border, and a roughened appearance to the surface, and high double refraction, polarizing in colors ranging from brilliant to almost white. Owing to its great dispersion of the axes of elasticity, extinction is never complete. Enclosed in it, or closely associated, are several grains of black iron ore which show a bluish metallic lustre in reflected light, and which are without doubt ilmenite.

The structure is granular, resembling that seen so often in granite gneisses.

ALTERED LIMESTONES.

These constitute the dark basic rocks interbanded with the limestones near the granite contact. In the field they are conveniently divided into two classes depending on the predominance of pyroxene or of hornblende, and are called respectively pyroxene gneisses and amphibolites. Bands of them are very much mixed up, with one another, and with veins or dykes of the granite.

Pyroxenite, Township of Glamorgan, Lot 27 between Ranges IX. and X. (Sections 1269 A.B.C.D.)

This is one of the pyroxene gneisses. It is a very fine-grained, friable rock, of greenish gray color. It is very distinctly banded, being made up of dark colored bands alternating with bands of medium and light color.

When examined microscopically, this banding is also very apparent, as shown by the occurrence and arrangement of certain minerals. It is thus rather difficult to divide the constituents into essentials and accessories. The dark bands are composed almost exclusively of plagioclase, hornblende and augite. The lighter ones are found to be interbanded in themselves, one which appears homogeneous in ordinary light, may be seen, when the second nicol is put in, to consist of bands possibly as follows:—plagioclase, scapolite, and augite; plagioclase, microcline, calcite, and augite; plagioclase, calcite and augite. A few irregular individuals of quartz, numerous fragments of sphene, many small crystalline grains of apatite, a few grains of ilmenite, a little epidote, and a very few irregular individuals of biotite make up the accessory constituents. All the minerals, except the calcite individuals, which are often of good size, are present in small grains.

The quartz, examined in isotropic section in convergent polarized light, shows the stationary cross of a uniaxial mineral; by this means only is it distinguished from much of the plagioclase, for considerable of the latter is clear and untwinned. Some of the plagioclase, however, is twinned, in broad and narrow bands. From the separation, there seems to be both labradorite and oligoclase present. Microcline is recognized by its characteristic twinning, and is also quite clear. A colorless mineral whose optical properties show it to be scapolite occurs in irregular individuals, at times cracked, and often turbid. Its grains show sometimes parallel and sometimes rectangular cleavage lines; its refractive index is low, but its interference colors (double refraction) very brilliant. Sections showing prismatic cleavage give parallel extinction, while those showing two sets of cleavage lines give inclined extinction, and, when the cleavages are at right angles, are isotropic and exhibit in convergent polarized light a uniaxial figure, which, with the mica and gypsum plates, is seen to be negative. In many cases the scapolite is surrounded by a colorless border, from which, in ordinary light it cannot be distinguished, but which between crossed nicols gives aggregate polarization in bright colors, yellows and blues, and which may possibly be a "lamellar aggregation of kaolin and muscovite."[1] The epidote occurs in lath-shaped individuals which are irregularly cracked. The mineral is nearly colorless, but slightly pleochroic to pale yellow; extinction is parallel. The refractive index is high, causing it to stand out from its surroundings with a dark border, and giving to the surface a roughened appearance. The double refraction is also strong, polarizing in high colors. Calcite occurs in irregular individuals of good size. It is somewhat turbid, often shows rhombohedral cleavage, and is sometimes twinned. It has a high double refraction which causes it to polarize in silvery tints. The augite is light green and very slightly pleochroic; cleavage is imperfect. In the basal sections the cleavage lines intersect nearly at right angles; in the orthopinacoidal sections the extinction is parallel; and in the clino-pinacoidal, inclined, the maximum angle being 43.° Hornblende is much less abundant than the augite. It is green, though not very deep, in color, exhibits good cleavage and strong pleochroism, the absorption in the three types of sections being as usual, the maximum extinction angle recorded was 27.° The sphene is rather dark brown, slightly pleochroic, and much cracked. It occurs mainly, along with a few grains of ilmenite and numerous distorted crystals of apatite, included in the plagioclase.

In general the grains of this rock have a smooth,

1. Rosenbusch, H., "The Microscopic Physiography of the Rock-making Minerals," Trans. Iddings, 4th ed., 1898, p. 157

distinct outline, more or less polygonal, giving to a section a defined mosaic or paving-stone appearance, characteristic of a recrystallized metamorphic rock; the structure is granulitic.

The presence of epidote, and particularly of scapolite in this rock is of special significance, since these minerals are frequent, and may almost be said to be characteristic accompaniments of certain pyroxenites and amphibolites which, in matamorphosed contact-zones, are the equivalents of granular limestones.[1] The abundance of augite, and its preponderance over the hornblende, than which it is generally a mineral richer in lime, are also noteworthy points.

Scapolite Amphibolite, Maxwell's Crossing, Township of Glamorgan, east side of Lot 5, Range VI. (Section 1272).

This is a fine-grained, eminently crystalline, and somewhat friable rock, of dark greenish-gray color. It is foliated and banded, broad or narrow bands of the darker constituents alternating with bands which contain the lighter ones.

The microscope shows it to be composed essentially of scapolite and hornblende, though in some bands considerable calcite and pyroxene are seen, and in others individuals of plagioclase are common; a little quartz also occurs. As accessories, it contains numerous small wedge-shaped or irregular grains of nearly colorless sphene, which are much cracked, and many small, well-formed crystals of apatite, which in prismatic sections sometimes show the basal parting.

Plagioclase is in good sized individuals, quite fresh, often untwinned. It is an acid labradorite, having a specific gravity of about 2.69. Calcite is distinguished by its rhombohedral cleavage and the silvery tints in which

1. Rosenbusch, H., op. cit., pp. 158 and 294.
Harker, A., op. cit., pp. 284-286 and 296-298.

it polarizes. The scapolite occurs in large colorless irregular individuals, and near the edge of the slide shows good cleavage. In sections approaching the basal, the extinction bisects the angle formed by the cleavages. The mineral is clear and fresh. It separated from the heavy solution at specific gravity 2.699, indicating high content of lime; these grains were heated with dilute nitric acid to remove any calcite, the residue was thoroughly washed, and then boiled with pure concentrated nitric acid—it was decomposed, but not entirely dissolved. The solution was decanted, diluted, and to one portion silver nitrate was added, a white flocculent precipitate indicated chlorine; the other portion was made ammoniacal, and ammonium oxalate was added, an abundant white precipitate showed lime. The hornblende is green, in large individuals of angular form; strongly pleochroic, maximum extinction angle, 31°, indicating a high percentage of basic elements in the mineral. The augite is in very irregular grains, nearly colorless to light green. It shows imperfect cleavage and is also much cracked. Pleochroism very slight, extinction angle 43°.

This rock also has a typically granulitic structure, being made up of a mosaic of polygonal grains.

Amphibolite, Township of Glamorgan, Lot 27, between Ranges IX. and X. (Sections 1270 A.B.).

This is a very dark, fine-grained, and friable rock, with no banding apparent in the hand specimen. With the aid of the microscope there is seen to be a tendency toward foliation, which, however, is slight.

The essential constituents are plagioclase and hornblende, the latter making up about two-thirds of the rock. Quartz, scapolite, calcite, and augite are also present in much smaller amounts. A few irregular individuals of orthoclase, several irregular and broken grains of sphene, associated at times with black titanic iron ore, and here and there a small crystal of apatite complete the list of accessory constituents.

The quartz is clear, and is distinguished from much of the plagioclase only by its axial figure. The orthoclase is comparatively fresh, shows Carlsbad twinning in some cases, also cleavage approaching a right angle, with extinction sometimes parallel. Its occurrence in such basic rocks is not infrequent.[1] The plagioclase is in good sized individuals; some of it, labradorite, is twinned polysynthetically according to the Albite law, in broad bands, but most of it is perfectly clear and untwinned, and is andesine, specific gravity about 2.65. The scapolite is usually altered about the border as in the other specimen from this locality (section 1269), but otherwise is quite clear. The hornblende is of medium green color, and occurs in angular individuals of varying size. It shows good cleavage, is strongly pleochroic, and exhibits the usual absorption $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$, though in this case the absorption along $\mathfrak{b}$ and $\mathfrak{c}$ is not very different. Its extinction angle is 27°. The augite is in small grains, much cracked. It is very pale green, almost non-pleochroic, and gives an extinction angle of 40°.

The rock appears as a mosaic of various sized grains, less uniform than in the preceding specimens. Its structure may be said to be between granular and granulitic, but still points to recrystallization of the component minerals.

INCLUSIONS IN THE GNESSIC GRANITES.

These comprise the irregular dark masses in the granite, and are often near areas of gray gneiss. They present a gradation in form, appearance, and composition from angular, black, and exceedingly basic near the contact, to lenticular masses, with alternately light and dark bands, and less basic farther away in the granite mass.

1. cf. Kemp, J. F., "Crystalline Limestones, Ophicalcites, and Associated Schists of Eastern Adirondacks," Bull. Geol. Soc. Am., 1894, Vol. VI., p. 253.

Amphibolite, Township of Dysart, Lot 24, between Ranges IX. and X. (Sections 1267 A.B.C.)

This is a very dark fine-grained rock, foliated, but not banded.

When examined microscopically, it is seen to consist very largely of hornblende, with a considerable amount also of plagioclase. As accessory constituents there are a little quartz, numerous individuals of biotite, a little magnetite, sometimes enclosing pyrite, many small crystalline grains of apatite, and a very few small crystals of zircon.

The quartz grains are clear and glassy, and irregular in outline. The plagioclase, which is generally fresh, is sometimes twinned in broad and narrow bands, according to the Albite law, occasionally also according to the Pericline law. Cleavage is well seen in some cases, and extinction is inclined. This is labradorite, having a specific gravity of about 2.68 and an extinction angle, measured on the twin-lamellae, of 18.° There is also a variety of plagioclase which is perfectly clear, and is untwinned. It has a specific gravity of about 2.65, and is probably andesine. The biotite occurs in elongated pleochroic individuals of brown color. It often includes grains of plagioclase, and not infrequently penetrates individuals of hornblende. This last-named constituent, which makes up about three-fifths of the rock, is present in various sized grains, often of irregular shape. It is dark brownish green in color, pleochroism is intense, and the maximum extinction angle is 30.° It seems to be micro-poikilitic toward the feldspar, but this appearance is probably due to its irregular form, caused by interference while crystallizing.

Sometimes interpenetration of the grains, sometimes a mosaic effect is seen ; the structure is granulitic to granular.

Quartz Diorite Gneiss, Township of Glamorgan, Range IX., Lot 8. (Section 1274).

This is a dark gray rock, fine-grained, foliated and banded, composite bands alternating with light colored and dark colored bands. Microscopically the foliation is shown extremely well by the parallel arrangement of the minerals.

The rock is found to be composed essentially of quartz, plagioclase, and hornblende, while in certain bands biotite is common, and in others microcline occurs. A very few individuals of orthoclase, a little sphene, with titanic iron ore, and a few small crystals of apatite are the accessory constituents.

The quartz occurs in large and small irregular grains, often cracked, or showing undulose extinction. The orthoclase is quite fresh, except along the cleavage planes where it is apt to be turbid. It sometimes shows parallel extinction, and is usually untwinned. The microcline is in irregular individuals of medium size. The plagioclase is oligoclase. It is sometimes turbid, and frequently cracked. It is well twinned in broad, narrow, and alternately broad and narrow bands, sometimes also according to the Pericline law. The biotite is in very elongated individuals, with cleavage distinct, and pleochroism very marked. In some cases it gives evidence of strain by the bending and crumpling of the plates. Lath-shaped individuals of this mineral frequently penetrate grains of hornblende. The hornblende occurs in large and small individuals of very irregular form. It is deep brownish green, with strong pleochroism, and an extinction angle of 28.° The sphene is in small irregular masses, much cracked; pleochroic from nearly colorless to light brown. It often surrounds as a more or less even border, particles of black titaniferous iron ore, which is also found withou the sphene.

The structure is granular, approaching granitic, the grains partially interlocking and having very irregular outlines. The rock seems, in fact, to have approached very closely, both in structure and in composition, to the gneiss which lies near it.

Mechanical separations by means of Thoulet's solution were made of all the specimens. No attempt was made to separate the dark constituents, however, as a sufficient idea of their relative abundance could be had with the aid of the microscope. The following table, in which the figures represent percentage by weight, is arranged in order of the amount of basic constituents present. When the loss attendant on crushing (to 80-mesh) and washing of the powder, and the necessary error due to interposition of the constituent grains are considered, it is fully appreciated that the method by no means justifies the use of decimals, if, in fact, the units are reliable; but instead of making round numbers of them, it was thought at least as accurate, and perhaps wiser to record the actual results obtained. It may be noted that in the case of a crop of composite grains falling between the specific gravities of two minerals, half its weight was added to the weight of the crop of each mineral.

In the column at the left are the numbers of the different specimens, corresponding to the thin sections. In order to show the nature of the rocks without being obliged to turn back to the descriptions, the following symbols have been used :—

	+	Gneissic Granite.
	×	Gray Gneiss.
	±	Altered Limestone.
*	×	Inclusion.

In the column under *Basic Constituents*, the different minerals are represented thus: A—Augite, B—Biotite, H—Hornblende; and where two minerals are present, B & H indicate that the two are present in about equal

Rock.	Basic Constituent.		Calcite.	Scapolite.	Labradorite.	Andesine.	Oligoclase.	Quartz.	Microcline.	Orthoclase.
1273 +	B	6.8	..	..	..	..	39.1	22.0	23.4	7.6
1268 ×	B<H	10.0	..	..	..	36.2	..	51.0	—	2.8
1271 ×	B	22.8	..	..	..	..	35.8	22.7	18.8	—
1275 ×	H & B	28.0	..	..	..	..	32.0	22.0	2.7	14.8
1274 *	B<H	32.4	..	..	..	..	40.5	20.7	6.4	—
1269 ‡	A>>H	34.0	12.4	3.5	27.0	..	25.1	2.0	2.3	..
1272 ‡	A<<H	57.9	8.1	26.4	5.4	..	..	2.8	..	..
1267 *	B<<H	66.5	..	..	19.0	14.5	..	—	..	—(?)
1270 ‡	A<<H	68.0	1.2	1.7	2.4	25.0	..	1.7	..	—

amounts, $B > H$, more biotite than hornblende, and $A << H$, much more hornblende than augite, etc. Wherever a mineral has been found, but in amount too small to determine quantitatively, a dash is placed.

In the granite, the gray gneisses, and sometimes in the inclusions, the feldspar is seen to be acid, while in the altered limestones and the other inclusions it is richer in lime, and consequently of higher specific gravity. Another noticeable fact is that as the amount of calcite—the remains of the limestone—decreases in the altered limestones, the augite, which is richer in lime, gives way to hornblende which is poorer; and in the rock containing the most hornblende, that is, the one farthest removed, as regards composition, from the limestone, orthoclase appears. The pyroxene is probably especially rich in lime in this case, since it is so pale in color. In the altered limestones, the color of the hornblende is not very deep green, indicating a high percentage of lime, but in the gray gneisses and inclusions it is generally quite dark, and often brownish, pointing to the presence of more iron, magnesia, etc. The range in the character of the inclusions is also noteworthy, one having practically the same composition as the gray gneisses, and another resembling the most basic or most altered of the altered limestones.

HYPOTHESES AND DISCUSSIONS OF THE ORIGIN AND RELATIONS OF THE VARIOUS ROCKS.

Further consideration of the genetic relations of these rocks may now properly be entered upon; and immediately are recalled the two questions proposed at the outset, viz., the origin of the basic rocks at the contact, and the real nature of the dark streaks and patches held by the gneissic granites. If these could be settled, the solution of the whole problem here involved would be well under way.

The first question may be still farther limited to this :

What is the source of the various basic silicates which make up the dark bands in the limestone ? The principal materials which must have been added to the elements of limestone to produce the various silicate minerals observed in the altered limestones are: Silica, alumina, iron, magnesia, alkalies, and chlorine (for scapolite). As to the source of these materials, there are two possible explanations ; either they existed in the limestone or in beds interstratified with it before the intrusions took place, and were subsequently metamorphosed and re-crystallized ; or they have been derived in some manner from the substance of the intrusive mass. The question resolves itself, then, into one of metamorphism by diagenesis, or by metasomatosis.

It has been previously stated that the limestones are in general comparatively pure except as these igneous masses are approached. It may be noted in the first place that the peculiar manner of occurrence of these basic bands in the limestone is hardly in accord with the ordinary observed phenomena of sedimentation. Secondly, there seems to be no reason, supposing that the above mentioned materials, which may for the present be called impurities, were already contained in the limestone, why the igneous material should invariably choose just that locality for intrusion. And it is further impossible to see in the case of the pyroxene gneisses, how that supposition would account for the very general increase in the degree of metamorphism as the intrusion is approached, from pure limestones to such basic rocks. Moreover, if these impurities existed in the beds of the limestone in this region, it would be quite natural to suppose that other impurities, giving rise to different metamorphic products, might occur in other limestone regions similarly pierced by igneous intrusions. It will be shown, however, that such is generally not the case.

Too much importance can hardly be attached to the presence of certain of these minerals in this class of rocks. Scapolite has repeatedly been recorded in metamorphic zones in limestones cut by granite and other igneous rocks.[1] Several workers in the limestones of the Adirondacks have mentioned their great similarity to those of the Grenville Series of Canada,[2] and Van Hise goes so far as to suggest that they are identical. Now in these limestones of New York occur very analogous intrusions of igneous rocks, and the result are contact zones similar in nearly every respect to those under consideration here. Smyth[3] has remarked upon the presence of scapolite as a characteristic mineral in these zones, and Kemp says:[4] "Contact masses of silicates similar to those above described (scapolite, sphene, hornblende, augite, etc.) are characteristic of not a few exposures of white crystalline limestone in this eastern part of the United States, and always near them the igneous intrusions are found. Scapolite is especially characteristic of such, and invariably with it are hornblende, pyroxene, and titanite." And he continues: "In many places the contact effect of these intrusions on limestones *are so similar*[5] that one is inclined to suspect the near presence of igneous rocks wherever these contact minerals, and especially scapolite, are reported in limestones."

1. Adams, F. D. and Lawson, A. C., "Some Canadian Rocks containing Scapolite," Can. Rec. Sci., 1888, Vol. III., p. 201.

Nason, F. L., Ann. Rep't. State Geologist of New Jersey, 1890, pp. 32-33.

Kemp, J. F., Trans. N.Y. Acad. Sci., 1893, Vol. XII., p. 74.

Zirkel, F., "Beitrage zur Kenntniss der Pyrenaen," Zeit. d. d. geol. Ges., 1876, Vol. XIX., p. 68 et seq.

Lacroix, A., "Description des Syénites néphéliniques de Pouzac, etc.," Bull. Geol. Soc. de France, 1890, p. 511.

"Contributions à l'etude des gneiss a pyroxene et des roches a wernérite," Bull. Soc. Franc. de Min., 1889, Vol. XII.

Frossard, C. L., "Sur les Roches metamorphiques de Pouzac etc." Comptes Rendus, 1890, Vol. CX., p. 1013.

2. Kemp, J. F., "Gabbros on the Western Shore of Lake Champlain," Bull. Geol. Soc. Am. 1893, Vol. V., p. 214.

"Crystalline Limestones of the Eastern Adirondacks," loc. cit. Van Hise, C. R., "Correlation Papers, Archaean and Algonkian," Bull. U.S.G.S., No. 86, p. 508.

Smyth C. H., jr., loc. cit., p. 266.

3. loc. cit., p. 279.

4. "Gabbros of Lake Champlain," loc. cit., pp. 223-224

5. The italics are the present writers.

Smyth[1] says of these intrusions that the position of the zone of extreme alteration, following all the irregularities of the contact between the two formations, is sufficient proof that it has been formed by the action of the one on the other. This action, he says, can be explained in no other way than as a case of contact metamorphism resulting from the intrusion of the igneous rock into the limestone. This conclusion is entirely supported by the mineralogical composition of the contact zone, as the species named, scapolite, hornblende, augite, titanite, etc., are all recognized contact minerals, especially in limestones.

Furthermore, there seems no reason why metasomatism should not have taken place in this occurrence as well as it admittedly has in other regions. Many instances of this kind could be cited. Among the notable ones are the metamorphism of mica schists by plutonic intrusives in south-eastern New York,[2] and near Klausen[3] in the Tyrol, which have been noted by Rosenbusch[4] as presenting very similar phenomena; the contact of limestone with monzonite at Predazzo,[5] and of the limestones of Ramsberg in the Hartz[6] with granite, in both of which cases broad zones of lime silicates have been formed; and perhaps one of the most striking instances of metamorphism is that of the Albany Granite[7] in New Hampshire,

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1. loc. cit., p. 279.

2. Williams, G. H., "The Contact Metamorphism Produced in the Adjoining Mica Schists and Limestones by the Massive Rocks of the 'Cortlandt Series,' near Peekskill, N.Y.," Am. Jour. Sci., 1888, Vol. XXXVI., pp. 254-268. On page 267 he describes a dyke which is so narrow that the result of the whole action can be viewed at once under the microscope, and there can thus be no doubt as to what has occurred. The dyke cuts and alters limestone, and colorless pyroxene is one of the minerals produced in the latter. Reference will again be made to this example. About a dyke in another place, pyroxene, hornblende, sphene and quite abundant scapolite occur.

3. Teller and von John, "Geologisch-Petrographische Beitrage zur Kenntniss der Dioritischen Gestene von Klausen in Sudtirol," Jahrb. der K.K. Geol. Reichsanstalt, 1882, Vol. XXXII., pp. 589-684.

4. Rosenbusch, H., "Mikroskopische Physiographie der Massigen Gesteine," 3rd ed. Stuttgart, 1896, p. 263.

5. Lemberg, J., Zeit. d. d. geol. Ges., Vol. XXIV., p. 234.

6. Lossen, Ibid., p. 777.

7. Hawes, G. W., Am. Jour. Sci., 1881, Vol. XXI., pp. 21-32.

where a granite intrusion has caused profound chemical change in dark argillitic mica schists.

It seems to be a prevalent idea that *basic* magmas frequently produce such metasomatosis, but that the only effect of *granitic* intrusions, aside from insignificant exhalations in the way of boron and fluorine compounds, is diagenetic, It is possible that granites produce chemical change less frequently than more basic intrusions, but that they do produce such change in some cases is beyond all doubt when it is considered that several of the articles referred to have been based on careful chemical investigation of the intrusive, the rock penetrated, and the resulting contact zone. Hutchings[1] concludes that in many such cases there has been a transfer of material from the intruding rock to that which it metamorphoses, a transfer which is often large in proportion to the relatively small masses of igneous rock concerned in it.

Kemp and Hollick have described an intrusion in southern New York which is remarkably similar to this one. They say :[2] "Interesting and marked changes manifest themselves in both granite and limestone (near the contact). In general it may be said that either the former becomes an aggregate of light green monoclinic pyroxene and scapolite, or we find a granite-like zone formed between the two." "In résumé[3] of these contacts it may be said that the (hornblende) granite becomes richer in pyroxene as they are approached. . . . Along the contact is the 'scapolite zone' consisting of coarsely crystalline scapolite and malacolite. Next comes the coarsely crystalline limestone charged with the aggregates of silicates mentioned above"—pale pyroxene, green hornblende, scapolite, titanite, etc. And finally,[4] "those

1. "Notes on the Composition of Clays, Slates, etc., and on Some Points in their Contact Metamorphism," Geol. Mag., Decade IV., Vol. I., p. 74.

2. loc. cit., p. 644.

3. loc. cit , p. 647. 4. p. 649.

scapolites that are disseminated in the limestones in the bunches of silicates are doubtless due to solutions stimulated by the intrusive rocks." It may be added that metasomatic action is especially favored as an accompaniment to deep seated intrusions such as this Central Ontario occurrence undoubtedly was,—where the vapours and solutions cannot readily escape.

From these considerations, from their petrographical character, and from their relations in the field, it seems certain that the pyroxene gneisses are in reality altered limestones, that they are the product of metasomatic metamorphism of these limestones by the granite intrusions.

Regarding the amphibolites, the evidence is less conclusive. Dr. Adams has found bands of amphibolite which it is certain have been produced exclusively by the alteration of diabase dykes; and it is also certain that there are bands of amphibolite in the limestone away from the intrusions. These facts concerning the amphibolites, added to their probable lower content of lime and their sharper demarkation from the limestones, as compared with the pyroxene gneisses, admit of a lingering belief that none of the amphibolites were produced by metasomatic action, but that they all existed in something like their present condition in the limestone before the intrusion took place.

But their increased number within the area of metamorphic action, added to their frequent marked similarity in many respects to the pyroxene gneisses, render the support of such a belief, in the writer's opinion, very feeble; it seems highly probable that many of these amphibolites have originated in the same way as the pyroxene gneisses — that they are simply more highly altered portions of the original limestone. One thing which may account for the formation of amphibolites in one case and pyroxenites in the other is that where the amphibolites now occur might have been bands of the limestone especially favourable to the passage and action of the exhalations and solutions accompanying the magma, while where there are now the pyroxene gneisses, there were, before the intrusion, bands of the limestone which were less permeable, and in which, therefore, the addition o material was smaller and the transformation less complete. On this ground also, the presence, close to the contact, of bands of comparatively unaltered limestone would be due to the fact that they were particularly impermeable to the metamorphosing agents.

Coming now to a consideration of the true character of the so-called inclusions, there are found to be two possible explanations of that question also. Either these dark streaks and patches are basic secretions of the molten magma itself, or they are, in reality, fragments of the limestone series which have been detached and floated off from it.

The increasing approach of the rock of these masses to granitic structure and composition from the contact inward, the often-times sudden change from the true rock of the batholite to these highly basic streaks, their increasing basicity and angularity of form near the contact—in fact, the field relations generally, as well as the microscopic characters, favor the idea that they are actual fragments of the limestone series, included by the granite magma, and by it still more highly metamorphosed than their parent rocks, though possibly in a somewhat different way. The same conclusion has been reached in some similar occurrences. [1]

If this be the case, however, it may be pertinently asked why it is that although the rocks at the contact contain a basic feldspar and pyroxene and scapolite, those

1 cf. Lacroix on the Pyrenees; see Adams, F. D., "The Excursion to the Pyrenees in Connection with the Eighth International Geological Congress," Jour. Geol., 1901, Vol. IX., pp. 31-32.

of the inclusions often hold a more acid feldspar, contain no scapolite, and in place of the lime-rich augite, contain more hornblende and some biotite. That is a vital question, indeed, and unfortunately, it is a particularly difficult one to solve, especially in the absence of chemical data.

Dr. Adams thinks there may be a transition in the inclusions near the contact from the one composition to the other, but if so, that is very abrupt. The occurrence of labradorite in some of the most basic of these inclusions supports this idea. And at any rate, at least four theories can be advanced to explain the differences between them and the altered limestones; they are:—

1. That the same metamorphic forces, viz., heat, pressure, emanations such as vapors and heated solutions, etc., acted upon both classes of rocks, and that the differing results are due to the difference in degree and length of time in which these forces acted. It seems obvious that the action would be more intense and more prolonged in the magma itself than about its edge.

2. That the same forces acted possibly also, as in (1), to a different degree and for a different time, but in the case of the contact zone, in the presence of an excess of limestone, and in the case of the inclusions, in the presence of an excess of granite; thus in the first case the tendency would be for any minerals to become richer, and richer in lime, while in the second case, the lime which the minerals held would be more and more diluted, so to speak, by accessions of more silica, alumina, iron, alkalies, etc., from the granitic magma.

3. That different forces acted on each class of rocks; that those of the contact zone were subjected to exhalations and solutions from and accompanying the intrusion, but that those of the inclusions were subjected to quite a different influence—that due to the direct action of the

molten mass itself. In reality this theory does not differ greatly from the second.

4. This is, in part, a combination of the three preceding. It has already been shown probable that the movements which took place throughout this whole area occurred during the recrystallization of the rocks. To stretch this point somewhat, it is possible that many of the fragments which now form the inclusions were broken off and floated into the igneous mass after some metamorphic action had taken place at the contact. Thus, instead of receiving fragments of practically unaltered limestone on which to act, the magma had already had part of its work done for it at its periphery, and thus the final effect on these fragments would be much greater than on the rock which remained at the periphery. Further, if there were any difference in the influences acting at the border, and within the mass, respectively, it would make its effect manifest here.

While it is at present impossible to decide even which of these theories is the most probable, it may be that with further study, one of them will be found sufficient to account for the difference in character of the metamorphosed limestones at the contact of the intrusion, and those fragments which have been included by it.

In mentioning the possible causes of all these phenomena, on a previous page, and having noted the intrusion of new igneous material and the refusion of the underlying Fundamental Gneiss as two of these, it was stated that there is still a third explanation possible. This is to be found in the views of certain of the French geologists regarding the origin of granite intrusives and their relations to the rocks penetrated.

Michel-Levy[1] was one of the first of these to state it as his belief that the origin of the so-called primitive

1. "Sur l'origin der terrins crystallins primitifs," Bull. Soc. Geol. de France, 1887 Vol. III., p. 103.

rocks was due to the intrusion of igneous material into true sediments, which thereby received the addition of an immense amount of material, the metamorphism having been intense, and essentially metasomatic. This process he calls *granitization*, and the original sediments are said to be *granitizé*. In a later paper, [1] he describes the threefold manner in which this result was accomplished :—

1. By injection of molten granitic material between and around the fragments of the more or less shattered margin of the penetrated rock, and as thin layers along its foliation or lamination planes—*lit par lit*. This causes intense metamorphosis of the rock and gives to it a granitic character.

2. By action of heated mineralizing solutions carrying the essential elements of quartz and feldspar. In some manner, which he does not make very clear, these solutions penetrate the altered rock and cause the quartz and feldspar to crystallize through it.

3. By actual solution of the penetrated rock in the granite magma.

A number of workers on the geology of Mont Blanc record similar conclusions. [2] Their belief [3] opposed to the supposition of Suess that granite fills great cavities in the crust of the earth which have resulted from tangential stress, thus giving rise to batholites—is that " the granite magma first rises along lines of fracture in the crust. Its presence leads to a heating of the rock into which it is injected, and its intrusion accompanied by a *circulation intense* of mineralizing fluids, probably rich in alkalies. These produce at first a transferrence of quartz from one

1. " Contribution à l'étude du Granite de Flamanville, et des granites Français en général." Bull. des Services de la Carte Geol. de la France. No. 36, Paris, 1893.

2. Duparc, L. and Mrazec, L., " Nouvelles Recherches sur le Massif du Mont Blanc," Archives de Sci. Phys. et Nat., 1895, Vol. XXXIV.

Duparc, L., " Le Mont Blanc au point de vue geologique et petrographique ", ibid 1896.

Vallot, J., and Duparc L., " Sur un synclinal schistieux ancien formant le coeur du massif du Mont Blanc ", Comptes Dendus. March, 1896.

3. Duparc and Mrazec, loc. cit.

part of the mass to another, and the development of biotite, which is a marked feature in contact zones. Then follows 'feldspathization' which commences by the development of little strings of quartz and feldspar, following for the most part the schistosity of the invaded rocks, and which grow in size until the whole mass of schist is transformed into granite, the texture of the schist being broken down and its elements set in motion to form with the transfused material new combinations. The granite magma or emanations thus slowly dissolve, alter, or incorporate * * * the wall rock, transforming it first into a gneiss, then into a gneissic granite, and finally into a granite. The original intrusion thus slowly enlarges its boundaries and increases its volume—eats its way into the surrounding rocks and develops itself largely at their expense.

"This process, we are told, is at work wherever granitic magmas come in contact with clastic rocks in the deeper parts of the earth's crust, and it is thus that the crystalline schists are produced."[1]

Horne[2] and Greenly in Great Britain apparently also reach similar conclusions, and they describe a case where the foliation of an intruding granite is due to a retention of the original foliation of the invaded rock.

In certain parts of the French Pyrenees are intrusions of granite into limestone, similar in nearly every way, apparently, to those herein described. Lacroix,[3] however, explains their phenomena by this same theory of "granitization" and "feldspathization". He claims that the granite dissolves the limestone to form a diorite, and that, so long as the igneous forces continue active, the invading mass advances and enlarges, surrounded by an ever-

1. Adams, F. D., "Some Recent Papers on the Influence of Granitic Intrusions on the Development of Crystalline Schists", Jour. Geol, 1897, Vol. V., p. 296.

2. "On Foliated Granites and their Relation to the Crystalline Schists in Eastern Sutherland", Q. J. G. S., 1896, Vol. LII.

3. Le Granite des Pyrenees et ses Phenomènes de Contact". Bull. des Services de la Carte Geol. de la France, No. 64.

widening zone of metamorphosed limestone. He says [1] "La mise en place du granite s'est effectuée par dissolution graduelle des roches sedimentaires dont il occupe la place". "L'évidence [2] de la transformation du granite par dissolution du calcaire est complète". In a thin section from south-eastern New York, described by Williams [3] and already mentioned, where a narrow dyke cuts limestone, the nature of the igneous rock is considerably modified and can be seen to have become enriched in lime from the limestone, while this latter, on the other hand, has derived silica, alumina, iron, etc., from the material of the dyke.

Of so-called intrusions in the granite, Lacroix says: [4] "Je considère donc, toutes ces couches metamorphiques isolées aujourdhui au millieu du granite comme le résidue non digéré des assises sédimentaires dont le granite a pris la place." This may have an important bearing on the gray gneisses or quartz diorites which occur throughout these granites in Ontario.

If these views are correct, they would serve to explain nearly every phenomenon observed in this occurrence in Central Ontario. But the great weakness in them is the lack of chemical proof. Till that is at hand, it may be said that "while the transfusion of a certain amount of material into the limestones along the immediate contact of the intrusions, and also a solution of the limestones to a limited extent in certain cases seems highly probable, the wholesale transformation of limestone into diorite, or of shale into gneiss and granite—is as yet very far, indeed, from being proved." [5] It may be said in their favor however, that as the study of this area has gone on, these views have come to appear to the writer, at least less and less irrational.

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1. ibid., p. 3. 2. ibid., p. 60. 3. loc. cit., p. 267.
4. Livret Guide, p. 15, see Adams, "The Excursion to the Pyrenees," loc. cit., p. 42.
5. Adams, F. D., "The Excursion to the Pyrenees," loc. cit., p. 46.

SUMMARY.

In the writer's opinion, the following conclusions may be drawn from the foregoing pages :

The district exhibits a development of Grenville limestone pierced by intrusions of gneissic granite which contain masses of dioritic rock.

Considerable deformation took place during the intrusion.

Between the limestone and the granite is a highly brecciated zone, holding large amounts of lime-rich silicates which are eminently characteristic of contact metamorphism.

Diagenesis took place.

To a great extent, however, the elements, other than the lime necessary for the formation of these minerals, came from the intrusion and its accompanying exhalations.

The metamorphism, then, was largely also metasomatic.

In the gray gneisses and in the granite are dark basic masses which represent fragments broken off from the limestone series and floated away into the igneous mass They have been still more highly metamorphosed than the rocks from which they came, and have been more or less dissolved and changed in character by the granite. In other words, they have been partially "granitized."

The gray gneisses, which have the composition of quartz diorites, may represent an intermediate phase of this "granitization"—between the inclusions and the granite. This theory may account for the large amount of plagioclase feldspar found in the granite itself.

Dr. Adams is now making a more extended examination of the rocks of this area, working on a greater number of specimens, from a wider range of localities, and it is expected that his studies will throw additional light on the actual processes which have been at work.

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A Sketch of the Progress of Botany in the Nineteenth Century.

Being the Substance of the Somerville Lecture delivered on March 13, 1902, and now published at the request of the Natural History Society.

It is not claiming too much for Botany to say that it kept pace with the most progressive of the Sciences in the last hundred years. Its domain during that period was vastly extended both from a theoretical and practical point of view. Botany as we now know it has, indeed, been largely the product of the nineteenth century. If we look into systematic treatises on the science published a century ago, or into the Botanical Journals of that period, and compare them with those belonging to the present day, we are struck with the very great difference between them, and conclude that Botany occupies quite another plane from that on which it stood at the beginning of the last century. Then the main object sought was the collecting and identifying of plants and discussing their geographical distribution; and attention was confined mostly to the phanerogamous families and to the outstanding features of plants. When a treatise on Botany of our time is taken up, or a Botanical Journal is examined, it is found that the starting point of the study of the science is entirely altered, and that the differentiation of the science is carried into the minutest details.

In 1801, the artificial system, founded by Linnæus, was still in vogue; and there were enthusiastic collectors working away in accordance with it, constantly adding to the number of determined species. But the limitations of the Linnæan system hampered progress. It was found inadequate for classifying the lower forms of life, as they came to he more fully known and needed to be dealt with.

The first very important step in advance was, therefore, taken when the Natural System of De Jussieu was substituted for that of Linnæus. Under this system, which was communicated in 1789, the entire structure of a plant and its affinities, and especially its form of fructification, are taken into account, as well as the number of its stamens and pistils, in determining its place in nature. The essential elements of the great work done by the distinguished Swedish naturalist have not been superseded, but form,—so far as the nomenclature of Genera and Species is concerned,—the basis of the new departure. The influence of Linnæus and his reputation as the founder of modern Botanical Science have suffered no eclipse from the changes and additions since made to it. Even long after De Jussieu's system began to commend itself, that of Linnæus continued to have its champions. For instance, the great English publication of Smith and Sowerby, begun in 1790, and extending to thirty-six volumesissued at intervals, retained the old system, even in a second edition which was completed only in 1846. Smith's "Flora Britannica," 1800–04, as well as his "English Flora" of 1823, was also constructed on the Linnæan system. William Hooker's "Flora Scotica," published in 1821, was the first work on Botany according to the new system issued from the British press. It was followed on the same lines by Lindley's "Synopsis of the British Flora" in 1828; and all subsequent publications in Great Britain have accepted and worked upon the plan laid down by the French naturalist. The system of De Jussieu was modified and improved by the labours of De Candolle, Mirbel, Lindley and Robert Brown.

The earliest students of Botany in North America—Kalm, Michaux, Muhlenberg, Pursh, Eaton, Houston and Clayton—presented it in accordance with the Linnæan system. But Professor Torry, who had been a student under Eaton, became converted to the Natural System, and he and his pupil, Asa Gray, laid the foundation of

North American Systematic Botany, by issuing as their joint work the "Flora of North America," between 1838 and 1843. The publication embraced the Polypetalæ and the Gamopetalæ, to the end of the Compositæ; and it was not till 1878 that the remainder of the Gamopetalæ was published by Dr. Asa Gray. In 1840 Sir William Hooker gave to the world his great work, "Flora Boreali Americana," in which he recorded all the knowledge then reached of the species of our Continent and of their distribution, gathered from early travellers and explorers.

Up to this period many individuals were at work on the Continent of Europe, in Great Britain and in North America, collecting and classifying species, and numerous publications issued from the press, some of them of a popular description, which created a widespread interest in Botany and disseminated information on the subject. The Hookers, father and son, who were successively superintendents of the Royal Gardens at Kew, took the lead in this good work in Great Britain, and they were aided by Balfour, Arnott, Babington and Bentham.

But a new era for the science was at hand, and as a contributory cause to its introduction were the improvements made upon the microscope. Difficulty had long been experienced in the use of lenses of great magnifying power, on account of the breaking up of the rays of light into their elementary colors. The invention of achromatic microscopes removed this obstacle. Professor Amici, of Modena, found, in 1812, that by combining concave and convex lenses the colour aberrations could be checked, and since his day improvements have gone on, until now the highest magnifying powers can be used in examining minute objects and yet a true image of them be secured.

Another factor contributing to the advancement of Botany during the past century ought to be mentioned; that is the policy of the governments of all civilized countries in instituting national surveys for the purpose of ascertaining the natural resources of the territories subject to them. Men of competent attainments have been at work under them on all departments of National History, and in the reports submitted by the botanical experts employed very full information has been obtained as to the Flora of the several countries of Europe and America, as well as of the British possessions in the Pacific, in Asia and Africa. In addition, the British Admiralty has helped materially in this good work by having naturalists attached to its ships at different times, who made collections of the Flora as well as the Fauna of the various regions visited. Parry's and Sir John Franklin's voyages,—Beechey's voyage to the Pacific and Behring's Straits, and the Antarctic voyage of the Erebus and Terror, all furnished valuable materials which were used to purpose by Sir William Hooker. It was as a Naturalist accompanying Captain Fitzroy on the surveying voyage of the Beagle, from 1838 to 1843, that Charles Darwin laid the foundation of his reputation as the first man of Science of the nineteenth century. Professor Huxley, in like manner, accompanied the "Rattle-Snake" with Captain Strachey's expedition to the Southern Pacific Ocean ; and Professor Wyville Thomson went as scientist with the "Challenger" on its Deep Sea exploring expedition. No country has pursued a more enlightened policy as regards ascertaining what its natural resources are, than the United States of America. Not only the Federal government but also the several State governments have their full staffs of scientific workers, reporting on the Flora of the country, as well as on its Fauna and Geology. Canada has followed suit, but certainly not with the enthusiasm and efficiency of equipment exemplified by our neighbours. Yet, though the amount spent upon reporting on the botanical productions of Canada has been too meagre, excellent work has been done with the resources placed at the disposal of the Geological

Survey for this department. Professor John Macoun and his son, James M. Macoun, who are exceptionally gifted with botanical instincts, have given a good account of themselves, and are still busily engaged in adding to the list of plants that have been discovered within the limits of the Dominion. Macoun, the elder, was one of the men to whom the advent to Canada of Professor George Lawson, a pupil of Dr. John Balfour, of Edinburgh, proved an inspiration. He had been previously trying to work away with a most imperfect apparatus, making collections in the central part of Ontario, and identifying them as best he could, when he learned of Dr. Lawson's appointment as Professor of Natural History at Queen's College, Kingston. He was not long in making the acquaintance of the Professor, with the result that he was put in the way of acquiring that practical mastery of the subject which he has since displayed. It was not to Mr. Macoun alone that Dr. Lawson proved a stimulating teacher. He imparted an impulse to the study of Botany throughout Canada, so that in many centres,—in Montreal among the rest,—about the year 1860, there was more enthusiasm over this subject than had been before or has been, perhaps, since.

And this brings us to the date at which both Botany and Zoology entered upon a new stage of progress. It was in the year 1859 that Charles Darwin's epoch-making work, "The Origin of Species," was given to the public. I can recall, as if it were yesterday, the sensation which it at once created in scientific, literary and theological circles, in Canada as well as elsewhere. Every reader was charmed with the glow which warmed and lighted up the pages of this book, and admired the diligence and patience of the author, in the accumulation of the facts from which he inferred his inductions, as well as the modest way in which he formulated his conclusions, so as to shock as little as possible those who might be indisposed to accept his views. His main thesis was that nature makes a selection out of the different animals and plants that come into existence, there being a struggle for continuance among them, with the result that the fittest survive—namely, those forms which are best adapted to the several situations in which they find themselves—and these perpetuate the best modifications of an organic form, leading progressively to improvements which, in time, amount to the creation of a form so changed that it may be denominated a new specific type. He laid great stress on the variability, occasioned by the direct and indirect influence of the external conditions of life, or by use or disuse, along with the fact that many more seeds germinate and plants start out in life than have room or opportunity to grow to maturity. As a consequence, only a few survive, and those few, he held, must possess a fitness for the situation in which they continue; and this special quality of theirs, being exercised in constant competition, gradually acquires greater strength and prominence, while inherited qualities that are not used in competition become less prominent through disuse. The ill-adapted and less vigorous species or individuals perish in the struggle. This theory, when applied and carried backwards, he suggested, might be held to account for the derivation of all existing specific forms from one or more primitive forms.

Ahout the same time, Alfred Russell Wallace, of London, England, formulated similar conclusions. It is rather a curious pschycological phenomenon, which finds frequent parallels in history, that two minds working independently, and even unknown to each other, should have arrived at the same result about the same time, as if there were influences at work in the air, as we say, environing circumstances and conditions leading up to this issue.

The idea of evolution, or the derivation of all existing forms and modes out of older ones, was no new one.

Lamarck in France, and Treviranus in Germany, about 1802—another noticeable coincidence—suggested that the present forms of life might be accounted for on the principle of derivation from simpler ones. Dr. W. C. Wells, in 1813, and Patrick Matthew, in 1831, asserted the principle of natural selection. Goëthe, the German poet-philosopher, not as the result of Natural History Studies, but from a comprehensive survey of the universe, also believed in evolution. All the naturalists mentioned above, Darwin included, found most of the illustrations in support of their views in the animal kingdom, because the operation of the influence of environment is more easily traced and followed among animals than among plants. Yet they did not exclude the vegetable kingdom from the scope of their theory.

In support of the theory they called attention to the striking fact that the original form of all organisms is one and the same, and that out of this one form all—the lowest as well as the highest—are developed in such a manner that the latter pass through the permanent forms of the former as transitory stages. "From this, they conclnded, the presumption is that there was a period when the lowest only existed. It was further noticed that both in animals and plants rudimentary organs are found," which appear to play no part whatever in the economy of the structure, and from this the inference was drawn that they are remnants of a former structure which has not undergone modification because of the disuse of the rudimentary organ.

The scientific world was much divided as to the legitimacy of Darwin's conclusions at the time of their promulgation—the major part being sceptical, while some gave them a partial adhesion, and others suspended judgment. All, however, admitted the singular clearness and ability with which he made his points. Asa Gray was cautious. He was prepared to admit that variation might be operative along useful lines. Naëgeli's criticism was that the acquisition of characters, without any apparent usefulness in waging the warfare for existence, created a difficulty in the way of accepting the theory of natural selection. He thought the teleological argument, namely, that the plant was striving after perfection, was better supported by the facts pointed out. Mivart held that variations were definite, and often sudden and considerable, which made against the theory of imperceptibly slow variability and development from it. Others pointed out that natural selection trusts to the chapter of accidents in the matter of varieties, and asked how we get the variations without which natural selection would have nothing on which to operate, the survival of the variations being a matter really only secondary to their origin. It was pointed out that many plants of wide range and great diversity of experience remain uniform in character. Then similar modifications are seen suddenly to occur under different conditions, while, on the other hand, different modifications are found under similar conditions. Even Huxley, who was one of Darwin's warmest supporters, made the admission that nature "does make considerable jumps in the way of variation now and then, and that these saltations give rise to some of the gaps which appear to exist in the series of known forms." George J. Romanes, in criticising Darwin's main position, laid stress on the difference between species and varieties, in respect of mutual fertility, and he held that this fact made against the probability of any variety prevailing over an existing species. He held that in the process of free crossing the individual variety would be surely swamped. He also dwelt on the inutility to species of a large proportion of specific distinctions. His general conclusion from the facts presented by Darwin was that it was an accumulation of adaptations, not new species, that resulted from the struggle of existence. Herbert

Spencer, not as an expert naturalist, but as a logician and philosopher, having the facts before him, while avowing himself an evolutionist, thought that environment and functional use were far more influential than variation. Other thinkers also demanded that the term "fittest" should be defined. What was *a priori* to be regarded as fittest? They pointed out that Darwin reasoned in a circle—his whole argument assuming that that was fittest which survived. Not always the strongest and likeliest individual, they showed, got a chance to survive. The porpoise, when the opportunity presents itself, seizes the biggest, not the smallest herring; and the moth in selecting a cabbage leaf on which to lay its eggs, alights not on the worst in the garden. Darwin admitted in a later work that he probably attributed too much to the action of natural selection, or survival of the fittest. Speaking of structures now useless, he said, "such structures cannot be accounted for by any form of selection or by the inherited effects of the use and disuse of parts." He yielded up to criticism that his principle was less important than he had thought it. It is still a disputed question whether variations are insensibly minute or saltative, nor is it settled whether they are impressed upon the organism by influences exerted from without, or from causes operating from within the germ cell.

The general outcome of the discussions which took place in scientific circles undoubtedly was to gain many disciples to the side of evolution. Huxley, *Wallace and Spencer held to it. Tyndal, the great physicist, became a champion of the theory. It was he who, in his famous Belfast address as President of the British Association,

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*Dr. Wallace, now in his eighty-first year, has gone back from evolution pure and simple and entirely dissents from the views of Herbert Spencer and others who hold that man's natural and moral nature is the product of force alone. He declares his belief in the spiritual nature of man and holds "that we possess intellectual and moral faculties which could not have been developed by natural selection, but must have had another origin; and for this origin we can only find an adequate cause in the universe of spirit."

gave eloquent utterance to his belief in the ancient Lucretian philosophy, " that matter has in it the promise and potency of all life." This was the main contention of the well-known work, " Vestiges of Creation," which had long before been issued anonymously, the authorship of which was avowed by Robert Chambers, of Edinburgh, before his death. The alleged facts and arguments by which the theory as to spontaneous generation was supported in that treatise had been thoroughly exploded. But Professor Haëckel, of Germany, a well-known monist, the most thorough going of Darwin's disciples, contends for the position that all atoms are living. To combat this theory was the task Professor Rucker, President of the British Association, set himself at Glasgow, in September, 1901, which he was thought to perform successfully. For many years the meetings of the British Association were made the battle-ground around which the doctrines of evolution were fought. I have mentioned its champions. On the other side there were such stalwart men of science as Lord Kelvin, Professor Virchow, Professor Clerk-Maxwell, Professor Agassiz, Professor Clifford, Professor Sidgwick, Sir George Stokes, the late Duke of Argyll, and Sir William Dawson.

Outside of scientific circles, the great mass of men, so far as they apprehended the matter at all, remained incredulous. They see that all life now proceeds from foregoing life and takes the form substantially of that from which it originated—like begetting its like. And as to the fact that all life starts from protoplasm, they asked how is it that one specimen of protoplasm tarries at the stage of a structure of cellular tissue only, while another goes on developing until finally a man is produced ? The reason of course is that each had a germ in it of the old structure from which it got its start, into a new specimen of which it afterwards developed. The common sense of mankind asked, why should all these graded forms of life be contemporaneous if there has been evolution from the lower to the higher? If the lower had ceased to exist when the higher were developed, color would be lent to the theory that the higher evolved from the lower; but the co-existence of an infinite series of beings, ranging from the micrococcus up to man, the lord of all things visible, all starting from the simple cell, satisfies the ordinary observer and thinker that the presumption is that things have gone on as they are now going, since both the higher and the lower started out on their career in the present conditions. Especially does the inertia of the popular mind present a stolid obstacle to the Darwinian theory when men of science speak of the countless millions of years needed to bring the phenomena of nature up to the present stage of the universe. The inability to grasp a situation thus conditioned produces a state of mind which amounts to incredulity.

Twenty years ago it was the vogue for a person claiming to have the scientific spirit to profess adherence to the views of Darwin, but during the two last decades of the century a reaction set in, so that even Professor Hàèckel in a recent work, "The World Riddle," laments over the fact that practically all his former pupils and disciples, who have attained prominence in Germany, have repudiated his Darwinian views. The number of naturalists who oppose it, either *in toto* or at least in its original form, is constantly on the increase, in the old world. One used to hear it said that there was not a naturalist of any considerable repute who was not an evolutionist, but that can no longer be said. Indeed, it ought not to have been said at any time, when, men like Virchow and Agassiz rejected the entire Darwinian hypothesis. However, it is not a question that is to be settled by counting heads or citing names. Heads and names were against it in 1859 and it looks as if they would ere long be against it once more. At all events, science ought not to be dogmatic; for we may assume that our present outlook will be left as far behind, at the close of the twentieth century, as the science of a century ago has been left behind by the well ascertained knowledge of to-day. One of the most recent German writers, Professor Zöckler, speaking of Darwinism, says that the process of disintegration has already to a great extent undermined the theory and shown its weakness. So great is the difference between the original Darwinian position and the substitute that is now taking its place that the resemblance can often be scarcely recognized. The biology of the future, he predicts, will practically contain nothing of the one-sided monistic form of the development theory, as formulated hy Darwin and Hàèckel, notwithstanding the loud and long protests of the followers of the latter to the contrary. Professor Zöckler quotes as the best statement of the present status of the theory the recent work of the Wurzburg philosopher, Dr. Stölzle, on "Kölliker and his relations to Darwinism." Kölliker, who is eighty-four years of age, and a veteran authority in his branch, is, on all real points of issue, against the English naturalist. His opposition is chiefly on these points:

1. Darwinism does not explain the connection and harmony of the different classes of organisms.

2. Its utility principles do not explain the phenomena for which it aims to account.

3. The absence of real transitions of one species to another in our day, or in former days, as for as we can trace, is an element of weakness

I have dwelt at length on this subject because the publication of Darwin's "Origin of Species" was the beginning of a new era in biological study, and whatever estimate may be formed of the theory which goes under his name, both his spirit and his methods were admirable. He went to work in the true scientific way, and the temper of his writings was marked by moderation, as well as by a sincere desire to get at the truth. The researches and speculations to which his book gave birth imparted a mighty influence to the study of all forms of life. One immediate result was that greater attention than they had hitherto received began to be bestowed, on the beings lowest in the scale. In consequence, the methods of botanical study have been revolutionized. The microscope plays now the leading part in every botanical laboratory; and evolution has proved a good working theory. Recent treatises on Botany begin with the study of embryology, dealing with the simplest forms of plant life, and work upwards to the most complex. Whatever one's views of evolution may be, this is clearly the most advantageous as well as most philosophical starting point for the student. The researches of the last forty years have brought to light innumerable forms of minute vegetable organisms. Of diatomaceæ, for instance, there were known only about fifty species in 1800,—now four thousand at least have been differentiated on the Continent of Europe alone. A new world of fungal species, called bacteria, has been discovered, and in some of these mankind has a serious interest. That fell disease consumption is now known, since Koch traced it in 1882, to originate in the ravages of a fungus in the lungs,—*bacillus tuberculosis.* Pasteur diagnosed the malady Hydrophobia, tracing it also to a *bacillus.* Diphtheria, in like manner, is now known to be caused by a microbe, *bacillus diphtheriticus.* Erysipelas too takes is rise from the working of a fungus. So also does malarial fever, and the curious fact has been established that it is projected into the human system by the action of a female mosquito,—taken from one person and communicated to another. The processes of fermentation and putrefaction,—and the familiar experience of milk's turning sour in hot weather,—are all traceable to the action of fungi, so minute that a microscope is needed to discover them. Nor can you turn to a species of plant of the higher forms, but has its own parasitic fungus. Fungi are everywhere, and the section of Botany dealing with them offers scope for diligent work to the student. There is a wide field for research in this quarter.

One might be tempted to dwell on botany's affiliations with other branches of science, say, entomology on the one hand, and geology on the other; but we must forbear. Suffice it to say, that no one did more to establish the curious and intimate connection between insects and plants than Darwin, with the exception, perhaps, of Lord Avebury, better known as Sir John Lubbock. Insects, it is now known, do more than any other agency to secure the fertilization of plants. Many insects, too, find their nesting place on distinctive plants, on which, and on no other, they lay their eggs; and the science of the future must keep these two lines of study close together—Entomology and Botany.

Palæobotany has become a recognized branch of geology and helps us to imagine the prodigious climatic changes that have occurred in the history of the Earth; and we are glad to be able to claim Professor Penhallow, one of our own members, as an expert in this department of geological science. Fossil plants are playing an increasingly important part in the determination of the age of rocks.

In conclusion, I have only to remark that science is cosmopolitan. It knows no national boundaries, and each of the civilized nations of the West has borne an honourable part in the progress achieved by botany in the last hundred years. The end of the century left an eager band of workers prosecuting botany in all lands where science is encouraged and cultivated, students maintaining all the best traditions of the past, yet addressing themselves to their task, conscious that no finality has been reached or is likely soon to be reached, in their favourite science, any more than in other sciences, and hopeful that to them it may be given to elicit from nature hitherto hidden secrets and add something to the domain of useful knowledge. The twentieth century sets out on its career in the investigation of the vegetable kingdom in circumstances far more favorable than those in which the botanists of a hundred years ago were situated; and one has only to cast his eye over the array of the prominent workers in this field as set forth in the recently formed International Association of Botanists, to feel assured that a still more rapid advance may be counted on in the years that lie before us.

GEOLOGY OF ST. HELEN'S ISLAND.[1]

BY A. W. NOLAN AND J. D. DIXON.

INTRODUCTION. One of the most interesting formations in the vicinity of Mount Royal is a breccia, which occurs in isolated patches at several points in the district. The best known exposure is found on St. Helen's Island, situated in the St. Lawrence River, opposite the City of Montreal. The breccia also occurs on Ile Ronde, north of St. Helen's, on Ile Bizard, at White Horse Rapids, Rivière des Prairies; and in small fissures in the Trenton limestone near Pointe Claire, and at McGill University.

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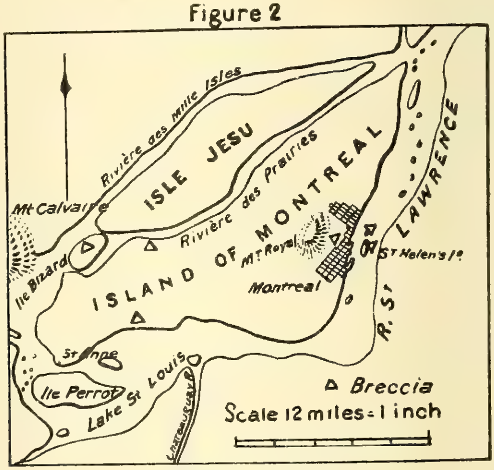
1. A detailed geological survey of St. Helen's Island formed part of the Honour Course in Geology and Mineralogy in the Faculty of Arts of McGill Universty for the session of 1901-1002. The present paper embodies certain results of the examination of the Island, which seem especially worthy of record.

The position of these various exposures is shown on the accompanying sketch map of the Montreal district, the breccia being indicated by a triangle.

Figure 2



Sketch Map

Showing distribution of Breccia

In working out the geological relations of the breccia, the occurrence on St. Helen's Island being considered the most typical as well as the largest, has been made the subject of a detailed study. The other exposures have also been examined and correlated with that of St. Helen's with the view of arriving at some general conclusion which will satisfactorily account for the origin and age of the breccia.

General Geology. See map, fig. 1. Two geological formations are represented on St. Helen's Island and these have had a marked influence on the topographic features. The south-west half of the island, underlain by Utica shale, is low and level, while the north-east area, underlain by breccia, is rolling and comparatively hilly. Both shale and breccia are cut by dykes and sills which

Figure I.

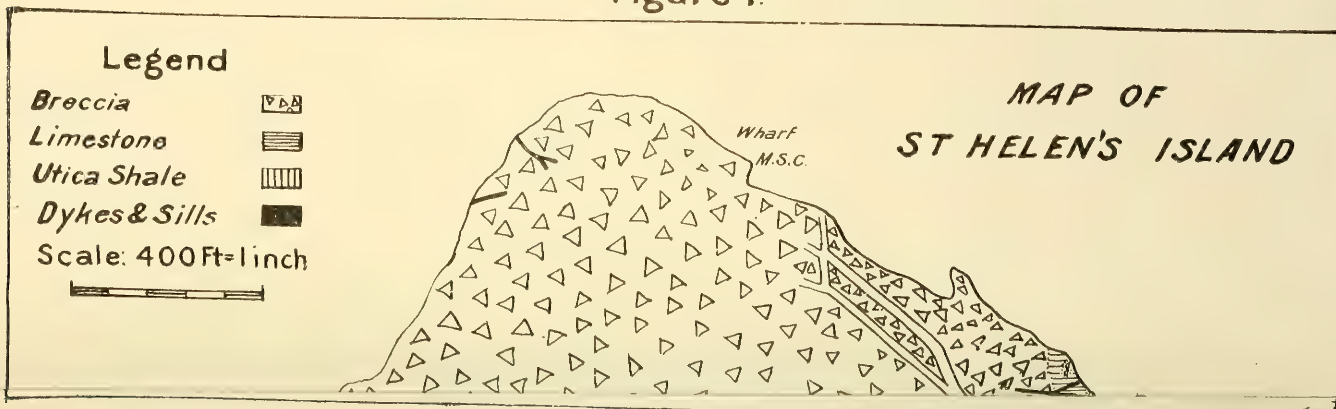
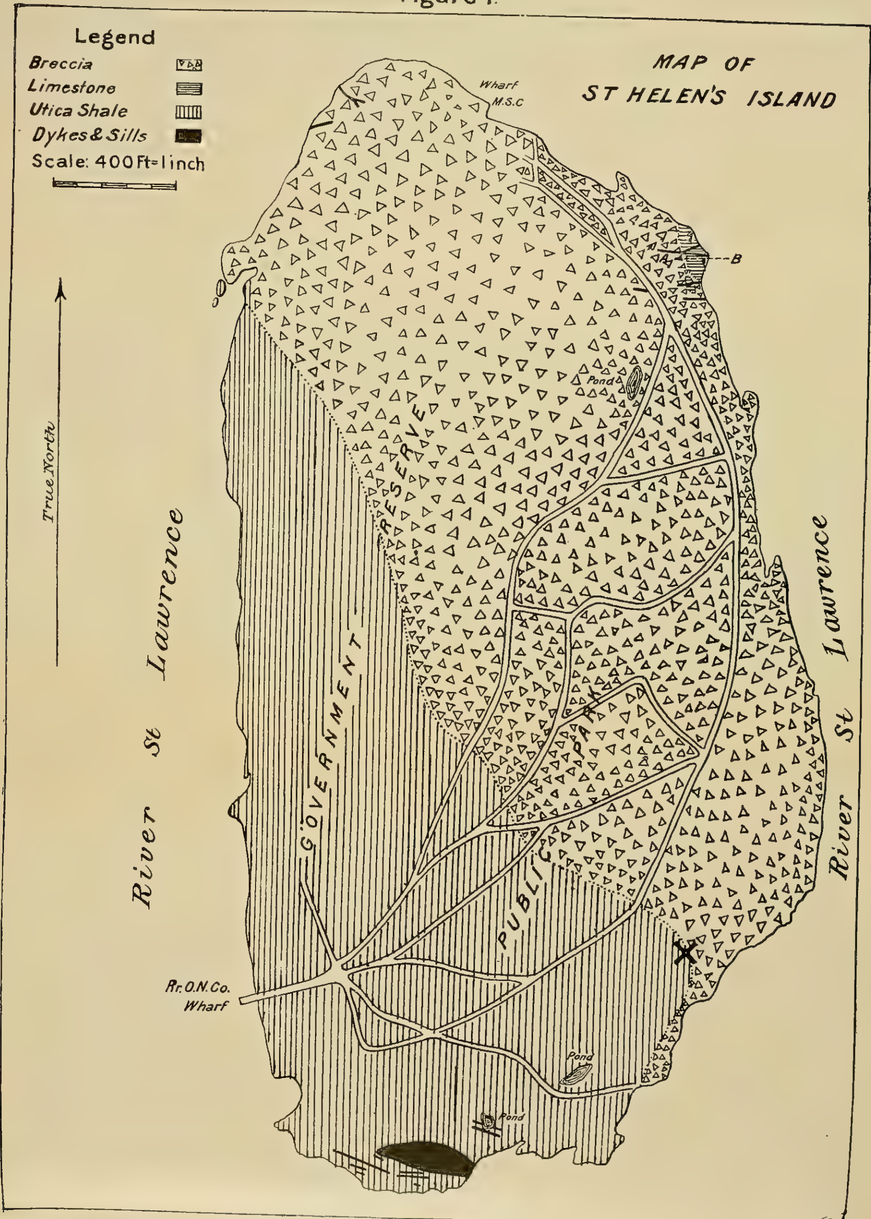

MAP OF
ST HELEN'S ISLAND
Legend
Breccia
Limestone
Utica Shale
Dykes & Sills
Scale: 400 Ft = 1 inch
Wharf
M.S.C.

Figure I.


Legend
Breccia
Limestone
Utica Shale
Dykes & Sills
Scale: 400 Ft = 1 inch
MAP OF
ST HELEN'S ISLAND
True North
River St Lawrence
River St Lawrence
GOVERNMENT RESERVE
PUBLIC PARK
Wharf
M.S.C
Pond
Pond
Pond
Rr. O.N.Co.
Wharf
B

are genetically connected with the Mount Royal intrusion. These will be referred to more in detail later on.

PLEISTOCENE. The drift covering extends over almost the whole island. It varies in thickness from practically nothing on the breccia hills to 35 feet along part of the western shore, where the St. Lawrence River has cut a terrace in it, which reveals the whole section. In composition, the drift is an unmodified sandy clay, holding large and small glaciated boulders, principally of Laurentian and Trenton age, though the intermediate formations are also represented. The augen, syenitic and garnetiferous gneisses are particularly noticeable. Towards the top of the deposit fragments of breccia are common, as well as a few erratics from Mount Royal.

ORDOVICIAN. The Utica formation is only exposed at the south end of the island, the rest of the area underlain by it being covered by the drift. The rock is a dark almost black highly bituminous shale, weathering in places to a rusty brown. The ease with which it disintegrates into small thin laminæ, has masked both the strike and dip. However it is probable that the beds are practically horizontal, or dip to the east at a very low angle. No fossils were found though a diligent search was made. When cut by dykes and sills, a narrow zone of shale in contact with the igneous rock has been altered to hornstone. With one exception, the contact between the breccia and shale is concealed by drift and the approximate boundary, (see map, fig. 1), which may be considered fairly accurate, was therefore drawn from the evidence furnished by the topographic features.

DEVONIAN. (?) The breccia, which underlies the remainder of the island, is an unstratified massive rock. It is composed of fragments of rocks, which are angular, subangular, or rounded with facets, but not waterworn. These fragments vary in size from microscopic grains to boulders 12 and 15 inches in diameter, and the range in age extends from Archæan to early Devonian. They are embedded in an extremely fine grained greyish matrix, which weathers to a rusty brown. The rocks represented are red and black shales, hornstone, limestone, mainly Trenton, red and grey sandstones, the latter probably Potsdam, quartzite, granite and syenite gneiss.

No trace of stratification could be seen but vertical joint planes are numerous. Three sets were determined, the directions being N. 23° W., N. 36° W., and N. 77° W.

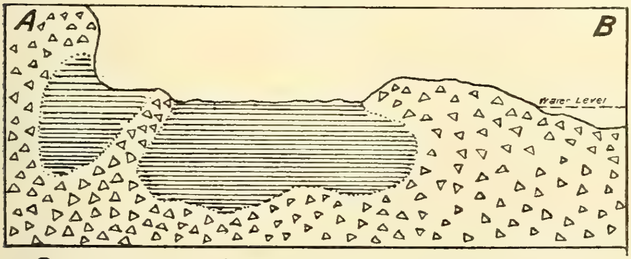
At one point only was the breccia seen in contact with the Utica (see X on map fig. 1.). The contact is a brecciated one, the shale being broken up into angular fragments with the interstitial spaces filled with a yellowish white crystalline dolomite, which dissolves out leaving the shale in relief. Part of this shale has in some way been altered to hornstone. The contact is not sharp, but there is a regular transition from the normal shale through the brecciated facies to the breccia proper.

Beside the ordinary inclusions, the breccia holds two very large masses of limestone, which merit special mention. These occur on the north-east side of the island. The south exposure is lenticular in shape, and is cut by a dyke which has been subsequently faulted. It has an area of about 100 square feet. The rock is a fine grained, light grey, friable limestone. The north exposure is 200 feet in length, and is a dark grey fine grained semi-crystalline limestone, which is somewhat bituminous. It has been brecciated along the contact with the breccia, and the angular fragments have been cemented by a paste which differs in composition from the limestone. On a weathered surface this matrix stands in relief forming a complicated network, which shows the most minute detail in structure. Both limestones are fossiliferous, being particularly rich in Brachiopods. These limestone occurrences were opened up by blasting, the material obtained being forwarded to Dr. H. S. Williams of Yale University, who has made a careful study of the fauna which they contain, and through his courtesy we are enabled to state the age of the two limestones. The larger area is of Lower Oriskany age (early Devonian), as expressed in Western Ontario and Virginia, while the smaller area is Lower Helderberg (Upper Silurian), and corresponds to the Upper Pentamerus zone of Eastern New York.

It is of peculiar interest to find remnants of these two formations in the present locality, inasmuch, as they have not been found in situ elsewhere in Western Quebec. The occurrences indicate an extension of the Upper Silurian and early Devonian seas as far north as Montreal.

An east and west section (A B figure 3) across the Lower Oriskany inclusion and the breccia, shows the relations of the two, and from this it is apparent that at an earlier period the former was wholly enclosed in the latter.

Figure 3



Section across Limestone inclusions in Breccia

Breccia *Oriskany Limestone*

Scale Horizontal Vertical 25'

Petrography of the Breccia. For a more minute examination, a typical specimen was chosen from the breccia near the limestone, and a thin section was made of the matrix. Macroscopically the matrix is fine grained, grey in color, quite hard and dull, with an irregular conchoidal fracture. It holds, in addition to the various rock fragments, small grains of glassy quartz, and feldspar both fresh and kaolinized. Under the microscope the following minerals were recognized, quartz, orthoclase, plagioclase, and apatite, in a fine grained quartz-dolomite groundmass. The quartz individuals are numerous. In form they are oval, angular, or rounded hexagonal. The borders are irregular, this being due, in some cases at least to a deposition of secondary silica, which is in optical continuity with the parent grain. The feldspar is present in less amount than the quartz, and is principally orthoclase. The form is angular, but a few idiomorphic individuals are present in each section. The mineral is quite turbid from kaolinization, but some of the clearer grains show a microperthitic intergrowth of orthoclase and plagioclase. The plagioclase individuals are few in number, and are twinned according to the albite and pericline laws. Apatite occurs in slender prisms, with the double pyramidal terminations.

Throughout the sections there are irregular cavities filled with secondary quartz and calcite. The latter is clear with well marked rhombohedral cleavage, and shows faint strain shadows in polarized light with crossed nicols. In the same light, the quartz is seen to have a radiate fibrous structure.

The matrix or ground mass, which makes up the greater part of the section, is very fine grained, and consists of quartz and dolomite with probably some calcite. A qualitative analysis showed considerable insoluble residue after prolonged boiling in hydrochloric acid, and the solution gave heavy precipitates of iron and magnesia, with a smaller quantity of lime.

In order to more fully examine the inclusions in the breccia, several types were separated from the matrix and thin sections made from them. These were a granite, sandstone, hornstone and limestone.

The granite was a light colored, medium grained rock, consisting wholly of quartz and feldspar. Under the microscope it presented the usual hypidio-morphic structure. The feldspar was principally ortho-clase, with subordinate amounts of plagioclase and microcline. The individuals were large with irregular borders, which interlocked with one another and with the quartz. Many of the grains were almost opaque owing to a heavy deposit of limonite along the cleavage planes. The quartz is traversed by cracks and holds minute hair-like inclusions. A few small grains of magnetite and hematite were also noted.

The sandstone selected was fine grained, and light brown in color. Microscopically it consisted of quartz, with a small amount of feldspar, the grains being cemented by silica and limonite. The quartz grains were rounded, or irregular through secondary growth. Of the feldspar the orthoclase was turbid, while the plagioclase was clear and finely twinned polysynthetically.

The hornstone was a dark, almost black rock, of dull lustre, and brittle with conchoidal fracture. Under the microscope it was seen to consist of minute grains of calcite, quartz, and pyrite. There were many spots of dark carbonaceous matter scattered throughout the section.

The limestone examined was a typical Trenton specimen, being made up of fragments of brachiopods, crinoids, and corals, held together by a calcite cement.

Other Occurrences of Breccia. Before inquiring into the origin of this breccia, a brief description of the other exposures will be given, in order to show their similarity with the typical occurrence. The Ile Ronde development is an extension of that of St. Helen's Island and smiilar to it in all respects.

On the north end of Ile Bizard[1] (fig. 2), the breccia

1. Geology of Canada, 1863, p. 357.

forms a prominent hill and the rock apparently rests on the Calciferous formation. It is composed of fragments of hornstone, sandstone similar in appearance to the Potsdam, limestone, granite, and a dyke rock presumably alnoite. The matrix is grey, weathering rusty brown, and under the microscope shows a finely granular dolomite, holding a few grains of clear quartz and plagioclase feldspar. The sandstone often has a peripheral zone which is decolorized and glassy, and probably represents a zone of fusion. The limestone is in but small amount and is wholly altered to a marble of sugary texture. The fossils which it contains show it to be of Trenton age. Pyrite in small cubic crystals and in veins is present in the matrix and in the hornstone.

At White Horse Rapids, on the right bank of Rivière des Prairies, four and a half miles east of Ile Bizard (see Fig. 2), there is another mass which rests on the Trenton limestone. It differs from the Ile Bizard exposure, in containing anorthosite, different varieties of gneiss, and relatively more alnoite. The matrix is coarser in grain, and is light yellow in color. Quartz is in small amount but forms aggregates which under the microscope with crossed incols show radiate fibrous structure.

Another locality is on the line of the Grand Trunk Railway between Pointe Claire and Ste. Anne's,[2] where the breccia filled a worn fissure in the Trenton limestone.

Still another occurrence was discovered recently when excavations for the foundation of the new wing of the Medical Building, McGill University, were in progress. Here a fissure in the Trenton held a breccia principally of limestone, but holding in addition a fragment of graphitic gneiss of Laurentian age.

PROBABLE ORIGIN OF THE BRECCIA. From what has been said above it will be seen that these isolated areas of breccia are remarkably similar in character and that a satisfactory hypothesis for the origin of one ought to answer for the others.

An analogy might be drawn between this breccia and that of Mato Teepee in South Dakota.[1] Mato Teepee is an erosion remnant of columnar trachyte, underlain by horizontal strata of Jurassic age. On the side toward the Little Missouri Buttes, which are about four and a half miles to the north-west, there is an outcrop of breccai beneath the porphyry. In this are found fragments of rocks of various ages, some of which are not only stratigraphically higher than the present position of the breccia, but also higher than any of the surrounding formations. These fragments of newer rocks are apparently from the shales of Lower Cretaceous age, and the nearest occurrence of these in situ is at Little Missouri Buttes.

Mato Teepee, according to Jaggar, is a remnant of an old laccolith, the pipe through which the igneous material rose being beneath the Little Missouri Buttes. The breccia is really a decomposed porphyry, filled with fragments of rocks from all the strata through which it forced its way. The igneous material connecting Mato Teepee with the Little Missouri Buttes, together with all the overlying strata, has been removed by subsequent erosion, leaving Mato Teepee and the breccia as isolated remnants.

The St. Helen's Island breccia, like that of Mato Teepee, contains fragments of rocks which are more recent than the stratigraphical position of the breccia would lead one to expect, and the following hypothesis is put forward to account for its origin.

When Mount Royal, which in all probability was once an active volcano, was clearing its vent, a comminuted lava or volcanic ash, together with fragments of all the strata through which the lava forced its way, was thrown out and deposited upon the surrounding country. This

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1. Jaggar, T. A., jr., The Laccoliths of the Black Hills U.S. Geol. Survey 1899-1900, Part III.

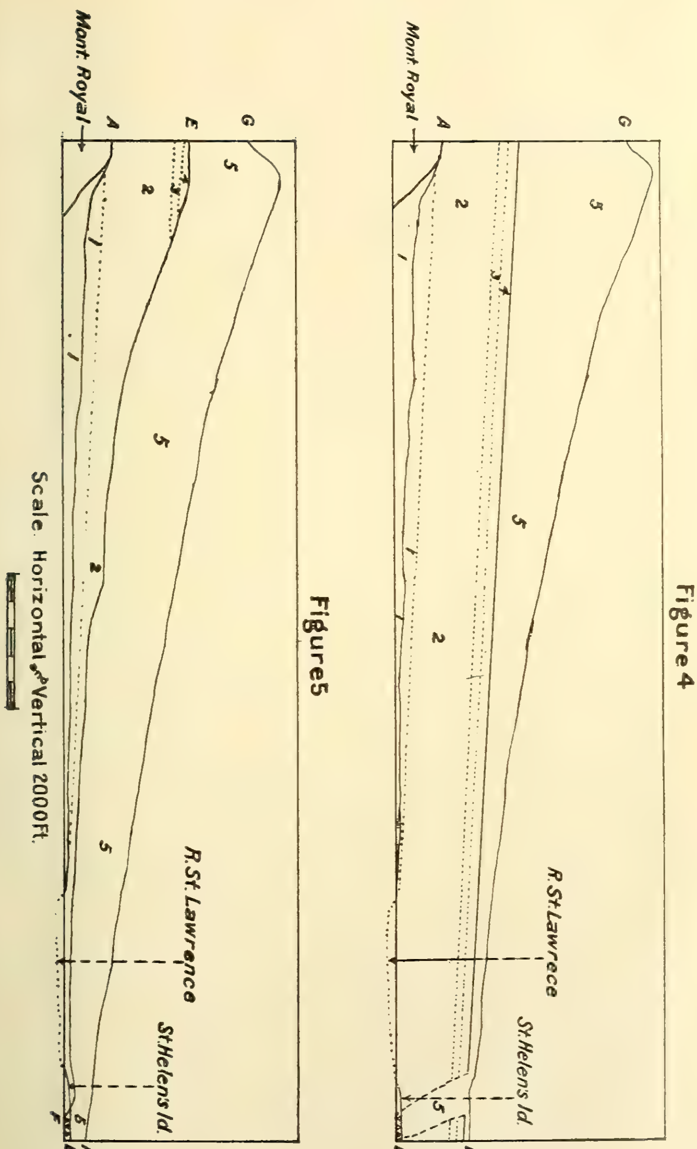
deposit would form the base of a volcanic cone, built up upon it by later eruptions of ashes and lava. Judging from the composition of the rocks of Mount Royal this ash would consist of a nepheline bearing lava, which in its finely divided state would readily alter by the action of percolating waters, to the impure dolomite now forming the matrix of the breccia. This seems a reasonable inference, as the nepheline bearing dyke rocks of the region show a marked tendency to alter to rhombohedral magnesian carbonates.

Jaggar's explanation of the breccia at Mato Teepee as a lava filled with rock fragments, constituting part of a sheet extending laterally through the strata, does not seem to be applicable in the case of the Montreal occurrences.

With respect to the position of the breccia on the Utica and other Ordovician formations, two explanations seem possible.

The first is, that deep fissures were formed during the first stages of the eruption, and that these extended down to the several formations of the Ordovician, and were filled wholly or partially by volcanic breccia. Figure 4 is a cross section from Mount Royal to St. Helen's Island. The line C. D. gives a profile of the volcano, and at the right of the section is a fissure extending down to the level of St. Helen's Island. In the other localities the fissures would extend down to the Calciferous or Trenton Subsequent erosion has reduced the surface from C. D. to A. B. as it is at present.

The second explanation demands a period of erosion after the deposition of the lower Oriskany, which would reduce the land surface to E. F. as in figure 5. Here it is seen that small remnants of the Lower Helderberg, and Lower Oriskany, remain directly over the centre of the subsequent volcanic activity. These and parts of the other formations, would be thrown out and deposited on



Scale Horizontal and Vertical 2,860 ft. to inch.

1. Utica.
2. Hudson River.
3. Lower Helderberg.
4. Driskany.
5. Volcanic ashes.

eroded surface E. F. Later accumulations would build the cone up to the line G. H. After the volcanic action had ceased, erosion would reduce the land to the line A. B., leaving isolated patches of the base of the cone or basal breccia. Of the explanations, the latter seems to be the more probable.

The breccia is post-Oriskany in age and may possibly be later Devonian.

Volcanic activity continued after its deposition as evidenced by the many dykes which cut it.

A point to be noted in this connection is that the Alnoite dykes must be older than the series about Mount Royal for as mentioned in the descriptions of the Ile Bizard and White Horse Rapids breccia Alnoite fragments are frequently found in those occurrences.

Petrography of the Dyke Rocks. It was stated on a former page that the Utica shale and the breccia on St. Helen's Island were cut by a series of dykes. About 20 of these were noted and mapped (see fig. 1), but it is probable that many more are concealed by the drift. They vary in direction from N. 60° W. to N. 80° W. Their width varies from 1 to 6 feet. Their length could not be ascertained as the drift on the one hand and the river on the other cut them off.

In addition to the dykes, a prominent sill occurs at the south end of the island. It is in two beds 0.8 and 1.6 feet respectively with a thin layer of altered shale between. Both the dykes and the sills belong to the great series which cut the Ordovician formations in this district, and which represent a phase of the Mount Royal eruption. It was found by the aid of the micoscope that these rocks could be divided into two classes, one containing feldspar, while in the other the mineral is absent.

Of the feldspathic class a specimen from the upper bed of the large sill was taken as a type.

Macroscopically the rock is porphyritic, dark grey in color, and fine grained. The lustre is dull, and the rock breaks with an irregular conchoidal fracture. Under the microscope the following minerals were recognized, plagioclase feldspar, hornblende, pyroxene, pyrite, magnetite, chlorite and calcite. The structure is typical panidiomorphic. The plagioclase is fresh and occurs in numerous slender lath-shaped individuals twinned according to the albite law. The hornblende is abundant but subordinate to the feldspar, and occurs in long slender phenocrysts. It is brown in color and the pleochroism is strong, ranging from very pale to dark brown, the absorption being $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$. The cleavage is good and the maximum extinction along $\infty P \breve{\infty}$ is 12°. The phenocrysts are greatly altered, the product being a pale green almost isotropic chlorite, and magnetite dust. A pale yellow pyroxene is subordinate in amount to the hornblende, and is much altered to chlorite and calcite. Iron ore is present as numerous small grains of magnetite and pyrite scattered throughout the section. Whatever the original base was, it is now represented by a fine calcite-chlorite aggregate.

The rock is a hornblende lamprophyre, and is allied to the Camptonites.

As a type of the non-feldspathic class, a specimen was chosen from the faulted dyke which cuts the inclusion of Lower Helderberg limestone mentioned as occurring in the breccia.

Macroscopically the rock is basaltic in appearance, and is both porphyritic and amygdaloidal. The amygdules are irregular or rounded in form, and contain both calcite and analcite, the former mineral usually occupying the centre of the cavity. Microscopically the rock is composed of pyroxene, hornblende, analcite, calcite, apatite, and magnetite.

The pyroxene is comparatively fresh and occurs in small slender oblong phenocrysts with rounded terminations. These lying in all directions interpenetrate to some extent. It is slightly pleochroic, the absorption ranging from colorless to pale yellow. The cleavage is good, and the extinction along $\infty P \grave{\infty}$ is 44°. The hornblende occurs as a few large irregular individuals, and in numerous small idiomorphic ones. The pleochroism varies from deep brown to pale yellow. The extinction along $\infty P \grave{\infty}$ is 22°.

Apatite in long slender needles and idiomorphic basal sections, is well represented. The ground mass consists of a finely granular aggregate of the ferro-magnesian constituents, but there is, in addition, a very large amount of isotropic material. This is colorless, quite allotriomorphic, and has a low index of refraction. Heated with hydrochloric acid, it gelatinizes. It is optically similar to the analcite in the cavities, but whether it is primary or secondary it is impossible to state.[1]

The analcite in the cavities is secondary, and in many cases has crystallized out, showing the outline of the tetragonal trisoctahedron. It occasionally is feebly doubly refracting.

The rock is evidently an olivine—free analcite basalt which corresponds to the Fourchites[2] of J. F. Williams.

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1. The Monchiquites or Analcite Group of Igneous Rocks, by L. V Pirsson. Jour. of Geol., Vol. IX., No. 6, 1896, p. 679, *et seq.*
2. Igneous Rocks of Arkansas. Rep. of Geol. Survey, 1890, p. 110.

Notable Display of Northern Lights During the Night of May 4th-5th, 1900.

By Mr. Charles J. Stuart.

The subject of the present note was an exceedingly interesting, and in several respects rather exceptional display of northern lights seen in this locality during the night of May 4th-5th, 1900.

Everyone is more or less familiar with the general appearance of the aurora, ever suggestive of the lone, mysterious North, and the robust poetic myth of the old Norseman, that the Merry Dancers, as they called these lights, were conducting in triumph the spirits of brave warriors to their Valhalla.

There is first the gathering arch of light rising slowly from the northern horizon; then the commencement of "rippling streamers," and dancing "beams" travelling to and fro; and on rarer occasions the overhead tent-like canopy of nervous fuming light, climbing to the magnetic zenith. In almost every display, the three successive stages can be noticed in some degree at least. In discussing the present occurrence, the observations divide naturally into two parts or phases.

In the earlier period, the auroral light was seen to be playing between separate layers of cloud, a thing rare in itself, but, when a second recurrence of the display had fully developed, I made the surprising discovery that the whole mass of light in a succession of six or seven arches, or great scollops, was moving steadily and quite rapidly from west to east across the sky. I thought at the time that the exhibition of such a movement was quite unique, but I have since read in a paper, by Professor Loomis, that displays of aurora borealis have been seen to move every way, South, North, East, West, and also swing or "turn around the vertical;" but I have not yet been able to find particulars of an observation quite corresponding to my own on this occasion.

Either locality or the maxima and minima of periods of frequency, may have a good deal to do with variations; but at the same time, I may say that the appearances in this neighbourhood are fairly regular in behaviour, and marked by typical weather conditions. The few exceptions that I have noticed seem to owe their peculiarity to the abnormal development of some condition, rather than to any distinct difference in the circumstances of the display. I may indicate briefly why I am inclined to attach importance to the observation under discussion.

In the first place, the height of the aurora has been computed to be at from 45 up to 500 miles above the earth's surface. Lower estimates have been made, but they are generally held to be in error. Professor Loomis says: "That, although it is *possible* the aurora may sometimes descend nearly to the earth's surface, there is no sufficient evidence to prove that the true polar light has ever descended so low as the region of ordinary clouds." Now, upon this occasion, while the light appeared to play *between* cloud levels, twice very distinctly rays were seen to gather more brightly, and leap up and down beneath patches of cirro-cumulus cloud, *which was more strongly illuminated on the underside.* The general body of thin cirrus clouds above seemed bathed in light, but in these two instances, I am positive about the difference of the illumination of the cirro-cumulus cloud being coincident with the gathering of rays, about their position, which apparently clung to them in a vertical beneath, and seemed reaching to the heavy stratus cloud bank below.

When you come to consider the practical difficulty of getting any well defined edge or point, to take angular measurements upon, much of the accuracy that we are accustomed to attribute to theodolite observations disappears, and I think the question of height might be susceptible of correction in some particulars.

I have long been of the opinion that the silent auroral discharge takes place between the higher reaches of the atmosphere and lower strata, where it becomes dispersed, and where air-currents of different electric potential play a somewhat similar part to thunder clouds. It would seem that the present observation tends to confirm that view. If, however, the aurora *never* descends to cloud level,—if 45 miles above the earth's surface is the lowest limit, and 500 the upper, it would be difficult to understand what air-currents could exist at that elevation, to play the part I have in mind. We would have to fall back on a superior atmosphere of cosmic dust, or something of that kind; and while meteoric dust no doubt *gives tone* to the spectroscopic light of the aurora polaris, yet we appear as far from the mechanism of the electric display, when assuming a medium of intrusive meteoric dust, as when we confine our flights of speculative ingenuity to the air.

In the second place, the West to East motion of the succession of arches, which was a distinct feature of the latter part of this display, leads me to suppose that almost every aurora has a certain amount of motion of the kind.

In support of this idea I may point out that while the rays or beams move east or west, up or down, and while the arch swells south, or sinks back north or sways east and west,—yet during a period of say half an hour, or more, spots and patches, and more particularly crests of recurrent brightness have a marked tendency to drift off to the east, and disappear there.

Likewise when the display is fuming and flickering up overhead, cloud like fields have the tendency to be every now and then re-illuminated. If these patches are watched for, they also exhibit a slow drift in their position, always to the east. Frequently as the display fades out, these drifting overhead patches *are replaced* by thickening fields of cirrus, or cirro-cumulus clouds, moving east, at about the same rate of speed, as the previous light. The presence and arrangement of these wisps of cloud are sometimes very difficult to distinguish at night, and at the dawning, the weather conditions often change; but on several occasions I have been able to distinguish this succession plainly enough by moonlight.

Now, if it could be established that the eastward drift was a feature of the average aurora, it would I think be a step toward establishing a connection with the wind circulation beneath, and possibly give a further insight into the nature of the phenomena in general.

These remarks of course apply to local observations entirely, but would no doubt be capable of extension to a wider region.

The evening was raw and overcast. At 11.20 p.m. it was still cloudy and cold. So much so, that heavy stratus clouds looked almost like snowing. At 11.45 it was clearing up on a westerly wind—showing fair and clear to the south. Cloud banks to the north passing down N.E. The pole-star could be seen at this time well above the cloud banks. There were two visible layers of cloud with the ledge of the auroral light lying between them. These banks to the north lay at a visual angle of from 40° to 60° above the horizon—rather higher in the eastern sky, at this time, but rapidly passing down. The lower layer was of the heavy stratus banks blowing smartly off to E. by N. The upper clouds had hardly any movement that was noticeable in comparison; but in places where masses showed thickest, there was a slow motion E. by S.—or inclined that way. These high clouds also showed marks of a N. and S. streak, or probably of a N. by W. blow, making wind ruffles. They were of the cirrus varieties, the highest part barred with wind, and the under inclined to a cumulus "cotton wool" bottom, showing a slow movement E. by S. They were thinning or evaporating, and soon only remained visible in the brightest light.

The lower or stratus clouds were illuminated on the upper side, while the cirrus clouds with enough body to show a shadow, *were illuminated on the under side mostly*, although often, as it were, appeared bathed in light—whereas the under side of the low-lying stratus bank appeared very dark by contrast. The development of the several stages of the aurora was exceedingly rapid and brilliant. The beaming or streamer state, which followed the first break of the clouds within five minutes, showed a distinct tendency to gather about and play between high and low masses of cloud, and under the action, the upper "fluff" looked to melt, or at any rate perceptibly diminish in density. The light toward the lower cloud bank was brighter, but that may have been from looking into a greater depth, or field of illumination; otherwise the light showed no very unusual phase, except that the principal zone of light played in a space apparently between two layers of cloud, and was simply the familiar to and fro dancing streamers. The light on the whole was very brilliant. In dark nooks, where the city arc-lamps did not interfere, I could see a cast shadow at times. The fuming or flickering state soon came on, but I noticed that this did not occur where masses of high cirrus cloud still appeared. When the fuming light reached the zenith, the patches showed an irregular streak, or mark, like long wisps lying W. and E., somewhat like "mare's tails." Several of these masses of distinct form were observed to recur. They lighted up at intervals, roughly, of two or three seconds, and across the stars showed a motion from W. to E. by S. (this motion is the usual thing when it can be observed). I take it that these were the remains of cirrus clouds seen as such previously, but now not thick enough to show as clouds at night. Four "shooting stars" were noticed all radiating from a point somewhere S.W.—but I was facing north, and only caught a glimpse of them over my shoulder Three were into the west (low) and one high N.E. These shooting stars had no effect whatever on the aurora, unless a red and green tinge for a short time afterwards could have been connected with their débris. The prevailing color of the auroral light was the common pale greenish yellow, but iridescent colors were at one time seen low west, and also high in the east. By one o'clock (a.m. 5th) the display had subsided to a considerable extent, and the weather was then clear and cold.

The cloud effects at the earlier period were of quite an exceptional combination, in my experience. Twice before, I have seen displays above the clouds, but these happened to be almost overhead. In this case, there was a section view, as it were, and the upper clouds for a time had enough body to show reflected light. The active light seemed confined to an air space lying between the two layers of cloud. This tended to confirm me in an opinion, formed from other scattered observations—namely, that while the arches may be higher, yet the active field of light seems to lie in a stratum of air, itself lying between two other air-currents blowing in different directions; and that the phenomenon is possibly largely due to thermal electricity.

2nd Phase.

By two o'clock a.m. (morning of May 5th) the arch had reformed and indications were for a renewal of the display. I sallied forth again, to the north end of Mount Royal, to get a free field of view, clear of the city lights. As the arch of the new aurora rose from the north, southward, it then exhibited a bend inwards to the northern horizon at both ends. When the arch reached a point almost overhead, the zone of light, which was very broad, was seen to be broken into long bands or streaks lying W. to E. but not in continuous belts, but rather mottled,—mottled streaks would describe the structure. I saw a somewhat similar appearance once before, and on another occasion in early spring three continuous bands, stretching from W. to E., right across the sky. This of course was simply the appearance of the arch viewed at an unusually high angle. The light at this period was simply a quiescent haze. At a later stage it showed a running wave transmission E. and W. (moving both ways), probably corresponding to the rippling beams. Still later it exhibited jerky leaps from streak to streak, passing south. From this time it began to sink and spread back to the north, and soon the whole broke into the fuming or flickering state.

At 2.15 a.m. this great arch had risen high and curved into the east (as is quite often seen), but to the west it had an extension suggesting an elliptical ring form. At this time the remains of the arch were sinking back north. At 2.20 a.m. I was in a position to see the horizon, *and the western extension was developing into a second arch.* I also became aware at about this time, that the whole body of the first arch *was shifting east.* The second arch from the west was followed by a third. It could then be plainly seen that the arches were not elliptical rings that might be completed below the horizon, but were great scollops or bows with a slow but steady motion from west to east. In fact, five such arches or bows *passed* within the hour, and a sixth rose high in the west; but as this last one came up, the fuming stage interfered, and the whole northern sky was soon in a flicker and continued so until dawn, which was then beginning to creep on apace.

This procession of connected arches was something quite exceptional as far as my experience goes. I never in the least suspected such a motion, but having seen it I can recall many peculiar appearances, whose explanation would be simplified by such a phenomenon. In fact, I now realize that probably every ordinary Aurora Borealis has a proper motion of this kind, but perhaps not often so rapid as it happened to be this time, also the legs or span of the arches is usually more extended, and certainly the primary phase of quiescence is very seldom so prolonged as on the occasion of this display. If for nothing else, the phenomena on this night were notable, and I hope properly observed here and elsewhere. The fifth arch to pass (at 2.50 or 2.55 a.m.) was particularly brilliant and much larger than any except, perhaps, the first at 2 o'clock. It was this fifth arch that showed the distinct divisions of the streaked movement overhead, as already mentioned,—first mottled streaks of light lying W. and E. ; second, a fluctuating ripple of light running E. and W., slowly to and fro and comparatively regular in progress, succeeded by the third stage of a waving passage of light from patch to patch always fuming up to the zenith or leaping N. to S. By 3 o'clock the first streaks of dawn were reddening in the east. The aurora was then commencing the active fuming of its last stage, a process of dispersion which continued until quite overpowered by the morning light.

Three more meteors radiating from a constellation in the S. W. were seen—and again for a short time iridescent colors followed low on the N. W. horizon, but I do not think the two phenomena were connected although the coincidence was noted. There was a thick hoar frost on exposed places, which is an unusual thing with an aurora here. At the same time, there was a good deal of swampy water still lying about (from rain and the spring melting) which may account for it. Several small dark clouds drifted with, but lower than the arches. They were rather low on the horizon, passing from W. to E. The light of the aurora was bright enough for me to see the time by my watch, but not enough to write notes, or sketch by. The stars were not especially bright, nor visible within some distance of the horizon, with one exception, almost due north, which showed under the fifth arch, for a short time ruddy and green, and was covered over again by cloud, or mist.

All night, the surface wind set cold from the N. W. It was the ordinary slow and steady wind, only more westerly than is usual. Several of these minor points such as wind, moisture, and an indefinite "*look* of the weather," that I am accustomed to associate with northern nights, were exceptional this time.

Sky at Dawn.

In the morning twilight, clouds became visible. There lay a low bank of wind-swept clouds (cirro-stratus) far along the northern and eastern horizon. There were larger banks in the south, showing wind flares on the northern edge. Both those east and south for a long time did not seem to move much, but at sunrise they began to shift rapidly. There were occasional cloudlets in the north, that had been noted under the aurora arches, these had a very slow motion to the east,—they afterwards, in the strengthening light, turned out to be high cumulus of the "cotton wool" variety, pretty far north. As the light increased, high cirrus clouds were seen, exhibiting double wind bars cross hatched E. and W. and N. W. to S., or thereabouts. Long wisps or "mare's tales" also lay toward the east. Just before sunrise, two columns of heavy vapor blew up on the surface wind at a smart pace,—one N. W. and one S. E. of my position. The northern column, although it showed great speed at first in the rolling mass of its body, yet did not make much progress. The masses looked to rise and evaporate, and showed a tendency to change direction and move E. by N. in the higher parts. The southern column soon became a heavy stratus-nimbus bank, changing direction and moving slowly E. by S. E., and had got far down by 5 o'clock. The sun rose copper red. The sky was not brilliant in color. The change from blue-gray to white daylight was rather rapid. It was a cold dawn after a frosty night, and at sunrise the clouds betokened a windy sky.

The Wind at Sunrise.

In day light the higher cirrus clouds showed cross hatched wind bars—short streak N. by W. to S. by E.—long streak W. to E. The lower cirrus, of the cotton wool kind, moved slowly to the east, with a tendency that might have been N. E., but as they were well down toward the horizon it was hard to judge their true direction. These clouds were the same as already mentioned floating under the arches of the aurora. The wind and surface clouds (morning mist from the lakes lying up the river) came from the W. or S. W.

But now a notable thing happened. Some of this misty "fluff" rising from the southern column already mentioned, was caught by a *south wind* and moved to the N.E. by N., or north, quite seven or eight points back from its first direction. I noted these changes of motion by the stem of a sapling in front of where I sat; it, like the similar clouds to the north, began to thin or evaporate, and like them did not travel far, although it moved quickly for a time. Not only so, more of this fluff rising as the sun's heat strengthened, drifted from the south, but rising higher began to exhibit the N. by W. to S. by E. wind bars, and shortly joined patches of cirrus cloud marked mackerel wise, floating to E. by N. (another change of direction.) By 5.15 a.m. the sky was almost clear. At 5.30 a.m., mare's tails and white wisps were out again, but I turned in to get warm, being nearly frozen.

About 6 o'clock a.m., a spread of cirrus clouds overhead (my view was now limited) exhibited a very windy appearance, and changed form from time to time rapidly (now and again suggesting the rippling motion of the beams of aurora.) High rolling bars lying almost E. and W. had a movement S.E., while numerous lower cross wisps lay N.W. by N. to S. by S.E., and showed some movement N.E., but these wisps were small and many and seemed to fill and back, while the whole mass or field had a motion almost due east at a goodly pace. The form and figure also changed rapidly, so it was difficult to say surely what the component movements actually were. A wavy or rippled appearance would grow in places, and again the wisps would be tossed in great confusion. All this time the body or field of cloud was sailing rapidly eastward. My impression on the whole was, however, that all the appearances were due to the body of cloud floating between two cross winds, the upper from the N. by N.W., the lower current W. by S., or S.W., with a gusty drift layer lying in between and moving to the east, as the resultant in which the cirrus clouds mostly floated.

Immediately below the upper winds there was a *dry* south wind, at least up to sunrise. I judge this by certain wind flares from the southern cloud bank seen in the early morning, and the behavior of the fluffy clouds that rose in the morning sunshine as noticed. That it was a dry wind I argue from its not carrying vapour, and absorbing cloudlets that rose into its influence. The only question with me is, could the existence of this southern under current be made to explain the markings and motions of the cirrus clouds above, and bearing to the east, yet I think not altogether, for the high cumulus verging on the lower cirrus clouds were "cotton wool" spindles and cumuli plainly floating in a wind current, while the high wind swept cirrus clouds were for the most part sharply barred and streaked, of which their eastward motion was evidently a direct composition or drift. Still, in the reckoning of these winds, I may be misinterpreting the indications. Reading the clouds is never an easy thing, except in their broad aspects. Certainly there was a surface wind blowing smoke to a different point from any of the clouds above; and the clouds were of at least three kinds, and had two distinct directions in well marked levels. We may, therefore, be quite sure that there were several currents of wind one above the other. At 8 o'clock very little cirrus clouds were visible. Large low cotton wool masses of cumuli were sailing rapidly toward the sun—lower surface wind still from the W.—but weather conditions distinctly changed. It was a brilliant morning until nearly noon, when it clouded over and came on a snow flurry, which did not last long. A few minutes after 1 p.m. it cleared, the cumulus clouds drifting to the S.E. The high cirrus clouds were still far above, and still cross hatched as before, and held their course east. They continued on in this way for the afternoon, when seen, and on Sunday following, but there was no noticeable renewal of northern lights.

The Trees of Montreal Island.

By F. C. Emberson, M.A.

"Exiguus spatio variis sed fertilis herbis."
"Its flowers countless, tho its acres few."

About half a century ago. I saw this written over the greenhouse of the famous Dr. Ward, originator of "The Wardian Case" It is in Virgil. He defied anyone to find out where. So do I.

Flora seems to have brought out her works in three successive volumes.

I. Plants without leaves.
II. Flowers with straight veined leaves.
III. Blossoming flowers with net-veined leaves.

(By "Blossoming flowers" is meant those with petals and sepals instead of petaloids).

These three kinds of plants are distinct in every respect, tho curiously blending into one another, and all follow the *predetermined* mathematical series,

0, 1, 2, 3, 4, ... n.

So phyllotaxis follows the series

$\frac{0}{0}$ $\frac{0}{1}$ $\frac{1}{1}$ $\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{5}$ $\frac{5}{8}$ etc.

These two series together *prove* the existence of a Creator who knew Algebra; which is good, as no knowledge, methinks, is of practical importance except in so far as it teaches us something about ourselves or God,—the latter concerning ourselves the most of the two.

VOL. I.—TREE FERNS.

"He wears fern-seed. He is invisible." As ferns have no seeds—only spores—it must be mighty hard to wear-'em.

These are not indigenous to Canada; a specimen or two may be found in the hot houses of the city.

The Conebearers.

Abies Alba—White Spruce.
A. Balsamea—Balsam.
A. Canadensis—Hemlock.
A. Rubra—Red Spruce.
A. Nigra—Black Spruce.
Juniperus nana—Juniper.
Larix Americana—Larch.
Pinus divaricata—Labrador Pine.
Pinus resinosa—Red Pine.
P. Strobus—White Pine.
Taxus Canadensis—Yew.
Thuja occidentalis—Cedar.

VOL. II.

Contains no trees such as the Dracænas and Palms indigenous in Canada.

VOL. III.

Contains trees belonging to (1) The Catkin bearers including A. The Willows. B. Poplars. C. Birches. D. Oaks. E. Walnuts, and (2) The Nettles. (3) The Maples. (4) The Rues. (5) The Lindens. (6) The Pulses or Butterflies (Leguminosæ). (7) The Roses. (8) The Olives.

III. (1)—CATKINBEARERS.

Or "Little Pussy-Cat bearers."—*Fr. Chaton.*

A. Willows.

Salix alba vitellina—Golden Osier.
S. amygdaloides—Peach-leaved Willow.
S. Bebbiana—Bebb's Willow.
S. discolor—Glaucous Willow or Bog Willow.
S. fluviatilis—Sand-bar Willow.
S. fragilis—Brittle Willow.
S. lucida—Shining Willow (Bright-eyed Salix.)
S. nigra—Black Willow or Black-eyed Salix.
S. Wardii—Ward's Willow.

B. Poplars.

Populus alba—White Poplar.
P. balsamifera—Balsam Poplar.
P. grandidentata—Large toothed Aspen.
P. monilifera—Cotton Wood.
P. monilifera, *Var.* candicans—Balm of Gilead.
P. tremuloides—American Aspen.

VOL. III.—THE BIRCH.

In my day this tree did nearly half the work of the schoolmasters in England. The Headmaster of Marlborough shortly before I taught there was a mannikin named Wool. The boys called him "Much Cry, Little Wool." Of Dr. Hawkins of Eton it was said that when upborne to Heaven by Cherubim he would be regretting all the way that there was nothing to flog.

Alnus incana—Speckled Alder.
A. viridis—Mountain Alder.
Betula lenta (pliant)—Black Birch.
B. lutea—Yellow Birch.
B. papyracea—Silver-barked Birch or Canoe Birch.
B. populifolia—American White Birch.

D. Oaks or Cup-bearers.

Carpinus Americana—Blue Beech.
Ostrya Virginica—Iron Wood.
Quercus Alba—White Oak.
Q. macrocarpa—White Oak. Bur Oak. Mossy cup.
Q. platanoides—Swamp White Oak.
Q. rubra—Red Oak.
Q. velutina—Black Oak.

VOL. I. (APPENDIX)—WALNUTS.

A Spaniel, a Woman and a Walnut tree
The more you beat them the better they be.

Carya alba—Shell-bark Hickory.
C. amara—Bitter Hickory.
C. porcina—Pignut.
Fagus ferruginea—Beech.
Juglans cinerea Butternut—Grey.

Mr. Geo. Trussell, of Pied du Mont, Montreal, showed me a tree which he said was neither butternut nor walnut but perhaps a hybrid between the two. Archie Robertson, of Westmount, another good authority, agrees with him.

I have provisionally named it Juglans Trusselli or Walbutternut.

Dr. Robert Campbell, to whom I owe *all* that is of any value in this list, is dubious about it.

VOL. II.—THE NETTLES.

This order contains the Hemp—the great Necktie tree.

Celtis occidentalis—Sugarberry, (at Colonel Crawford's, Lower Lachine Road).

Ulmus Americana—White Elm.

U. fulva—Slippery Elm. (An excellent lubricant for sore throat.)

U. racemosa—Cork Elm (At and near Col. Crawford's, Lower Lachine Road)

VOL. III.—RUE.

Let "Rue for Remembrance" remind those about to marry of Schillers'—

"Short the Wooing, Long the Rueing."

or of Punch's, "DONT!"

Xanthoxylum Americanum—Prickly Ash.

VOL. III.—THE MAPLES—SAPINDACEÆ.

What Christian Grace the Maple can eclipse
With Swéetness flowing from its bleeding lips.
—EMBERSON.

Acer dasycarpum (rough-fruited)—Silver Maple.
Acer negundo—Ash-leaved Maple.
A. Pennsylvanicum—Striped Maple.
A. rubrum—Red Maple.
A. saccharinum—Sugar Maple.
A. saccharum—Rock Maple.
A. spicatum—Mountain Maple.

III.—LINDENS.

Tilia Americana—Basswood.

III.—THE SUMACHS—ANACHARDIACEŒ.

The French name is Vinaigrier—Vinegar Tree. Vinegar used to be made of it blossoms, bark and twigs in Montreal.

Rhus typhina (smoky)—Staghorn Sumach or vinegar tree. Fr. Vinaigrier. (There was once a Vinegar Factory near the Champs de Mars, Montreal, where it was madé from fruit and twigs of this tree.)

III.—PULSES—BUTTERFLIES—LEGUMINOSÆ.

Robinia pseudacacia—Locust.
R. viscosa—Clammy Locust.

VOL. III.—ROSES.

The bonnie Rose blew, all yearning for Love
The Honey-bee flew and kissed from above
Faith kindles to see That some prescient Power
Made the Flower for the Bee and the Bee for the Flower.
—From Goëthe, by F. C. EMBERSON

Amelanchier botryapium—Shadbush.

A. Canadensis—Juneberry.

A. rotundifolia—Roundleaved Juneberry.

Cratœgus coccinea—Hawthorn.

C. crus-galli—Cockspur Thorn.

C. macracantha—Longspined Thorn.

C. Mollis—Red Thorn.

C. punctata—Yellow Haw.

C. rotundifolia—Glandular Thorn.

C. Tomentosa—Blackthorn or Pear Thorn. (The Irishman's joy.)

There are 14 species of Hawthorn on the road between the well and so favorably known, Verdun Hospital and Montreal.

Prunus Americana—Plum.

P. Pennsylvanica—Red Cherry.

P. Virginica—Choke Cherry. (Very handsome as a little tree, more often a shrub.)

Pyrus Americana—Mountain Ash.

P. Coronaria—Crab Apple.

P. Malus hybrida—Apple. (Of this there are different varieties and subvarieties.)

P. Serotina—Black Cherry.

III.—WITCH HAZELS.

Hamamelis Virginica—Witch Hazel.

The Divining Rod Hazel—my old pupil, Mr. Hepburn, of Picton, the well known owner of the Alexandria, etc.,—says he has never failed to find water with it.

III.—OLIVES.

And then in the land of my birth will I fall,
In the land of the Olive and Phig ;
And bury me deep in the What-do-yer-call
And play on the Thingamyjig.

Ashes.

"Fraxinus in silvis pulcherrima" Not thought so in houses.

Fraximus Americana—White Ash.

F. nigra—Black Ash.

Catalogue of Canadian Plants.

CATALOGUE OF CANADIAN PLANTS, PART VII.—LICHENES AND HEPATICAE. By JOHN MACOUN, M.A., F.R.S.C., Naturalist to the Geological Survey of Canada. Ottawa: Government Printing Bureau, 1902. Price, Ten Cents.

This volume, issued under the direction of the Geological Survey of Canada, will be heartily welcomed by botanists the world over as a valuable addition to the scientific stores of the North American Continent. By this publication, the veteran author acquires new laurels as the Nestor of the botanists of the Western world. It is pleasant to note how cordially his fellows in the prosecution of this branch of science have recognized the service he has rendered to it by affixing his name to a large number of the species described in this volume, and thus his zealous work becomes honourably commemorated and perpetuated. The distinction has been well earned by the Herculean labour which he has successfully performed, the results of which are embodied in his reports to the Government of Canada. The list of Hepaticae embraced in this publication—196 species and 7 varieties—includes the catalogue of 165 species already reported in 1890, as determined by William Henry Pearson, although the latter are, many of them, classed differently. Only one of the Hepaticae, *Anthoceros Macouni* (Howe), is described, because of its being hitherto unfamiliar to students of this department of botany.

The Lichens reported number 614 species and 119 varieties, of which only one species and three varieties are described, from which we are to conclude that the rest have been previously identified as occurring in Canada and elsewhere.

Nearly one-half of the volume is taken up with additions to the list of Mosses, published in 1892 by the Geological Survey. The number previously catalogued was 953. This number is now raised to 1,196, besides 77 sub-species and varieties given in this volume. A new Genus, "Bryo Brittonia," is described, embracing a single species. There is also furnished a description of 116 other species, 22 sub-species and 15 for a large number of the habitats varieties, besides new species reported in 1892. Doubtless the science of the future will make alterations in the determinations here given to the public by Professor Macoun, elevating sub-species and varieties to the dignity of species, and perhaps combining into one two or more species counted distinct in this catalogue. But any changes that may be effected in the ranking of the large materials which he has accummulated will not lessen the value of the work he has accomplished, or detract from the obligations under which he has anew laid the scientific world by this last contribution to the Natural History of Canada. His many friends will hope and pray that he may be spared to complete his work, by giving to the public in good time lists of the Fungi and Algae of the Dominion.

The Government has done well to offer this report, with paper cover, to those interested in the subject, at the low rate of ten cents. All students of botany should order copies at once.—R. C.

CONTRIBUTIONS TO CANADIAN PALAEONTOLOGY, PART II.—ON VERTEBRATA OF THE MID-CRETACEOUS OF THE NORTH-WEST TERRITORY. By HENRY FAIRFIELD OSBORN, *Vertebrate Palaeontologist Assistant Palaeontologist.* 1. Distinctive Characters of (*Honorary*) *of the Survey,* and LAWRENCE M. LAMBE, the Mid-Cretaceous Fauna, by Henry Fairfield Osborn. 2. New Genera and Species from the Belly River Series (Mid-Cretaceous) by Lawrence M. Lambe.

This publication of 81 pages is a sequel to the late Prof. Cope's article on "The Species from the Oligocene or Lower Miocene beds of the Cypress Hills," and in it Mr. Lambe gives additional proof of his rapidly extending acquaintance with Palaeontology, which he has been making his speciaity.

The first twenty-two pages are devoted to an introduction by Prof. Osborne, whose efficiency and gratuitous services to the Geological Survey of Canada, are heartily acknowledged by Dr. Robert Bell, administrative head of the Survey. Prof. Osborn, as Curator of the Department of Vertebrate Palaeontology, of the American Museum of Natural History, New York, has special qualifications for giving authoritative advice on all questions bearing on Vertebrate fossils. This work he undertook at the request of the late Dr. George M. Dawson, Director of the Survey. In his paper, he outlines the general characteristics of the fauna of the Mid-cretacious formation. The question he has sought to settle is the age to which the fossil remains of the Belly River series of rocks in the vicinity of Red Deer River, Northern Alberta, belong. Mr. Lambe made collections in the years 1897, 1898 and 1901, which have added materially to the data previously procured by Dr. G. M. Dawson, Mr. R. G. McConnell and Mr. J. B. Tyrrell, for determining the Geology of the region around Edmonton. Dr. G. M. Dawson had, with the materials then within reach, assigned the Belly River rocks to a later age, ranking them with the Laramie beds of Converse County, Wyoming, as Upper Cretaceous. Prof. Osborn institutes a detailed comparison between the two series named, and shows that the prevailing types of the remains of Vertebrate animals in the Belly River rocks have much more in common with the Montana or Mid-Cretaceous series. The four species most numerously found in the series under consideration are *Testudinata,* *Megalosauria, Iguanodontia* and *Ceratopsia ;* and there are many more of these species in the Montana than in the Laramie series. His conclusion is that the Belly River formation is older than the Laramie, not only because the fauna which it embodies is more ancient in character; but also because the animals belonging to both series seem to have reached a higher development in the Laramie than in the Belly series.

Mr. Lambe's contributions to the present publication gives detailed information regarding the fossils of the Belly River series. The species collected belong, for the most part, to the class REPTILIA. They occur abundantly and in an excellent state of preservation. Five species of *Pisces* are shown first, two of them being new: *Acipenser Albertensis*, and *Diphyodus longirostris*, belonging to a new Genus, DIPHYODUS. The BATRACHIA are represented by but one species, *Scapherpeton tectum.* The PLESIOSAURIDAE are also represented by only a single species, *Cimoliasaurus Magnus.* The CHELONIA family show *Trionyx foveatus, T. vagans, Adocus lineolatus, A. variolosus, Neurankylus eximius,*— a new Genus and species. The RHYNCHOCEPHALIA family is represented by *Champsosaurus annectens, Troödon formosus, Crocodilus humilis,* and *Bottosaurus perrugosus.* There are two species of DEINODON, *Deinodon horridus* and *D. explanatus*, belonging to the DINOSAURIA. A new species of Ornithomimus is reported, *O. altus.* Three species of the Stegosauridae are given, *Palaeoscincus costatus, P. asper,* and among them *Stereocephalus tutus*, a new species of a new Genus. The family CERATOPSIDAE is one of the most important of those included in the Belly River rocks. Three of the species reported by Mr. Lambe are new, *Monoclonius Dawsoni*, in honour of the late Dr. G. M. Dawson, Director of the Geological Survey, M. *Canadensis, M. Belli*, in honour of the present acting Director, Dr. Robert Bell, *Stegoceras validus.*

Three new species of TRACHODONTIDAE are described, *Trachodon (Pteropelyx) Selwyni*, named after a former Director of the Geological Survey of Canada,—*T. marginatus*, and *T. altidens.*

Mr. Lambe's paper concludes with a description of two new species of fossil mammals, *Ptilodus primaevus* and *Boreodon matutinus*, belonging to the family of PLAGIAULACIDAE. The determination of these species rests upon the fossil remains of teeth,—in the former case, the first molar and the fourth premolar are preserved ; in the latter case, the type is represented by a single tooth, a premolar, having two slightly divergent roots.

Figures occur all through the paper, showing details of the several species described in the text, and an appendix is added, containing twenty single plates and one double plate, admirably figured and finely printed, in which the leading features of the several species are seen differentiated. The publication does credit to the department issuing it, and cannot but add to the reputation for careful investigation and solid thinking of Mr. Lambe, whose good work it makes known.—R. C.

, 1902,

eet. C. H. McLEOD, *Superintendent.*

	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	75	0.28	....	0.28	1
	92	....	....	....	2
	20	0.09	....	0.09	3
	85	....	....	....	4
	30	*r*	....	0.00	5
Sund	82	....	....	....	6..........Sunday
	18	0.25	....	0.25	7
	85	0.03	....	0.03	8
	13	*r*	....	0.00	9
	70	....	....	....	10
	97	....	....	....	11
	80	*r*	....	0.00	12
Sund	51	....	....	....	13..........Sunday
	61	0.01	....	0.01	14
	09	0.93	....	0.93	15
	61	0.18	....	0.18	16
	00	0.36	....	0.36	17
	92	....	....	....	18
	30	....	....	....	19
Sund	28	*r*	....	0.00	20..........Sunday
	00	0.76	....	0.76	21
	22	*r*	....	0.00	22
	40	....	....	....	23
	44	0.04	....	0.04	24
	89	....	....	....	25
	88	....	....	....	26
Sund	02	0.04	....	0.14	27..........Sunday
	90	0.17	....	1.17	28
	65	....	....	....	29
	96	....	....	....	30
	84	*r*	....	0.00	31
Mean	56.5	3.14	....	3.14	..............Sums.
28 Y for an this m	¶ 59.0	4.24	....	4.24	28 Years means for and including this month.

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Warmest day was the 31st. Coldest day was the 17th.

Highest barometer reading was 30.17 on the 2nd; lowest barometer was 29.56 on the 15th; giving a range of .61 inches.

Minimum relative humidity observed was 40 on the 6th.

Rain fell on 18 days.

Thunder and lightning on the 7th, 8th, 15th, 17th and 31st.

Solar halo on the 13th.

Lunar Corona on the 13th.

ABSTRACT FOR THE MONTH OF JULY, 1902.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	64.2	74.0	55.0	19.0	29.87	30.02	29.81	.21	67	N.W.	12.0	75	0.28	....	0.28	1
2	68.2	75.6	59.8	15.8	30.11	30.17	30.02	.15	58	W.	13.3	92	....	....	....	2
3	63.4	69.3	60.5	8.8	29.89	30.08	29.79	.29	87	N.E.	9.7	20	0.09	....	0.09	3
4	68.0	75.2	58.5	16.7	29.94	30.01	29.89	.12	62	N.E.	8.4	85	....	....	....	4
5	70.0	78.2	64.0	14.2	29.87	29.92	29.85	.07	81	W.	6.9	30	r	....	0.00	5
SUNDAY........ 6	67.8	77.9	55.9	22.0	30.06	30.11	29.92	.19	55	N.E.	10.2	82	....	....	....	6..........SUNDAY
7	67.2	71.1	63.2	7.9	30.05	30.11	29.95	.16	79	S.	16.3	18	0.25	....	0.25	7
8	75.0	85.5	63.2	22.3	29.91	29.97	29.84	.13	75	W.	23.9	85	0.03	....	0.03	8
9	70.5	77.0	67.0	10.0	29.89	29.94	29.81	.13	81	N.	12.8	13	r	....	0.00	9
10	66.9	73.0	60.4	12.6	29.90	30.00	29.73	.21	61	N.W.	13.2	70	....	....	....	10
11	64.0	72.0	55.9	16.1	30.06	30.13	30.00	.13	61	N.W.	13.5	97	....	....	....	11
12	68.5	78.0	57.5	20.5	29.93	30.00	29.87	.13	64	S.W.	18.3	80	r	....	0.00	12
SUNDAY........13	71.4	81.0	62.5	18.5	29.89	29.94	29.84	.10	67	S.W.	20.5	51	....	....	....	13..........SUNDAY
14	73.7	82.4	66.8	15.6	29.88	29.94	29.82	.12	71	W.	14.2	61	0.01	....	0.01	14
15	64.3	73.5	57.8	15.7	29.65	29.78	29.56	.22	88	W.	14.9	09	0.93	....	0.93	15
16	60.7	68.0	54.5	13.5	29.82	29.90	29.65	.25	74	N.W.	13.9	61	0.18	....	0.18	16
17	57.3	62.0	54.0	8.0	29.74	29.90	29.59	.31	93	W.	12.0	00	0.36	....	0.36	17
18	65.5	73.8	55.2	18.6	29.91	30.09	29.71	.38	74	S.W.	21.1	92	....	....	....	18
19	65.5	75.0	57.0	18.0	30.04	30.12	29.93	.19	72	S.	3.6	30	....	....	....	19
SUNDAY........20	65.8	73.8	60.4	13.4	29.87	29.93	29.83	.10	73	S.E.	8.5	28	r	....	0.00	20..........SUNDAY
21	58.5	62.8	56.2	6.6	29.76	29.83	29.71	.12	97	E.	19.7	00	0.76	....	0.76	21
22	61.4	67.3	56.0	11.3	29.92	30.02	29.79	.23	83	E.	8.4	22	r	....	0.00	22
23	63.1	70.5	56.2	14.3	30.08	30.14	30.02	.12	86	S.E.	7.2	40	....	....	....	23
24	67.8	75.7	60.5	15.2	30.07	30.10	30.04	.06	84	S.	6.5	44	0.04	....	0.04	24
25	68.7	76.2	60.0	16.2	30.10	30.12	30.07	.05	70	S.	11.0	89	....	....	....	25
26	68.9	77.0	60.0	17.0	30.07	30.13	30.01	.12	73	S.	10.3	88	....	....	....	26
SUNDAY...... 27	66.7	72.0	61.5	10.5	29.94	30.02	29.81	.21	90	S.	13.5	02	0.04	....	0.14	27..........SUNDAY
28	73.0	80.2	66.0	14.2	29.85	29.92	29.81	.11	71	S.W.	20.7	90	0.17	....	1.17	28
29	72.5	80.4	63.1	17.3	29.97	30.02	29.92	.10	71	E.	5.5	65	....	....	....	29
30	73.2	82.9	62.8	20.1	29.98	30.03	29.93	.10	71	E.	7.0	96	....	....	....	30
31	76.2	86.0	65.0	21.0	30.01	30.05	29.93	.12	73	S.W.	7.9	84	r	....	0.00	31
Means......	67.35	75.07	59.88	15.19	29.936	30.01	29.85	.16	74.6	S. 6° W.	12.42	56.5	3.14	....	3.14	..............Sums.
28 Years means for and including this month	68.84	77.28	60.79	16.49	29.898	......	......	.14	71.8	....	§ 12.92	¶ 59.0	4.24	....	4.24	28 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	854	709	549	675	1155	1959	2094	1248	
Duration in hrs..	68	78	70	80	103	115	133	97	
Mean velocity....	12.6	9.1	7.8	8.4	11.2	17.0	15.7	12.3	

Greatest mileage in one hour was 46 on the 18th.
Greatest velocity in gusts was 68 on the 15th.

Resultant mileage, 2,366.
Resultant direction, S. 6° W.

Total mileage, 9,243.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 21 years only. § 16 years only.

The greatest heat was 86.0 above zero on the 31st: the greatest cold was 54.0 above zero on the 17th; giving a range of temperature of 32°.

Warmest day was the 31st. Coldest day was the 17th.

Highest barometer reading was 30.17 on the 2nd; lowest barometer was 29.56 on the 15th; giving a range of .61 inches.

Minimum relative humidity observed was 40 on the 6th.

Rain fell on 18 days.

Thunder and lightning on the 7th, 8th, 15th, 17th and 31st.

Solar halo on the 13th.

Lunar Corona on the 13th.

', 1902.

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

	possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	08	0.95	....	0.95	1
	16	0.96	....	0.96	2
SUND	70	....	....	....	3..........SUNDAY
	77	....	....	....	4
	54	r	....	0.00	5
	36	....	....	....	6
	57	r	....	0.00	7
	01	0.06	....	0.06	8
	96	....	....	....	9
SUND	53	....	....	....	10..........SUNDAY
	13	0.80	....	0.80	11
	30	....	....	....	12
	98	....	....	....	13
	60	....	....	....	14
	26	0.36	....	0.36	15
	83	....	....	....	16
SUND	91	....	....	....	17..........SUNDAY
	97	....	....	....	18
	84	....	....	....	19
	59	....	....	....	20
	02	1.18	....	1.18	21
	92	0.08	....	0.08	22
	39	r	....	0.00	23
SUND	97	....	....	....	24..........SUNDAY
	84	r	....	0.00	25
	63	0.02	....	0.02	26
	89	....	....	....	27
	92	....	....	....	28
	91	....	....	....	29
	90	....	....	....	30
SUND	78	....	....	....	31..........SUNDAY
Mean	51.7	4.41	....	4.41	..............Sums.
27 Y for a this m	¶ 58.0	3.60	....	3.60	27 Years means for and including this month.

	Warmest day was the 3rd. Coldest day was the 17th.
evel and	
Direc	
n from	Highest barometer reading was 30.26 on the 29th; lowest barometer was 29.57 on the 7th; giving a range of .69 inches.
Miles	
Dura ng 100. rs.	Minimum relative humidity observed was 48 on the 4th.
Mean	Rain fell on 12 days.
Great zero on / Great ve zero of 30.2°.	Thunder and lightning on the 1st and 21st. Lightning on the 31st.

ABSTRACT FOR THE MONTH OF AUGUST, 1902.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	71.2	80.5	67.7	12.8	29.91	29.92	29.89	.03	93	N.E.	6.5	08	0.95	....	0.95	1
2	66.7	71.0	62.1	8.9	29.91	29.93	29.89	.04	92	N.E.	4.5	16	0.96	....	0.96	2
SUNDAY........ 3	72.6	80.8	62.5	18.3	29.81	29.89	29.76	.13	74	S.	9.8	70	....	....	....	3..........SUNDAY
4	67.8	74.2	62.8	11.4	29.90	29.96	29.78	.18	61	N.E.	10.9	77	....	....	....	4
5	66.4	73.6	56.5	17.1	29.87	29.96	29.73	.23	62	S.	5.0	54	r	....	0.00	5
6	69.6	75.9	63.9	12.0	29.64	29.73	29.58	.15	79	S.W.	10.8	36	....	....	....	6
7	63.0	68.3	57.9	10.4	29.62	29.67	29.57	.10	79	N.W.	14.8	57	r	....	0.00	7
8	62.3	67.2	56.7	10.5	29.71	29.80	29.66	.14	83	W.	8.4	01	0.06	....	0.06	8
9	64.4	71.0	58.0	13.0	29.98	30.11	29.80	.31	73	N.W.	13.9	96	....	....	....	9
SUNDAY........10	66.7	76.1	53.0	23.1	30.05	30.13	29.94	.19	76	S.E.	9.3	53	....	....	....	10..........SUNDAY
11	68.1	78.0	66.0	12.0	29.79	29.94	29.70	.24	81	S.	14.5	13	0.80	....	0.80	11
12	58.6	62.3	55.6	6.7	29.99	30.11	29.80	.31	79	N.W.	16.0	30	....	....	....	12
13	62.9	70.7	52.9	17.8	30.10	30.18	30.04	.14	64	N.W.	13.1	98	....	....	....	13
14	66.0	75.6	52.0	23.6	30.00	30.06	29.94	.12	70	S.W.	16.6	60	....	....	....	14
15	60.3	66.4	55.2	11.2	29.92	29.96	29.89	.07	77	N.	8.9	26	0.36	....	0.36	15
16	59.2	66.4	52.0	14.4	29.86	29.91	29.80	.11	63	N.W.	7.5	83	....	....	....	16
SUNDAY........17	58.4	66.2	50.6	15.6	29.81	29.87	29.76	.11	66	N.W.	12.0	91	....	....	....	17..........SUNDAY
18	61.8	68.9	53.0	15.9	29.78	29.81	29.74	.07	64	N.W.	12.2	97	....	....	....	18
19	63.7	71.2	55.1	16.1	29.83	29.90	29.79	.11	71	N.W.	7.7	84	....	....	....	19
20	63.0	71.7	56.4	15.3	29.96	30.00	29.90	.10	71	S.	5.7	59	....	....	....	20
21	59.6	63.8	57.5	6.3	29.79	29.96	29.67	.29	92	S.W.	11.7	02	1.18	....	1.18	21
22	61.8	70.8	53.5	17.3	29.76	29.80	29.73	.07	79	S.W.	11.7	92	0.08	....	0.08	22
23	61.8	70.0	56.5	13.5	29.90	30.02	29.80	.22	85	N.	10.0	39	r	....	0.00	23
SUNDAY........24	64.6	71.4	55.5	15.9	30.07	30.12	30.02	.10	72	N.E.	9.2	97	....	....	....	24..........SUNDAY
25	68.3	77.8	57.5	20.3	29.98	30.06	29.88	.18	69	W.	6.0	84	r	....	0.00	25
26	69.2	77.5	64.5	13.0	29.83	29.88	29.78	.10	78	S.W.	16.5	63	0.02	....	0.02	26
27	63.1	69.5	58.4	11.1	30.03	30.12	29.86	.26	61	N.E.	6.1	89	....	....	....	27
28	63.4	72.4	51.7	20.7	30.19	30.23	30.12	.11	67	E.	3.2	92	....	....	....	28
29	66.6	76.8	56.1	20.7	30.21	30.26	30.16	.10	77	E.	3.6	91	....	....	....	29
30	69.0	79.0	58.0	21.0	30.11	30.19	30.02	.17	78	S.	4.8	90	....	....	....	30
SUNDAY........31	71.7	80.1	62.7	17.4	29.95	30.02	29.84	.18	77	S.	7.8	78	....	....	....	31..........SUNDAY
Means..........	64.89	72.42	57.48	14.94	29.912	29.98	29.83	.15	74.6	85° E.	9.67	61.7	4.41	....	4.41	..............Sums.
27 Years means for and including this month	66.71	74.97	58.83	16.14	29.941	......	......	.13	73.5	....	§ 12.01	¶ 58.0	3.60	....	3.60	27 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	548	652	326	205	869	1477	1310	1807	
Duration in hrs..	73	77	66	31	113	107	112	165	
Mean velocity....	7.5	8.5	4.9	6.6	7.7	13.8	11.7	11.0	

Greatest mileage in one hour was 25 on the 6th and 26th.
Greatest velocity in gusts was 25 on the 6th and 26th.

Resultant mileage, 2,709.
Resultant direction, 85° E.

Total mileage, 7,194.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 21 years only. § 16 years only.

The greatest heat was 80.8 above zero on the 3rd: the greatest cold was 50.6 above zero on the 17th; giving a range of temperature of 30.2°.

Warmest day was the 3rd. Coldest day was the 17th.

Highest barometer reading was 30.26 on the 29th; lowest barometer was 29.57 on the 7th; giving a range of .69 inches.

Minimum relative humidity observed was 48 on the 4th.

Rain fell on 12 days.

Thunder and lightning on the 1st and 21st.

Lightning on the 31st.

ER, 1902.

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

	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	03	0.37	....	0.37	1
	87	....	....	....	2
	96	....	....	....	3
	30	0.11	....	0.11	4
	93	....	....	....	5
	75	....	....	....	6
SUNDA	58	0.53	....	0.53	7 ....SUNDAY
	98	....	....	....	8
	40	0.33	....	0.33	9
	71	0.04	....	0.04	10
	92	....	....	....	11
	68	....	....	....	12
	00	0.35	....	0.35	13
SUNDA	94	....	....	....	14 ....SUNDAY
	93	....	....	....	15
	72	....	....	....	16
	74	....	....	....	17
	54	....	....	....	18
	23	....	....	....	19
	00	0.11	....	0.11	20
SUNDA	50	0.05	....	0.05	21 ....SUNDAY
	00	0.08	....	0.08	22
	03	0.76	....	0.76	23
	74	....	....	....	24
	69	....	....	....	25
	01	0.17	....	0.17	26
	00	0.01	....	0.01	27
SUNDA	00	r	....	0.00	28 ....SUNDAY
	25	....	....	....	29
	02	r	....	0.00	30
Means	49.1	2.91	....	2.91	..............Sums.
28 Y for anc this mc	¶ 53.67	3.28	....	3.28	28 Years means for and including this month.

-level and	Warmest day was the 1st. Coldest day was the 25th.
Directi ... ken from	Highest barometer reading was 30.36 on the 17th; lowest barometer was 29.52 on the 8th; giving a range of .84 inches.
Miles ...	
Durati being 100. ours.	Minimum relative humidity observed was 46 on the 6th.
Mean	Rain fell on 14 days.
	Rainbow on the 1st and 13th.
Greate ro on the	Thunder and lightning on the 23rd.
Greate ero on the 7.1°.	Lightning on the 7th.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1902.

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

DAY	THERMOMETER. † Mean.	Max.	Min.	Range.	* BAROMETER. ǁ Mean.	Max.	Min.	Range.	‡Mean relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	69.7	74.0	66.5	7 5	29.78	29.81	29.73	.08	93	S.W.	13.2	03	0.37	....	0.37	1
2	64.9	71.8	59.2	2.6	29.87	29.98	29.79	.19	64	N.W.	16.8	87	....	....	....	2
3	65.0	72.6	56 8	15.8	29.93	30.00	29.77	.23	72	S.W.	8.2	96	....	....	....	3
4	61.0	66.9	52.5	14.4	29.71	29.86	29.64	.22	81	S.W.	13.5	30	0.11	....	0.11	4
5	53.3	59 9	46 0	13 9	30.11	30 29	29.86	.43	67	N.W.	13.3	93	....	....	....	5
6	56 5	65.6	44.1	21.5	30 23	30.33	30.11	22	65	S.	7.5	75	....	....	....	6
SUNDAY........ 7	62.6	72.1	55.8	16.3	29.94	30.11	29 85	.26	79	S.E.	12.0	58	0.53	....	0.53	7............SUNDAY
8	63.3	71.5	55.0	16.5	29.98	30.04	29.91	.13	74	W.	7.4	98	....	....	....	8
9	65.2	75.9	54.8	21.1	29.69	29 91	29.52	.39	78	S.W.	12.5	40	0.33	....	0.33	9
10	55.7	63.7	49 6	14.1	29.86	29.99	29.62	.37	80	S.W.	13.2	71	0.04	....	0.04	10
11	59.9	69.0	48.5	20.5	30.02	30.06	29.99	.07	77	S.W.	7.1	92	....	....	....	11
12	62.3	71.5	53.9	17.6	30.07	30.11	30.03	.08	83	S.	4.3	68	....	....	....	12
13	57.2	63.5	50 2	13.3	29.97	30 05	29.89	.16	90	S.W.	9.3	00	0.35	....	0.35	13
SUNDAY........14	51.1	57.5	44 5	13.0	30.15	30.22	30 05	.17	73	S.W.	12.3	94	....	....	....	14...........SUNDAY
15	56.0	63.8	45.5	18.3	30.16	30.19	30.11	.08	73	S.W.	7.7	93	....	....	....	15
16	58.5	67.0	46.5	20.5	30.27	30.32	30.18	.14	83	S.	2.0	72	....	....	....	16
17	60.9	71 2	51.0	20.2	30.32	30.36	30.27	.09	78	S.	2.0	74	....	....	....	17
18	59 8	66.6	51.1	15.5	30.22	30.29	30.16	.13	82	S.	4.7	54	....	....	....	18
19	63.0	68.9	56.1	12.8	30.21	30.24	30.17	.07	83	S.	3.5	23	....	....	....	19
20	60.5	64.7	55.9	8.8	30.27	30.31	30.22	.09	96	N.	10.3	00	0.11	....	0.11	20
SUNDAY....... 21	65.3	74.9	57.5	17.4	30.19	30.27	30.10	.17	85	S.	2.8	50	0.05	....	0.05	21...........SUNDAY
22	63.9	69.0	58.2	10.8	30.02	30.10	29.96	.14	94	S.W.	1.9	00	0.08	....	0.08	22
23	65.0	70.8	62.1	8.7	29.86	29.96	29.78	.18	96	W.	5.9	03	0.76	....	0.76	23
24	50 9	62 5	44 0	18.5	30.14	30.26	29.86	.40	65	N.E.	9.2	74	....	....	....	24
25	47.8	55.7	38.8	16.9	30.26	30.33	30.19	.14	71	E.	7.7	69	....	....	....	25
26	53.7	57.5	43.8	23.7	30.10	30.19	29.97	.22	97	S.W.	5.2	01	0.17	....	0.17	26
27	62.4	69.3	57.1	12.2	29.85	29.97	29.76	.21	90	S.	3.7	00	0.01	....	0.01	27
SUNDAY...... 28	64.8	69.3	61.2	8.1	29.74	29.76	29 71	.05	93	N.	4.3	00	*r*	....	0.00	28...........SUNDAY
29	64.6	70.8	60.2	10.6	29.82	29.86	29.76	.10	89	N.E.	11.8	25	....	....	....	29
30	60.2	66.6	55.7	10.9	29.78	29.86	29.69	.17	91	N.E.	9.5	02	*r*	....	0.00	30
Means......	60.17	67.47	52.74	14.73	30.018	30.101	29 922	.179	81.4	S 88° W.	8.08	49.1	2.91	....	2.91	..............Sums.
28 Years means for and including this month	58.59	66.53	50 91	15.63	30.015	......	......	.185	76.4	....	§ 12.52	¶ 53.67	3.28	....	3.28	28 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	432	605	377	151	706	859	868	778	
Duration in hrs..	53	66	64	20	167	216	82	52	
Mean velocity....	8.1	9.2	5 9	7.5	4.2	4.2	10.6	15.0	

Greatest mileage in one hour was 24 on the 2nd.
Greatest velocity in gusts was 30 on the 2nd.

Resultant mileage, 1,146.
Resultant direction, S 88° W.

Total mileage, 5,817.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 21 years only. § 16 years only.

The greatest heat was 75.9 above zero on the 9th. The greatest cold was 38.8 above zero on the 25th, giving a range of temperature of 37.1°.

Warmest day was the 1st. Coldest day was the 25th.

Highest barometer reading was 30.36 on the 17th; lowest barometer was 29.52 on the 8th; giving a range of .84 inches.

Minimum relative humidity observed was 46 on the 6th.

Rain fell on 14 days.

Rainbow on the 1st and 13th.

Thunder and lightning on the 23rd.

Lightning on the 7th.

R, 1902.

eet. C. H. McLEOD, *Superintendent.*

D	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	00	0.15	....	0.15	1
	00	0.01	....	0.01	2
	25	....	....	....	3
	96	....	....	....	4
SUNDAY	10	0.00	....	0.00	5 ....SUNDAY
	10	0.69	....	0.69	6
	23	0.15	....	0.15	7
	48	0.06	....	0.06	8
	17	0.10	....	0.10	9
	95	....	....	....	10
	32	....	....	....	11
SUNDAY	04	....	....	....	12 ....SUNDAY
	00	0.07	....	0.07	13
	74	....	....	....	14
	07	0.01	....	0.01	15
	72	....	....	....	16
	92	....	....	....	17
	03	0.01	....	0.01	18
SUNDAY	09	0.06	....	0.06	19 ....SUNDAY
	67	....	....	....	20
	53	....	....	....	21
	32	0.11	....	0.11	22
	83	0.15	....	0.15	23
	00	0.20	....	0.20	24
	90	....	....	....	25
SUNDAY	00	0.09	....	0.09	26 ....SUNDAY
	23	0.06	....	0.06	27
	00	0.44	....	0.44	28
	22	0.01	....	0.01	29
	52	0.06	....	0.06	30
	63	0.06	....	0.06	31
Means.	38.7	2.49	....	2.49	..............Sums.
28 Yea for and i this mon	¶ 41.47	3.01	....	3.01	28 Years means for and including this month.

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Warmest day was the 1st. Coldest day was the 26th.

Highest barometer reading was 30.59 on the 26th; lowest barometer was 29.40 on the 6th; giving a range of 1.19 inches.

Minimum relative humidity observed was 52 on the 16th and 17th.

Rain fell on 20 days. Hoar-frost on the 18th.

Thunder and lightning on the 24th.

ABSTRACT FOR THE MONTH OF OCTOBER, 1902.

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 relative humidity.	WIND.H General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	60.4	65.5	57.2	8.3	29.72	29.87	29.67	.20	97	N.E.	5.9	00	0.15	....	0.15	1
2	51.5	56.5	49.6	6.9	30.03	30.09	29.87	.22	92	S.W.	7.3	00	0.01	....	0.01	2
3	52.3	59.1	46.1	13.0	30.08	30.12	30.02	.10	78	W.	7.3	25	....	....	....	3
4	46.2	52.5	41.8	10.7	30.09	30.15	30 03	.12	73	N.W.	5.9	96	....	....	....	4
SUNDAY........ 5	46.1	51.4	37.3	14.1	29.90	30.03	29.71	.32	91	E.	4.0	10	0.00	....	0.00	5............SUNDAY
6	54.2	60.1	50.3	9.8	29.52	29.71	29.40	.31	93	S.W.	13.6	10	0.69	....	0.69	6
7	52.8	63.2	45.8	17.4	29.70	29.76	29.66	.10	95	S.W.	10.7	23	0.15	....	0.15	7
8	43.1	54.6	41.0	13.6	29.93	30.02	29.76	.26	78	S.W.	13.8	48	0.06	....	0.06	8
9	40.4	46.4	37.3	9.1	30.16	30.35	29.98	.37	78	S.W.	10.2	17	0.10	....	0.10	9
10	40.4	48.1	31.3	16.8	30.30	30.42	30.12	.30	73	S.W.	9.1	95	....	....	....	10
11	48.8	59.6	36.0	23.6	29.89	30.12	29.74	.38	80	S.	3.2	32	....	....	....	11
SUNDAY........12	50.2	54.2	47.4	6.8	29.80	29.88	29.74	.14	79	N.E.	10.5	04	....	....	....	12............SUNDAY
13	53.4	62.8	41.8	21.0	29.67	29.90	29.51	.39	84	S.E.	10.0	00	0.07	....	0.07	13
14	45.9	62.8	38.3	24.5	29.78	29.93	29.55	.38	73	S.W.	18.5	74	....	....	....	14
15	44.6	46.8	37.8	9.0	29.81	29.93	29.73	.19	84	S.W.	14.4	07	0.01	....	0.01	15
16	41.6	48.0	36.3	11.7	30.02	30.24	29.80	.44	64	N.W.	10.9	72	....	....	....	16
17	34.9	39.8	30.8	9.0	30.33	30.38	30.24	.14	66	N.W.	5.2	92	....	....	....	17
18	38.9	47.6	27.1	20.5	30.16	30.34	29.95	.39	89	S.E.	2.8	03	0.01	....	0.01	18
SUNDAY........19	53.6	62.1	44.0	18.1	29.89	29.99	29.74	.25	93	S.W.	6.8	09	0.06	....	0.06	19 ....SUNDAY
20	44.9	58.6	39.8	18.8	29.97	30.08	29.87	.21	75	S.W.	21.6	67	....	....	....	20
21	37.5	42.6	34.3	8.3	30.28	30.34	30.08	.26	67	N.W.	13.7	53	....	....	....	21
22	40.4	46.6	30.2	16.4	30.18	30.35	30.00	.35	79	S.W.	8.0	32	0.11	....	0.11	22
23	37.8	44.6	33.0	11.6	30.27	30.39	30.00	.39	73	N.E.	10.6	83	0.15	....	0.15	23
24	43.0	48.8	29.8	19.0	29.97	30.34	29.65	.69	87	S.W.	9.3	00	0.20	....	0.20	24
25	42.0	58.5	34.0	24.5	30.22	30.57	29.65	.92	81	N.W.	18.5	90	....	....	....	25
SUNDAY........26	33.5	37.3	26.2	11.1	30.37	30.59	30.01	.58	79	S-W.	11.6	00	0.09	....	0.09	26...........SUNDAY
27	51.3	59.7	36.8	22.9	29.83	30.01	29.77	.24	82	S.W.	11.1	23	0.06	....	0.06	27
28	44.8	53.5	37.7	15.8	29.61	29.77	29.50	.27	92	N.W.	8.4	00	0.44	....	0.44	28
29	35.5	41.1	30.0	11.1	29.91	30.24	29.66	.58	77	N W.	18.1	22	0.01	....	0.01	29
30	34.1	40.8	26.0	14.8	30.28	30.44	30.03	.35	71	S.W.	6.2	52	0.06	....	0.06	30
31	39.4	45.4	33.7	11.7	30.31	30.51	30.07	.44	80	S.W.	14.3	63	0.06	....	0.06	31
Means............	44.63	52.21	37.70	14.51	29.999	30.157	29.825	.331	80.7	S 75° W.	10.36	38.7	2.49	....	2.49	..............Sums.
28 Years means for and including this month	45.90	52.90	39.00	13.91	30.014	......	......	.221	77.1	....	§ 13.24	¶ 41.47	3.01	....	3.01	28 Years means for and including this month.

ANALYSIS OF WIND RECORD.H

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	149	599	370	292	123	3644	522	2007	
Duration in hrs..	22	48	62	47	41	288	70	151	15
Mean velocity....	6.8	12.5	6.0	6.2	3.0	12.7	7.5	13.3	

Greatest mileage in one hour was 32 on the 20th.
Greatest velocity in gusts was 36 on the 20th.

Resultant mileage, 3,630.
Resultant direction, S 75° W.

H The wind records are from the instruments on the tower of the City Hall, Montreal.

Total mileage, 7,706.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 21 years only. § 16 years only.

The greatest heat was 65.5 above zero on the 1st. The greatest cold was 26.0 above zero on the 30th, giving a range of temperature of 39°.5.

Warmest day was the 1st. Coldest day was the 26th.

Highest barometer reading was 30.59 on the 26th; lowest barometer was 29.40 on the 6th; giving a range of 1.19 inches.

Minimum relative humidity observed was 52 on the 16th and 17th.

Rain fell on 20 days. Hoar-frost on the 18th.

Thunder and lightning on the 24th.

ER, 1902

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

	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	20	....	....	....	1
SUNDAY	71	0.00	....	0.00	2..........SUNDAY
	28	0.00	....	0.00	3
	70	....	....	....	4
	26	0.00	....	0.00	5
	00	0.26	....	0.26	6
	25	....	....	....	7
	87	....	....	....	8
SUNDAY	89	....	....	....	9..........SUNDAY
	38	0.01	....	0.01	10
	12	....	....	....	11
	00	1.07	....	1.07	12
	00	0.47	....	0.47	13
	46	0.27	....	0 27	14
	04	0.00	....	0.00	15
SUNDAY	46	0.00	....	0.00	16..........SUNDAY
	01	....	....	....	17
	00	0.08	....	0.08	18
	22	0.25	....	0.25	19
	01	....	....	....	20
	00	0.00	....	0.00	21
	01	0.07	....	0.07	22
SUNDAY	91	....	....	....	23.... .....SUNDAY
	17	0.03	....	0.03	24
	54	....	....	....	25
	00	....	1.5	0.12	26
	00	0.05	2.4	0.29	27
	00	....	2.0	0.15	28
	48	....	....	....	29
SUNDAY	32	....	....	....	30.........SUNDAY
Means.	27.9	2.51	5.9	3.07	.... Sums.
28 Ye for and this mor	¶ 28.66	2.33	13.61	3.72	28 Years means for and including this month.

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Warmest day was the 6th. Coldest day was the 26th.

Highest barometer reading was 30.53 on the 1st; lowest barometer was 29.24 on the 22nd; giving a range of 1.29 inches.

Minimum relative humidity observed was 53 on the 9th and 10th.

Rain fell on 16 days. Snow fell on 3 days.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1902

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

DAY	THERMOMETER. † Mean.	THERMOMETER. Max.	THERMOMETER. Min.	THERMOMETER. Range.	* BAROMETER. ‖ Mean.	* BAROMETER. Max.	* BAROMETER. Min.	* BAROMETER. Range.	‡Mean relative humidity.	WIND.H General direction.	WIND.H Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	36.9	40.2	33.5	6.7	30.45	30.53	30.36	.17	88	S.W.	2.0	20	....	....	....	1
SUNDAY........ 2	45.1	54.0	33.3	20.7	30.22	30.36	30.13	.23	81	S.	1.7	71	0.00	....	0.00	2..........SUNDAY
3	51.3	62.4	45.2	17.2	30.05	30.18	29.93	.25	80	S-W.	11.9	28	0.00	....	0.00	3
4	45.2	52.3	37.8	14.5	30.19	30.25	30 14	.11	83	S.W.	1.5	70	....	....	....	4
5	51.2	58.2	43.6	14.6	30.08	30.15	29.97	.18	77	S.	2.1	26	0.00	....	0.00	5
6	52.4	57.2	47.8	9.4	29.83	29.97	29.71	.26	87	S.W.	15.0	00	0.26	....	0.26	6
7	38.9	51.4	33.4	18.0	30.16	30.31	29.94	.37	70	S.W.	13.0	25	....	....	....	7
8	34.3	39.1	28.7	10.4	30.33	30.40	30.28	.12	76	S.E.	2.0	87	....	....	....	8
SUNDAY........ 9	38.7	46.5	29.3	17.2	30.16	30.28	29.97	.31	67	S.W.	3.0	89	....	....	....	9..........SUNDAY
10	39.5	46.9	27.9	19.0	30.07	30.30	29.94	.36	68	N.W.	13.5	38	0.01	....	0.01	10
11	27.4	36.0	22.0	14.0	30.38	30.46	30.28	.18	77	E.	5.5	12	....	....	....	11
12	30.6	33.5	28.5	5.0	29.98	30.24	29.78	.46	93	N.E.	10.4	00	1.07	....	1.07	12
13	29.7	37.8	24.5	13.3	30.20	30.35	29.99	.36	96	N.E.	9.6	00	0.47	....	0.47	13
14	39.9	42.7	34.3	8.4	30.10	30.17	29.98	.19	92	S.W.	5.5	46	0.27	....	0 27	14
15	45.2	54.3	36.2	18.1	29.90	30.03	29.78	.25	87	S·W.	11.5	04	0.00	....	0.00	15
SUNDAY....... 16	40.7	48.8	34.2	14.6	30.21	30.31	30.03	.28	83	S.W.	8.8	46	0.00	....	0.00	16..........SUNDAY
17	34.1	38.9	31.0	7.9	30.33	30.35	30.30	.05	85	N.E.	9.9	01	....	....	....	17
18	39.5	44.8	32.6	12.2	30.17	30.30	30.06	.24	83	N.E.	7.5	00	0.08	....	0.08	15
19	45.4	49.0	41.9	7.1	30.12	30.22	30.03	.19	84	S.W.	9.4	22	0.25	....	0.25	19
20	45.9	50.2	42.5	7.7	30.19	30.28	30.05	.23	83	S·W.	3.8	01	....	....	....	20
21	46.6	50.2	42.4	7.8	29.86	30 05	29 76	.29	87	S.W.	8.7	00	0.00	....	0.00	21
22	45.9	53.2	34.5	18.7	29.48	29.76	29.24	.52	81	S.W.	17.6	01	0.07	....	0.07	22
SUNDAY...... 23	29.1	41.0	25.2	15.8	29.66	29.73	29.48	.25	77	N.W.	19.8	91	....	....	....	23..........SUNDAY
24	39.7	43.9	25.2	18.7	29.42	29.59	29.30	.29	84	S.W.	13.1	17	0.03	....	0.03	24
25	31.7	39.9	24.2	15.7	29.86	30.08	29.53	.55	70	N.E.	12.6	54	....	....	....	25
26	24.2	29.0	19.0	10.0	29.87	30 08	29.68	.40	83	N.E.	24.8	00	....	1.5	0.12	20
27	28.6	32.5	24.1	8.4	29.55	29.68	29.50	.18	94	N E.	10.0	00	0.05	2.4	0.29	27
28	25.7	31.0	20.0	11.0	29.80	30.26	29.49	.77	82	S.W.	21.3	00	....	2.0	0.15	28
29	25.6	37.0	15.5	21.5	30.28	30.44	30.06	.38	75	S.E.	6.6	48	....	....	....	29
SUNDAY........30	35.0	39.0	27.4	11.6	30.01	30.05	29.97	.08	77	W.	23.4	32	....	....	....	30..........SUNDAY
Means......	38.16	44.69	31.52	13.17	30.030	30.172	29.889	.283	79.6	S 58° W.	10.18	27.9	2.51	5.9	3.07	.... Sums.
28 Years means for and including this month	32.67	38.91	26.79	12.12	30.014	......	......	.270	80.45	....	§ 15.62	¶ 28.66	2.33	13.61	3.72	28 Years means for and including this month.

ANALYSIS OF WIND RECORD.H

Direction......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	122	1640	347	107	379	3513	612	610	
Duration in hrs..	17	119	58	35	112	262	47	50	20
Mean velocity....	7.2	13.8	6.0	3.1	3.4	13.8	13.0	12.2	

Greatest mileage in one hour was 44 on the 30th.
Greatest velocity in gusts was 51 on the 30th.

Resultant mileage, 2,305.
Resultant direction, S 58° W.

H The wind records are from the instruments on the tower of the City Hall, Montreal.

Total mileage, 7,330.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 21 years only. § 16 years only.

The greatest heat was 62.4 above zero on the 3rd. The greatest cold was 15.5 above zero on the 29th, giving a range of temperature of 46°.9.

Warmest day was the 6th. Coldest day was the 26th.

Highest barometer reading was 30.53 on the 1st; lowest barometer was 29.24 on the 22nd; giving a range of 1.29 inches.

Minimum relative humidity observed was 53 on the 9th and 10th.

Rain fell on 16 days. Snow fell on 3 days.

BER, 1902,

7 feet. C. H. McLEOD, *Superintendent.*

	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	35	....	0.0	0.00	1
	00	....	2.8	0.11	2
	00	0.13	3.6	0.53	3
	78	....	0.2	0.04	4
	00	....	....	....	5
	60	....	....	....	6
SUNDA	00	....	2.7	0.30	7 ....SUNDAY
	25	....	0.5	0.05	8
	100	....	...	....	9
	00	....	7.3	0.53	10
	37	....	....	....	11
	29	....	....	....	12
	00	....	....	....	13
SUNDA	100	....	....	....	14..........SUNDAY
	00	....	....	....	15
	00	0.24	1.2	0.42	16
	08	....	0.7	0.06	17
	24	....	0.8	0.04	18
	07	0.00	0.1	0.00	19
	100	....	....	....	20
SUND	00	0.93	0.1	0.94	21 ....SUNDAY
	00	0.13	....	0.13	22
	25	....	....	....	23
	64	....	....	....	24
	00	....	0.5	0.05	25
	00	....	4.8	0.49	26
	00	....	4.4	0.36	27
SUND	53	....	0.1	0.01	28..........SUNDAY
	13	....	1.5	0.19	29
	01	....	....	....	30
	00	....	....	....	31
Mean	24.5	1.43	31.3	4.25	..............Sums.
28 Y for an this m	¶ 26.87	1.38	23.59	3.67	28 Years means for and including this month.

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Mean

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Grea f 59°.3.

H T

Warmest day was the 22nd. Coldest day was the 9th.

Highest barometer reading was 30.80 on the 15th; lowest barometer was 29.38 on the 3rd, giving a range of 1.42 inches.

Minimum relative humidity observed was 39 on the 9th.

Rain fell on 5 days. Snow fell on 17 days.

Rain and snow on 4 days.

No. inches snow on ground 18.

ABSTRACT FOR THE MONTH OF DECEMBER, 1902.

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 relative humidity.	WIND. H General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	30.2	33.4	26.0	7.4	29.86	29.94	29.81	.13	84	W.	11.5	35	....	0.0	0.00	1
2	28.1	30.5	25.8	4.7	29.89	29.94	29.80	.14	87	N.E.	7.8	00	....	2.8	0.11	2
3	26.9	30.3	23.0	7.3	29.55	29.84	29.38	.46	97	N.E.	15.3	00	0.13	3.6	0.53	3
4	17.9	29.6	11.0	18.6	29.95	30.05	29 64	.41	79	N.W.	14.5	78	....	0.2	0.04	4
5	8.6	16.6	3.9	12.7	29.99	30.10	29.89	.21	71	N.W.	12.7	00	....	....	....	5
6	6.1	11.8	2.3	9.5	30.32	30.42	30.10	.32	75	N.W.	6.5	60	....	....	....	6
SUNDAY........ 7	8.6	11.0	2.8	8.2	30.06	30.40	29.82	.58	84	N.E	8.6	00	....	2.7	0.30	7............SUNDAY
8	—0.8	11.0	—16.0	27.0	30.01	30.27	29.86	.41	61	S.W.	21.9	25	....	0.5	0.05	8
9	—12.9	—8.2	—20.0	11.8	30.38	30.45	30.27	.18	47	S.W.	14.3	100	....	...	....	9
10	12.8	31.2	—9.5	40.7	29.93	30.38	29.61	.77	77	S.W.	13.0	00	....	7.3	0.53	10
11	4.4	22.6	0.1	22.5	30.29	30.38	30.06	.32	62	E.	8.0	37	....	....	....	11
12	—1.0	4.0	—5.0	9.0	30.45	30.54	30.33	.21	69	N.E.	4.7	29	....	....	....	12
13	—1.5	3.2	—7.7	10.9	30.45	30.54	30.37	.17	69	N.E.	23 2	00	....	....	....	13
SUNDAY........14	—0.1	4.2	—10.7	14.9	30.62	30.69	30.47	.22	63	S.W.	7.6	100	....	....	....	14...........SUNDAY
15	7.5	10.9	—0.5	11.4	30.71	30.80	30.52	.28	76	N.E.	4.9	00	....	....	....	15
16	29.6	38.2	9.0	29.2	30.01	30.52	29.74	.78	91	S.W.	10.7	00	0.24	1.2	0.42	16
17	31.9	38.5	28.6	9.9	29.64	29.74	29.57	.17	93	S.W.	20.4	08	....	0.7	0.06	17
18	28.3	34.0	18.7	15.3	29.65	29.86	29.53	.33	85	S.W.	20.1	24	....	0.8	0.04	18
19	26.6	35.3	18.4	16.9	29.82	30.09	29.64	.45	85	S.W.	13.2	07	0.00	0.1	0.00	19
20	12.4	26.4	8.0	18.4	30.43	30.54	30.09	.45	76	N E.	6.5	100	....	....	....	20
SUNDAY........21	20.0	35.2	9.3	25.9	30.23	30 50	29 79	.71	94	N.E.	9.1	00	0.93	0.1	0.94	21 ....SUNDAY
22	34.3	39.3	24.4	14.9	29.76	30.06	29.58	.48	87	S.W.	19.5	00	0.13	....	0.13	22
23	14.3	28.9	7.5	21.4	30.29	30.45	30.06	.39	75	N.W.	10.5	25	....	....	....	23
24	8.2	11.8	4 5	7.3	30.31	30.45	30.14	.31	82	N.E.	7.3	64	....	....	....	24
25	14.1	19.8	5.5	14.3	30.05	30.14	29.99	.15	90	N.E.	13.5	00	....	0.5	0.05	25
26	20.0	21.8	17.5	4.3	29.92	30 00	29.87	.13	95	N E.	20.9	00	....	4.8	0.49	26
27	19.1	22.0	16.0	6.0	29.79	29.88	29.71	.17	92	N.E.	14.4	00	....	4.4	0.36	27
SUNDAY...... 28	9.9	18.7	6.2	12.5	29.93	30.03	29.88	.15	78	S.W.	14.2	53	....	0.1	0.01	28............SUNDAY
29	24.5	32.2	7.2	25.0	29.94	30.08	29.79	.29	93	S.W.	9.4	13	....	1.5	0 19	29
30	27.8	32.1	22.5	9.6	30.00	30.08	29.90	.18	87	S.W.	17.9	01	....	....	....	30
31	26.9	30.0	22.8	7.2	30.13	30.18	30.07	.11	85	S.W.	22.3	00	....	....	....	31
Means......	15.57	22.78	8.12	14.67	30.075	30.237	29 912	.325	80.3	N 84° W.	13.01	24.5	1.43	31.3	4.25	..............Sums.
28 Years means for and including this month	19.10	26.09	11.99	14.11	30.031	......	......	.296	83.3	....	§ 15.94	¶ 26.87	1.38	23.59	3.67	28 Years means for and including this month.

ANALYSIS OF WIND RECORD. H

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	516	2629	249	156	120	4033	676	1320	
Duration in hrs..	54	172	53	24	24	236	63	99	19
Mean velocity....	9.6	15.3	4.7	6.5	5.0	17.1	10.7	13.3	

Greatest mileage in one hour was 39 on the 22nd.
Greatest velocity in gusts was 48 on the 22nd.

Resultant mileage, 2,260.
Resultant direction, N 84° W.

H The wind records are from the instruments on the tower of the City Hall, Montreal.

Total mileage, 9,699.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 21 years only. § 16 years only.

The greatest heat was 39.3 above zero on the 22nd. The greatest cold was 20.0 below zero on the 9th, giving a range of temperature of 59°.3.

Warmest day was the 22nd. Coldest day was the 9th.

Highest barometer reading was 30.80 on the 15th; lowest barometer was 29.38 on the 3rd, giving a range of 1.42 inches.

Minimum relative humidity observed was 39 on the 9th.

Rain fell on 5 days. Snow fell on 17 days.

Rain and snow on 4 days.

No. inches snow on ground 18.

RY, 1903

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

	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	84	....	....	....	1
	20	....	....	....	2
	00	0.24	4.3	0.67	3
SUNDA	13	0.01	....	0.01	4 ....SUNDAY
	13	....	0.0	0.00	5
	09	....	0.1	0.01	6
	13	....	2.0	0.21	7
	15	....	1.0	0.12	8
	33	....	0.8	0.07	9
	17	....	0.1	0.01	10
SUNDA	00	....	6.7	0.47	11 ....SUNDAY
	45	....	2.0	0.26	12
	08	....	....	....	13
	70	....	....	....	14
	00	....	1.3	0.08	15
	28	....	0.0	0.00	16
	01	....	0.8	0.09	17
SUNDA	86	....	0.0	0.00	18 ....SUNDAY
	86	....	...	....	19
	54	....	....	....	20
	00	....	13.4	1.60	21
	48	....	0.0	0.00	22
	82	....	0.5	0.04	23
	34	....	....	....	24
SUNDA	00	....	0.0	0.00	25..... .....SUNDAY
	00	....	0.0	0.00	26
	00	0.00	....	0.00	27
	00	0.00	....	0.00	28
	00	0.21	....	0.21	29
	16	0.18	0.3	0.21	30
	73	....	0.2	0.02	31
Means	27.3	0.64	33.5	4.08	.... Sum.
29 Y for an this m	¶ 34.47	0.847	30.00	3.715	28 Years means for and including this month.

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Warmest day was the 29th. Coldest day was the 19th.

Highest barometer reading was 30.59 on the 24th ; lowest barometer was 29.11 on the 12th, giving a range of 1.48 inches.

Minimum relative humidity observed was 30 on the 19th.

Rain fell on 6 days. Snow fell on 24 days.

Rain and snow on 2 days.

Fog on 4 days.

No. inches snow on ground 15.

ABSTRACT FOR THE MONTH OF JANUARY, 1903

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

DAY	THERMOMETER.				* BAROMETER.				‡Mean relative humidity.	WIND.H		Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour.					
1	30.4	36.0	20.4	15.6	30.07	30.14	29.98	.16	89	S.W.	20.8	84	....	....	....	1
2	29.6	34.1	25.9	8.2	30.16	30.24	29.99	.25	88	S.W.	8.6	20	....	....	....	2
3	32.8	34.8	27.4	7.4	29.54	29.99	29.38	.61	93	N.E.	5.4	00	0.24	4.3	0.67	3
SUNDAY........ 4	30.3	34.6	25.2	9.4	29.64	29.73	29 44	.29	89	S.W.	10.7	13	0.01	....	0.01	4............SUNDAY
5	20.3	28.0	14.4	13 6	29.76	29.82	29.66	.16	90	S.W.	9.0	13	....	0.0	0.00	5
6	12.6	16.6	6.8	9.8	29.69	29.81	29.60	.21	85	S.W.	6.7	09	....	0.1	0.01	6
7	4.7	11.7	0.0	11.7	29.51	29.61	29.32	.29	85	N.	10.0	13	....	2.0	0.21	7
8	5.8	11.0	0.2	10.8	29.36	29.52	29.26	.26	88	W.	15.0	15	....	1.0	0.12	8
9	—5.5	2.0	—11.4	13.4	29.56	29.68	29.42	.26	81	W.	11.5	33	....	0.8	0.07	9
10	—0.1	9.8	—11.8	21.6	29.88	30.03	29.68	.35	81	W.	8.3	17	....	0.1	0.01	10
SUNDAY........11	14.7	20.5	6.1	14.4	29.76	30.07	29.18	.89	91	W.	5.4	00	....	6.7	0.47	11..........SUNDAY
12	14.3	23.6	6.0	17.6	29.49	29.80	29.11	.69	79	N.W.	24.5	45	....	2.0	0.26	12
13	2.3	14.2	—3.9	18.1	30.43	30.19	29.80	.39	59	N.W.	16.0	08	....	....	....	13
14	6.7	11.8	—0.9	12.7	30.12	30.21	29.93	.28	65	W.	11.5	70	....	....	....	14
15	23.1	27.9	9.9	18.0	29.69	29.93	29.60	.33	89	W.	13.2	00	....	1.3	0.08	15
16	24.8	32.4	14.6	17.8	29.80	29.86	29.70	.16	90	W.	13.2	28	....	0.0	0.00	16
17	28.7	33.9	11.9	22.0	29.47	29.70	29 34	.36	96	W.	14.4	01	....	0.8	0.09	17
SUNDAY........18	—2.1	22.4	—11.4	33.8	29.94	30.28	29.57	.71	64	N.W.	19.0	86	....	0.0	0.00	18..........SUNDAY
19	—10.2	—4.0	—20.0	16.0	30.52	30.57	30.28	.29	54	S.W.	8.7	86	....	...	....	19
20	2.4	16.8	—10.1	26.9	30.37	30.56	30.23	.33	79	S.E.	0.4	54	....	....	....	20
21	21.6	30.8	4.1	26.7	29.83	30.23	29.60	.63	92	N.E.	9.4	00	....	13.4	1.60	21
22	15.0	28.1	10.0	18.1	29.87	29.95	29.74	.21	80	W.	6.1	48	....	0.0	0.00	22
23	11.2	23.6	0.2	23.4	30.10	30.44	29.84	.60	75	N.W.	16.2	82	....	0.5	0.04	23
24	—4.5	3.4	—10 9	14.3	30.53	30.59	30.44	.15	67	N.E.	3.2	34	....	....	....	24
SUNDAY........25	—3.8	3.1	—13.4	16.5	30.40	30.45	30.36	.09	68	N.	10.6	00	....	0.0	0.00	25..........SUNDAY
26	6.9	11.0	1.0	10.0	10.41	30.46	30.33	.13	86	N.E.	7.5	00	....	0.0	0.00	26
27	26.2	31.5	7.8	23.7	30.16	30.33	30.12	.21	94	S.	3.0	00	0.00	....	0.00	27
28	31.6	33.8	29.1	4.7	29.99	30.12	29.89	.23	96	E.	1.1	00	0.00	....	0.00	28
29	34.2	38.2	29.9	8.3	29.80	30.03	29.42	.61	98	S.E.	3.3	00	0.21	....	0.21	29
30	30.8	38.6	13.6	25.0	29.26	29.42	29.17	.25	88	S.W.	17.1	16	0.18	0.3	0.21	30
31	18.0	21.8	10.4	11.4	29.72	29.96	29 41	.55	73	N.W.	...	73	....	0.2	0.02	31
Means...... ..	14.61	22.00	5.84	16.16	29.898	30.055	29.703	.352	81.3	N 77° W.	10.33	27.3	0.64	33.5	4.08	.... Sum.
29 Years means for and including this month	12.77	20.77	4.51	16.26	30.046	......	......	.334	82.5	....	§ 16.23	¶ 34.47	0.847	30.00	3.715	28 Years means for and including this month.

ANALYSIS OF WIND RECORD.H

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	552	501	190	40	101	1708	2286	2059	
Duration in hrs..	59	50	41	12	31	128	217	122	60
Mean velocity....	9.4	10.0	4.6	3.3	3.3	13.3	10.5	16.9	

Greatest mileage in one hour was 35 on the 12th.

Greatest velocity in gusts was 44 on the 30th.

Resultant mileage, 4,494.

Resultant direction, N 77° W.

H The wind records are from the instruments on the tower of the City Hall, Montreal. Mean for 30 days only.

Total mileage, 7,437.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 16 years only.

The greatest heat was 38.6 above zero on the 30th. The greatest cold was 20.0 below zero on the 19th, giving a range of temperature of 58.6°.

Warmest day was the 29th. Coldest day was the 19th.

Highest barometer reading was 30.59 on the 24th; lowest barometer was 29.11 on the 12th, giving a range of 1.48 inches.

Minimum relative humidity observed was 30 on the 19th.

Rain fell on 6 days. Snow fell on 24 days.

Rain and snow on 2 days.

Fog on 4 days.

No. inches snow on ground 15.

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INCLUDING THE PROCEEDINGS OF

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AND REPLACING

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CONTENTS.

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Canadian Fungi.

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

Thus far the reports of the Geological Survey of Canada have not listed the fungi of the Dominion. No very considerable number of this family of plants found in Canada has been reported or published hitherto. In the "Canadian Naturalist," Vol. II. (New Series), issued in 1865, there is found, pp. 390-3, "A Provisional Catalogue of Canadian Cryptogams," by Mr. D. A. P. Watt, which includes a list of the "Alliance Fungales" of our country, as known at that date. Those collecting at that time had, however, confined themselves mainly to the microscopic forms. Since then Mr. J. Dearness, of London, Ontario, has prosecuted the study of the latter, the *Physomycetes*, but his collections have been reported mainly in American magazines, although two papers from him bearing on this subject have appeared in this journal (Volumes V. and VIII). The undersigned list, collected partly at Cap-a-L'aigle, in July and August, 1902, and partly around Montreal, in September and October, 1902, and from August to October, 1903, embraces 129 species. Of these only about 25 are mentioned in Mr. Watt's catalogue, without any information as to where and when they were found.

In late years, much attention has been given to the native mushrooms or toadstools of this continent by the botanists of the United States, resulting in several important publications on the subject. I have availed myself of the information and descriptions given in three of these publications—"Studies of American Fungi," by Prof. George Francis Atkinson, of Cornell University; "Students' Handbook of Mushrooms of America," by Dr. Thomas Taylor, Chief of the Division of Microscopy, United States Department of Agriculture; and the "Reports of the New York Museum of Natural History," by Prof. C. H. Peck, State Botanist. I have not had access to the larger and more recent volume of Mr. Charles McIlvaine, of Philadelphia.

Special interest in this subject was first awakened in Montreal by a paper communicated to the Natural History Society by Miss Mary Van Horne in the winter of 1902, in which she described some sixty odd species which she and her niece, Miss Agnes Van Horne, had collected around their summer home at St. Andrews, New Brunswick. The list then submitted and described, it is hoped, will yet be given to the readers of the RECORD OF SCIENCE. Of the species given below, it will be observed that the number reported as edible is vastly greater than that of the poisonous ones. The knowledge of this fact has created a good deal of popular curiosity, for the word toadstool has generally been regarded as ominous—something to be avoided. Now that many species are found to be delicious and nutritious, it may be expected that this branch of botanical study will obtain new recruits. So distinct are the mushrooms from other vegetable organisms that a person who knows little or nothing of botany generally may take up the subject and prosecute it successfully. The subjoined list contains the substance of two papers submitted to the Natural History Society of Montreal. The order followed is that observed in Prof. Atkinson's work.

BASIDIOMYCETES.

Hymenomycetes.

AGARICACEÆ—GILL-BEARING FUNGI.

(PURPLE BROWN SPORED AGARICS.)

Agaricus silvaticus Schaeff. (Edible.) Edge of woods, Cap-a-L'aigle, July.

Hypholoma sublateritium Schaeff. (Edible.) Mount Royal, August.

Hypholoma appendiculatum Bull. (Edible.) Mount Royal Cemetery, October.

Stropharia semiglobata Batsch. In fields, Cap-a-L'aigle, August.

(BLACK-SPORED AGARICS.)

Coprinus comatus Fries. (Edible.) Mount Royal Cemetery, October.

Coprinus atramentarius (Bull) Fries. (Edible.) Mount Royal Cemetery, Westmount and Fort Street, August-October.

Coprinus micaceus (Bull) Fries. (Edible.) Mount Royal Cemetery, McGill College Grounds and St. Famille Street, July-October.

Panæolus retirugis Fries. Mount Royal Cemetery, July.

Psathyrella disseminata Pers. At the foot of maple tree, Cemetery Road, May.

(WHITE-SPORED AGARICS.)

Amanita Muscaria Linn. (Poisonous.) Under spruces, Cap-a-L'aigle, August.

Amanita phalloides Fries. (Deadly poisonous.) Edge of wood, Cap-a-L'aigle, August.

Amanita verna Bull. (Deadly poisonous.) Under spruces, Cap-a-L'aigle, August.

Amanita Cæsarea Scop. (Edible.) Under spruces, Cap-a-L'aigle, August.

Amanita solitaria Bull. (Edible.) In white birch woods, Cap-a-L'aigle, July.

Amanitopsis vaginata (Bull) Roz. (Edible.) On the ground, Mount Royal, August.

Amanitopsis farinosa Schw. Under white birch trees, Cap-a-L'aigle, August.

Lepiota naucina Fries. (Edible.) On the ground, Hochelaga Bank, July.

Lepiota cristata A. and S. (Edible.) On the ground, Mount Royal Park, July.

Armillaria Mellea Vahl. (Edible.) On the ground, Mount Royal Park, August.

Tricholoma personatum Fries. (Edible.) On the ground, Cap-a-L'aigle, July.

Tricholoma sejunctum Sowerb. (Edible.) On the ground, Cemetery, October.

Clitocybe candida Bres. (Edible.) On the ground, Cemetery, October; Cap-a-L'aigle, August.

Clitocybe illudens Schw. (Not edible.) At root of stump, Pte-aux-Trembles, September.

Collybia radicata Rehl. (Edible.) On the ground, Petite Cote Woods, August.

Collybia fusipes Bull—"spindle-foot collybia." (Edible.) McGill College Grounds, Mount Royal Cemetery, October.

Mycena galericulata Scop. (Edible.) On rotten log, Cap-a-L'aigle, August.

Mycena pura Pers. On rotten log, Cap-a-L'aigle, August.

Mycena vulgaris Pers. On decayed stump, Mount Royal Park, August.

Mycena aciculata Schaeff. On decayed trunk, Cap-a-L'aigle, August.

Mycena hæmatopa Pers. On rotten stump, Hochelaga Bank, July.

Omphalia campanella Batsch. On oak stump, Westmount, August.

Omphalia epichysium Pers. On logs, Westmount, August.

Pleurotus ulmarius Bull. (Edible.) Growing out of end of elm log, Longue Pointe, September.

Pleurotus ostreatus Jacq. (Edible.) On decaying log, Mount Royal Park, September.

Pleurotus Sapidus Kaleb. (Edible.) On dead trunk of tree, Mount Royal Cemetery, August.

Pleurotus dryinus Pers. (Edible.) On an oak tree at St. Anne's, September.

Pleurotus sulphuroides Pk. On a decaying log, Petite Cote Woods, September.

Pleurotus petaloides Bull. (Edible.) At foot of maple stump, Mount Royal Park, September.

Pleurotus applicatus Batsch. On under side of rotting oak log, September.

Hygrophorus chrysodon (Batsch) Fries. (Edible.) On the ground, at edge of Cemetery Woods, September.

Hygrophorus eburneus (Bulliard) Fries. (Edible.) Under the pines, top of Mount Royal, October.

Hygrophorus fuligineus Frost. (Edible.) In Cemetery Woods, October.

Hygrophorus miniatus Fries. On the ground in the Cemetery Woods, October.

Hygrophorus coccineus (Schaeff) Fries. On the ground in Mount Royal Woods, September.

Lactarius volemus Fries. (Edible.) On the ground in Bagg's Woods, July.

Lactarius fuliginosus Fries. On the ground in woods, Cap-a-L'aigle, August.

Lactarius piperatus (Scop) Fries. On the ground in Bagg's Wood, July.

Lactarius chelidonium Pk. (Edible.) On the ground in woods at Cap-a-L'aigle, August.

Russula alutacea Fries. (Edible.) On the ground in woods at Cap-a-L'aigle, July and August.

Russula lepida Fries. (Edible.) On the ground in Mount Royal Woods and in woods at Cap-a-L'aigle, August.

Russula virescens (Schaeff) Fries. (Edible.) On the ground in Mount Royal Woods, September.

Russula fragilis (Pers.) Fries. On the ground in woods at Cap-a-L'aigle and on Mount Royal, July and August.

Russula emetica Fr. (Poisonous.) Very common in the woods on Mount Royal and at Cap-a-L'aigle, July and August.

Russula adusta (Pers.) Fries. On the ground in Bagg's Woods, September.

Cantharellus cibarius Fries. (Edible.) On the ground under spruces near the St. Lawrence, Cap-a-L'aigle, August.

Cantharellus aurantiacus Fries. On rotten log, Cap-a-L'aigle, August.

Marasmius oreades Fries. (Edible.) Common on Fletcher's Field and in cemetery lots, July-October.

Marasmius cohærens (Fries) Bres. At foot of rotten stump, Inverness, October.

Lentinus vulpinus (Fries). On a decaying bass-wood, Westmount Woods, July.

Lentinus lepideus Fries. On underside of fallen maple, Cemetery Woods, September.

Schizophyllum alneum (L.) Schroet. On fallen log, St. Anne's, September.

Trogia crispa Fries. On fallen white birch, St. Anne's, September.

(ROSY-SPORED AGARICS.)

Pluteus cervinus Schaeff. (Edible.) Common on Mount Royal, in the Cemetery and Cap-a-L'aigle Woods, July-September.

Clitopilus primulus scop. (Edible.) On plot of made ground, Mount Royal Cemetery, October.

Entoloma jubatum Fries. On the ground in Bagg's Wood, September.

Entoloma grayanum Pk. In hollow in Mount Royal Woods, August.

Entoloma strictius Pk. On grassy plots in Mount Royal Cemetery, October.

Leptonia asprella Fries. On the grounds in Westmount Woods, September.

Leptonia incana Fries. In backyard, St. Famille Street, August.

Claudopus nidulans (Pers.) Pk. On side of fallen tree in Mount Royal Cemetery, September.

(OCHRE-SPORED AGARICS.)

Pholiota praecox Pers. (Edible.) In grass, Cap-a-L'aigle, July.

Naucoria semi-orbicularis Bull. (Edible.) On lots in Mount Royal Cemetery, September.

Naucoria Vernalis Pk. In Woods, St. Michel, August.

Hebeloma crustinuliforme Bull. In Mount Royal Cemetery, September.

Tubaria pellucida Bull. On top of rotten stump, St. Michel Woods, August.

Crepidotus Versutus Pk. On underside of rotten oak log, September.

Cortinarius Violaceus (L.) Fries. (Edible.) On the ground in woods near the St. Lawrence, Cap-a-L'aigle, August.

Cortinarius ochroleucus (Schaeff) Fries. On the ground in Mountain Woods, Cap-a-L'aigle, August.

Paxillus involutus (Batsch) Fries. (Edible.) In grass at edge of Mountain Woods, Cap-a-L'aigle, August.

Paxillus corrugatus Atkinson. On decaying spruce tree, Hochelaga Woods, September.

II. POLYPORACEÆ—TUBE-BEARING FUNGI.

Boletus edulis Bull. (Edible.) Common on ground, in hard woods, Mount Royal and Cap-a-L'aigle, July-September.

Boletus felleus Bull. (Bitter.) On hemlock stump, Cap-a-L'aigle, August.

Boletus retipes B. and C. In woods near St. Lawrence, Cap-a-L'aigle, August.

Boletus vermiculosus Pk. On the ground in high woods, Cap-a-L'aigle, August.

Boletus Americanus Pk. On ground under spruces, near St. Lawrence, Cap-a-Laigle, August.

Boletinus porosus (*Berk.*) *Pk.* On ground in woods, Cap-a-L'aigle, August.

Fistulina hepatica Fries. (Edible.) On oak stump, Westmount, September.

Fistulina pallida B. and Rav. At foot of elm stump, Longue Pointe, September.

Polyporus frondosa Fries. (Edible.) On stump of bass-wood, Mount Royal Cemetery, September.

Polyporus umbellatus Fries. At root of beech stump, Inverness, October.

Polyporus intybaceus Fries. At root of oak stump, Mount Royal Cemetery, July.

Polyporus sulphureus (*Bull*) *Fries.* (Edible.) On oak stump, Westmount, July.

Polyporus brumalis (*Pers*) *Fries.* On decaying maple log, Westmount, July.

Polystictus perennis Fries. On side of fallen oak, Mount Royal Park, September.

Polystictus connatus Schw. On fallen white birch, Salmon River, August.

Polystictus versicolor (*L.*) *Fries.* On decayed oak, Mount Royal Cemetary, August.

Polystictus hirsutus Fries. On fallen elm, Mount Royal Park, September.

Polystictus Pergamenus Fries. On fallen maple tree, Petite Cote Woods, August.

Polyporus giganteus Fries. At foot of a maple stump, Mount Royal Park, October.

Polyporus applanatus (*Pers.*) *Fries.* Common on wounded maple trees and dead trunks, September.

Polyporus sinuosus Fries. On decaying maple stump, Longue Pointe.

Polyporus lucidus (Leys.) Fries. On decayed trunk of white spruce, Hochelaga Woods, June.

Polyporus betulinus Fries. On decayed white birch, St. Anne's and Hochelaga Woods, September.

Polyporus leucophæus Mont. On wound in maple tree, Montreal, September.

Polyporus pinicola (Swartz) Fries. On dead spruce, Hochelaga Woods, August.

Polyporus igniarius (L.) Fries. On decayed birch, Mount Royal Park, September.

Dædalea ambigua. On side of a maple tree, St. Anne's, September.

III. HYDNACEÆ—HEDGEHOG FUNGI.

Hydnum coralloides Scop. (Edible.) On the ground, under spruces, near St. Lawrence, Cap-a-L'aigle, August.

Hydnum caput-ursi Fries. On wound on side of an Elm tree, St. Anne's, September.

Hydnum repandum L. (Edible.) On the ground in woods, Cap-a-L'aigle, August.

Hydnum imbricatum L. (Edible.) On the ground on the hillside, under white birch, Cap-a-L'aigle, August.

Hydnum putidum Atkinson. On dry hillside, under spruce, Cap-a-L'aigle, July and August.

IV. CLAVARIACEÆ—CORAL FUNGI.

Sparassis crispa Fries. (Edible). On stump off Greene Avenue, November.

Clavaria formosa Pers. (Edible.) On ground, under spruce trees, near St. Lawrence, Cap-a-L'aigle, August.

Clavaria botrytes Pers. (Edible.) In lane, under spruce, near St. Lawrence, Cap-a-L'aigle, August.

Clavaria pistillaris Linn. (Edible.) On the ground in high woods, Cap-a-L'aigle, August.

Clavaria mucida Pers. On top of rotten stump, Hochelega Woods, Cap-a-L'aigle, August.

V. TREMELLINEÆ—TREMBLING FUNGI.

Tremella frondosa Fries. On rotten wood, Cap-a-L'aigle, August.

Tremella fuciformis Berk. On ground, under spruce trees, near St. Lawrence, Cap-a-L'aigle, August.

Gyrocephalus rufus (Jacq.) Bref. From dead root, under ground, Cap-a-L'aigle, August.

V. TELEPHORACEÆ.

Craterellus cantharellus (Sehw) Fries. (Edible). On the ground, Cemetery Woods, August.

GASTEROMYCETES.

VII. LYCOPERDACEÆ—PUFF-BALLS.

Lycoperdon giganteum Batsch. (Edible.) In pasture field, Cap-a-L'aigle, July.

Lycoperdon cyathiforme Bosch. (Edible.) In grassy fields, Cap-a-L'aigle, August.

Lycoperdon gemmatum Batsch. (Edible.) In goose-pasture, Cap-a-L'aigle, July and August.

Lycoperdon pyriforme Schaeff. (Edible.) On top of decayed basswood stump, October.

Bovista plumbea Pers. (Lead colored.) In pasture field, Cap-a-L'aigle, August.

Scleroderma vulgare Fries. On the ground, in woods, Cap-a-L'aigle, August.

Scleroderma verrucosum Fries. On the ground, in woods, Mount Royal Park, August.

VIII. PHALLOIDEÆ—STINK-HORN FUNGI.

Dictyophora ravenelii (B. & C.) Burt. On ground, Mount Royal Cemetery, October.

ASCOMYCETES.

IX. MORCHELLÆ—MORELS.

Morchella esculenta Pers. (Edible.) Woods at St. Anne's and Westmount, June.

X. HELVELLÆ—CUP-FUNGI.

Spathularia velutipes Cooke and Farlow. On the ground, Cap-a-L'aigle, August.

Leotia lubrica Pers. On rotting stump, Bagg's woods, August.

Sarcoscypha floccosa. On high bank of St. Lawrence river, Cap-a-L'aigle, August.

New Genera of Batrachian Footprints of the Carboniferous System in Eastern Canada.

By G. F. Matthew, LL.D., F.R.S.C.

The following article is based chiefly on material in the Redpath Museum of McGill University that was collected by the late Sir J. W. Dawson, mostly at the Joggins Mines and shore in Nova Scotia, and which remained undescribed at the time of his death.

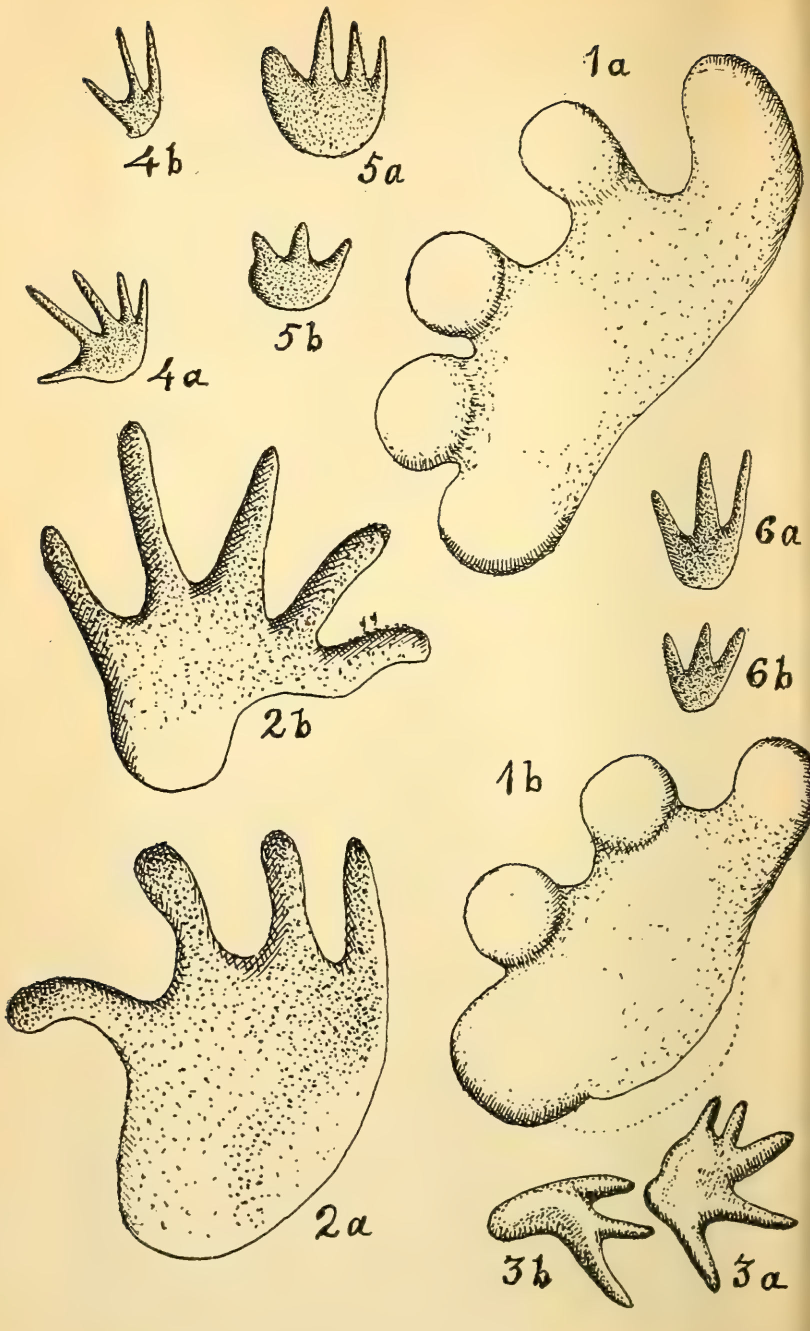
The collection contains a number of types which have not heretofore been described, chiefly among the smaller forms. They will serve to give greater fullness and variety to the series which have been described by other authors, and which are mostly of medium or larger size.

Asperipes n. gen.

This genus is characterized by having five toes on the supposed hind foot but only three on the supposed fore foot. The latter is usually placed behind the hind foot, sometimes midway between two prints of the latter.

In the hind foot the fifth toe sets off from the rest and is near the back of the footprint; the other toes also are widely spread and are progressively shorter to the first digit. The sole was large and rather deeply impressed.

The fore foot had three toes, of which the outer sets off from the other two, and the middle projects forward


4b
5a
1a
5b
4a
6a
2b
6b
1b
2a
3b
3a

somewhat more than the others. The sole projects backward in a prolonged heel.

This form of footmark is not uncommon on the layers at the Joggins, and, like Hylopus, had often a rough surface, perhaps owing to the sharp claws with which the toes were furnished. It is necessary to separate it from Hylopus, because there are the impressions of only three toes to the fore foot, and because of the distinct impression of a sole to both fore and hind foot. The fact that there were only three toes to the fore foot also separates it from a number of genera that have been described by authors. On comparing the fore foot with the hind, it will be seen that the obsolete digits of the fore foot are probably the first and second.

The irregularity of the foot print in some species of this genus shows the flexibility of the toes, and the name of the genus alludes to the rough and irregular imprints left by animals of this kind.

Asperipes avipes n. sp. (Pl. Figs. 3*a* and 3*b*), is the type of this genus. Two other species are known.

It might be thought that in Asperipes the footprint showing the marks of only three toes is that of the hind foot. In many mammals, and in the alligator among the reptiles the foot with fewest toes is the hind foot. The long heel also of the footmark, determined as the fore foot, is a mark of the hind foot in many dinosaurs, as, for instance, in Anomepus and Otozoum, and it is therefore necessary to explain why it is supposed this anomalous relation of the two footmarks exist in Asperipes. We have not seen any consecutive series of footprints of the type species that will determine this relation, and the determination is based on the relation found to exist in the footprints of the other two species.

In the second species the disparity in size between the print of the fore and hind foot is somewhat greater than it is in the type species, in which we see some indication that the three-toed footmark, being the smaller, is that of the fore foot. But another character of greater importance appears in the footprints of this species, there is a series of tracks of this species, showing eight footmarks, but of these only one is that of the three-toed foot; from this one might suppose that the common gait of this animal was bipedal, and that it only occasionally touched the fore foot to the ground. If this was its usual method of progression, it would explain the larger size of the hind foot, and the way in which the toes are spread out.

There is a third species, which I refer provisionally to this genus, Sir Wm. Dawson's *Hylopus* (?) *caudifer*. Here the disparity in size between the three-toed foot and the other is greater even than in the species last described, and the former has a lighter or shorter heel than the three-toed foot of the other two species. In this species also we note the infrequency with which the impression of the three-toed foot is found: on a slab showing eight footprints of a consecutive series, only one is that of the fore or three-toed foot.

As in the preceding species, one might infer that the animal was a biped. To this view, however, there is an objection, which arises from the presence of a groove which appears to represent the trailing of the belly or tail along the surface of the sand. If this animal were bipedal in its movement, it would not be unreasonable to suppose that this "tail" mark would sway from side to side: on the contrary, it continues strictly medial as far as it is impressed on the sand: a narrower median groove in the same track, however, is not strictly central.

In regard to the two last species, the evidence appears to indicate that the three-toed foot is the fore foot.

CURSIPES n. gen.

A series of footmarks, small and well preserved, appears to indicate another, but related genus. It is a light footprint, with long slender toes resembling Batrachites of

Woodworth, but in place of four toes on the fore foot, there are only three. It differs from Asperipes in having a small sole to the hind foot, and in wanting a long heel in the print of the fore foot; also in the length and slenderness of the toes of both feet.

The print of the fore foot was distinct from that of the hind, and placed some distance behind it, some times half way to the next posterior impression of the hind foot.

These footprints appear to have been made by active animals having comparatively light bodies and long slender toes.

Cursipes Dawsoni n. sp. (Pl. Figs. 4*a* and *b*), is the type of this genus, and there was one other species.

The name is in allusion to the supposed rapid movement of the animal.

In distinguishing the fore and hind foot of this genus, much the same criteria are available as in the preceding genus. To mention first the size of the foot. Although in the typical species there is a continuous series of the three-toed impressions, alternating with those of the footmark showing five toes, they are invariably considerably smaller than the latter, and more lightly impressed. In the other species assigned to this genus, the impression of the fore foot is so light that it may be entirely overlooked. Often only the tips of the toes touched the ground, and that very lightly; but if one were to observe the arrangement of these little pits, they would be seen to correspond to that of the three (or sometimes only two of the three) toes in the type species; and in the prints of the tips of the toes of the fore foot in species of Asperipes.

As in this latter genus, we must regard the foot which gives a three-toed impression as the fore foot; otherwise the weight of the body must have rested chiefly on the fore feet, which seems to be unnatural.

Barillopus n. gen.

Under the genus Baropus, Marsh, the writer, last year, described a neat little footmark from the Joggins shore, which, on further consideration, he thinks should be separated as the type of a new genus.

It is much smaller than Marsh's type of Baropus, and has a broad and rounded sole to the hind foot, while that of Baropus projects backward in a heel. The parallel grouping of the three inner toes, separate from the outer one, is also a distinctive character.

All the species were small, short legged, low-bodied animals, apparently of sluggish habit.

Barillopus unguifer, Matt. (Pl., Figs. 5*a* and 5*b*) is the type. There are two other species from the Joggins.

The name is a diminutive of Baropus = heavyfoot.

In Barillopus there seems less reason to question the relation of the two kinds of footmarks than in the two genera first described, because one is not only larger than the other, but the constant forward direction of most of the toes in this footmark would indicate a hind foot. If one examines the footprint left by a frog or an alligator, he will be struck by the radiate arrangement of the toes of the fore foot as compared with those of the hind; hence it seems quite in accord with the ordinary attitude of the toes in the Crocodilia and the tailless amphibians that these footprints should be relatively what we have assumed them to be.

Ornithoides n. gen.

Under *Hylopus* (?) *trifidus*, Sir Wm. Dawson has described a peculiar little track in which the number of toes is reduced to three on each foot. It has thus fewer toes than any other form of this fauna, and seems worthy of a separate generic name.

The toes are all directed forward in a fan shape, and thus have a distant resemblance to those of the wading birds, but are much more massive.

The track left by this creature resembled that of Barillopus in two respects; first that the stride was short, and second that the print of the fore foot was close behind that of the hind and apt to be confused with it. But it differed from the footstep left by animals of that genus in having a small and narrow sole; so small that Sir Wm. Dawson referred it provisionally to Hylopus.

These little animals had broad bodies, and probably were sluggish in their movements. The track was as wide as the space between each footmark in the row of footsteps.

Hylopus (?) *trifidus*, Dawson (Pl. Figs. 6*a* and 6*b*) is the type of this genus. The name is in allusion to the bird-like track, with three toes directed forward in a radiate manner like the wading birds.

Baropezia n. gen.

Sauropus [Lea ?], as defined by Sir Wm. Dawson, consisted of " large plantigrade animals, probably Labyrinthodonts, or allied. Hind foot usually larger, five toes."

The track described by Dr. Lea under this name was not very different from that which Dr. King had previously described inadvertently under the name of Sphaeropezium (changed by him in the same year to Thenaropus), either in size or in general appearance. There were, however, some important differences. Sauropus was represented as having a median " tail mark " or groove, and, so far as the figure shows, the fore foot left three toe prints in place of four as in Thenaropus.

Unless, therefore, Sauropus is made very broad in its scope, it will not include *S. Sydnensis*, in which the formula of the toes is 4—3; that is four on the hind and three on the fore. Also the form of the sole and toe prints is in many respects quite different from Lea's Sauropus, and more like King's Sphæropezium. There is also in *S. Sydnensis*, Dawson, no median furrow between the footprints; in this it differs from Lea's species. It would seem necessary, therefore, to separate Dawson's species from Sauropus.

But there is a cogent reason why Sauropus should be used neither for Lea's nor Dawson's species. The name was preoccupied, according to O. P. Hay, by E. Hitchcock for a genus of Triassic footprints of a different type.

Palæosauropus has lately been offered by Dr. O. P. Hay as a generic name for Dawson's species, above discussed, but as Dr. Hay refers to Lea's Sauropus as the type of his genus (being the first described) it obviously will not apply to Dawson's species, which is of quite a different type, as above shown. We therefore, propose the name Baropezia for this type.

Baropezia had the print of four toes on the hind foot and three on the fore; these toe prints were round, several were detached from the print of the sole, and all were without the trace of a nail. The impression of the sole was heavy, with usually apophyses or swellings on some part of the sole. The impression of the fore foot is smaller than that of the hind, and usually placed behind it.

Judging by the length of stride, these animals, notwithstanding their weight, were of active habit, and travelled rapidly over the sand.

Sauropus Sydnensis, Dawson (Pl., Figs. 1*a* and 1*b*) is the type of Baropezia, and there is one other species.

The generic name is in allusion to the heavy impression made by the sole of the foot.

In the type species of this genus the two footmarks are much alike; there is not a long heel on either foot to distinguish them; the number of toes, however, is distinctive. In both feet the normal number of digits is reduced, and the one with three toes may be seen to be smaller than the other.

It may also be mentioned (though not much weight can be laid upon this argument) that in the series of footprints which indicates this species, one of the three-toed footprints fails to appear; the series of footmarks runs across a strongly wave-marked slab, and this footmark has failed not in hollow of the ripple where the impression might naturally be wanting, but on the ridge of the wave mark; from this one might suppose that the weight of the animal was carried by the four-toed foot, which would, therefore, be the hind foot.

But when an examination of the footprints of the second species of this genus is made, there is much greater reason for concluding that the three-toed foot is the fore foot. The impression is not half as large as that of the four-toed foot; and, moreover, while in the latter the toe prints are arranged on one side of the print of the sole, in the former they are arranged radially around it.

Megapezia n. gen.

The peculiar shape of the print of the hind foot appears to separate this from any described genus, though there is a figure given by King in *American Journal Science*, without any name attached, which, in its very large sole, may be compared to Megapezia; that, however, is represented as having five toes to the hind foot, while in this new genus there are only four. Yet while the number of toes on this foot is four, that on the fore foot is five; it thus reverses the number observed in such Palæozoic footprints as have nine toes on the two feet collectively. To this relation, in the number of the toe prints, we have a parallel in the footprints of the alligator, which also has four toes on the hind and five on the fore. The resemblance extends to the attitude of the toes, which are turned forward in the hind foot, but radially arranged in the fore foot. There is this distinction, however, that the peculiar backward curve of the fifth digit of the hind foot in Megapezia is not found in the alligator.

In the hind foot of Megapezia the fifth digit sets off from the others, and the end is strongly curved backward The toes are rather short and blunt (though perhaps having claws); the second, third and fourth digits are somewhat grouped, and directed forward and the first appears to be the digit that is wanting. The sole of the foot is large, but not heavily impressed.

The fore foot has a short and weak fifth digit, and the others are progressively shorter than the first; they are proportionately longer than those of the hind foot. The sole is short, except behind the fourth and fifth digit, where it extends into a long heel somewhat as in Asperipes.

These animals were of good size and had a long stride, so perhaps were active in their habits; as the impression on firm sand was strong, they would have been rather heavy animals.

The type is *Megapezia Pineoi* of the Lower Carboniferous measures at Parrsboro, N.S. (Pl., Figs. 2*a* and 2*b*), and the generic name is in allusion to the large size of the sole of the hind foot.

In this genus the usual signs seem to designate without doubt which is the hind and which the fore foot. First the larger size of the sole in the foot bearing four toes shows that the weight of the body was born by this foot. The smaller number of toes and the forward direction of three point to a greater specialization of this limb for walking, &c.

On the other hand the full number of digits on the fore limb and the radial arrangement of the toes point to a varied use of this limb, for prehension as well as for walking, for which latter purpose it seems to have been habitually used. Every feature appears to point to this as the print of the fore foot of the animal.

If it be such, however, one cannot fail to note the strong resemblance between this which we have determined as the fore foot of Megapezia, and that which appears to be the hind foot of Asperipes. This is obvions on comparing Figure 2*b* of Plate with Figure 3*a* of the same plate.

It may be thought that we attach too much importance to the size and weight of the footmark as determining which marks were made by the fore, and which by the hind feet, since some amphibians show the fore limbs to be stouter, and in some (Siren) the hind limbs are quite wanting. But in such a possible condition amongst the extinct forms of the Carboniferous Time, we cannot but suppose that if the animal were walking on the land, very marked evidence of the unsupported posterior part of the body would be seen, in a groove or trail along the surface of the mud, made by the body or tail; the absence of a "tail" mark in most cases, as well as the disparity in size of the fore and foot prints in many species, supports us in the surmise that in some cases at least the body was sustained chiefly by the hinder limbs.

Pseudo bradypus n. gen.

This remarkable form was described by Sir Wm. Dawson under the name of *Sauropus unguifer.* He directs attention to the great claw on the fifth digit, of the hind foot, but seemingly did not notice that the claws on the other toes were also long. From the way these claws are tangled and crossed one might surmise that the creature did not habitually live on the ground, and that the foot was not adapted for such use. The hind foot, which is the one usually observed had a long sole and a prominent heel. The heel was not elongate longitudinally, but transversely; there was also a very decided instep or hollow in the sole in front of the heel. The hind foot in this animal was a powerful member for grasping, and would seem to have been adapted like that of the sloth for climbing in trees.

In walking this animal left a heavy tread which perhaps was partly caused by the weight being thrown on the hind feet, as it is only at intervals the print of the fore foot is seen. Notwithstanding the clumsy outfit for walking the animal appears to have moved rapidly, as the stride is twice as long as the space between the two rows of footmarks. The long interval between the footsteps also indicates legs of some length.

Sir Wm. Dawson's description states that there were five toes to the hind foot, and four to the forefoot, with a doubtful fifth toe.

The figure of this species, which is a rough presentation of its form, will be found in Geol. Magazine, London, Series 1, vol. ix. p. 251-253.

The generic name is in allusion to remarkable grasping power possessed by the foot in which it resembled the sloths.

DESCRIPTION OF THE PLATE.

Fig. 1. BAROPEZIA—Type *Sauropus Sydnensis,* Dawson —*a.* Mould of the right hind foot—*b.* Mould of the right forefoot. Both natural size. The figures show the relative positions of the hind and forefoot. From Coal Measures, Sydney, N.S. See p. 105.

Fig. 2. MEGAPEZIA—Type *Megapezia Pineoi,* n. sp.—*a.* The left hindfoot—*b.* The left forefoot. Both natural size. (Mud has flowed into the footprints so as to narrow them in places and blunt the ends of the toes.) The forefoot in a series of footmarks is not so near the hind as here represented, they are crowded on the plate to save space. From Lower Carboniferous sandstone at Parrsboro, N.S. See p. 107.

Fig. 3. ASPERIPES—Type *Asperipes avipes,* n. sp.—*a.* Mould of left hindfoot—*b.* Mould of left forefoot. Both natural size. The figures are in their natural position. From Coal Measures, Joggins, N.S. See p. 101.

Fig, 4. CURSIPES—Type *Cursipes Dawsoni,* n. sp.—*a.* Left hindfoot—*b.* Left forefoot. The footprints are in their natural position ; the line of the series of footprints if prolonged backward would pass between the two larger figures at the bottom of the plate. From Coal Measures, Joggins, N.S. See p. 103.

Fig. 5. BARILLOPUS—Type *Baropus unguifer,* Matt.—*a.* Left hindfoot—*b.* Left forefoot. Both mag. $\frac{2}{1}$. The forefoot in its natural position is close behind or partly

overlaid by the hind foot. From Coal Measures, Joggins, N.S. See p. 104.

Fig. 6. ORNITHOIDES—Type *Hylopus* (?) *trifidus.* Dawson—*a.* Left hindfoot—*b.* Left forefoot. Both mag. $\frac{2}{1}$. The two feet are usually close together, and usually the print of the forefoot is obscured by that of the hind. From Coal Measures, Joggins, N.S. See p. 104.

RESURRECTION PLANT.

LEWISIA REDIVIVA PURSH—ORDER PORTULACACEÆ.

By A. J. HILL, M.A., C.E.

This is unquestionably one of the most beautiful of the British Columbia flora and well worthy of cultivation, which its rare tenacity of vitality renders comparatively easy. Its name, *Rediviva,* is derived from the fact of its springing into active growth, even when dried for months in a herbarium, on the admission of dampness, or as a result of the change from the drying air of summer to the less arid atmosphere of autumn. It is a complete surprise to the unwarned collector to find on opening his crisp and dessicated specimens that the Lewisia roots have started their tiny plumules into vigorous growth.

The plant is limited in range, as far as known, to the arid plateau above the Cascades and to the meridian of Ashcroft, extending thence South into Eastern Washington and Oregon. (See Macoun's Canadian Catalogue). Its favorite habitat is the soddy trenches formed of the detritus of the adjoining trap mountains which are impregnated with potash salts—the source of the general fertility of the arid belt.

The plant gives notice of its presence in early spring by a plumule of small fleshy cylindrical leaves which appear above the surface, and attain a height of not more than $1\frac{1}{2}$ to 2 inches, followed late in May and June by the flowers that open only in the hot sunshine, after the manner of their type, into the most lovely waxen blossoms, ranging in tint from the purest white to a deep carmine pink, set off by the centre of crimson stamens.

The whole plant is sessile, the flowers resting upon the ground, the leaves withering as the flowers come into bloom, so that a colony of Lewisias appears on a clear warm day like a myriad of tiny water lilies in clumps of fives and sixes, scattered thickly over the arid bank. The effect is indescribably beautiful, and the lover of flowers feels a pang of compunction as he treads perforce upon the perfect blooms. The only drawback is the want of perfume, to make the Lewisia the veritable flower of Paradise.

The root of the Lewisia resembles a branching carrot in form and colour, and contains a large amount of farinaceous nutriment of wholesome quality. It is, or was, extensively used by the Indians of Oregon as food, under the name of *Spœtlum*, much as the Camass and Wapatoe of the lower coast lands.

The plants have been brought without difficulty into perfect bloom and ripened seed in New Westminster, and roots sent to England have yielded a profusion of choicest flowers.

The Theory of the Formation of Sedimentary Deposits.[1]

A Deductive Study in Geology and Its Application.

By Alfred W. G. Wilson, McGill University, Montreal.

After the completion of the study of the geology of any considerable superficial area of the earth's crust the geologist usually attempts to interpret the various form-

1 The discussion is confined chiefly to the sub-aqueous deposits.

ations which he has found within the district under discussion—to read the history told by its fauna or flora, whether of land or sea—and upon this foundation to construct a more or less elaborate account of the history of the region and to outline the various changes that it has undergone. There are many well recognized and generally accepted criteria, for the most part based on the study of present geologic process, by which the history of any region may be inferred from the nature of the deposits found within or adjacent to its boundaries, and from the character of the fossil remains which they contain. A primary pre-requisite to the interpretation of any sedimentary series must necessarily be a knowledge of the conditions under which the given series may be produced. The formation of sedimentary deposits under what may be termed normal conditions is a function of many varying factors and it not infrequently happens that similar formations may be produced in two localities at the same time, or in the same locality at different times, by a totality of conditions in each locality, although the factors contributory to their production were not precisely alike in the two places, or at the two different times.

The general conception of the origin of sedimentary deposits, and of the relations of the various types of deposits to each other, which is set forth in this paper, is one which has been long and widely entertained. In restating what has so long been generally held, the writer has but repeated the work of others. The method of presentation varies somewhat from that usually adopted in that it is deductive rather than inductive. The paper is offered rather as an illustration of the application of the deductive method to geologic problems than as a direct contribution to our knowledge. In the latter part of the paper direct application of the inferences from the study is made to two minor problems of local interest. In the present paper the writer attempts to present the subject in a systematic manner, and in so doing to lay special emphasis upon certain processes of formation of sedimentary deposits which, though apparently departures from the normal method of formation, have apparently been the dominant processes in the growth of our greater sedimentary formations. The problem of the formation of sedimentary deposits (chiefly aqueous), is considered from a deductive standpoint, but it is based upon studies, more or less defective as to detail, of present geologic processes as they are in progress in our Great Lakes and elsewhere. First assuming certain elementary conditions of general occurrence in the formation of sedimentary deposits, the effects of variation in either of these factors, singly, or in both simultaneously, are considered. Later, secondary factors—since they are less important or are less widespread in their operation—are introduced, and a very few of the many complications which they would produce in the nature of the resulting deposits are considered. Naturally it will be found that the increase in the number of variant factors results in an increased complexity of product, and it is under the operation of these complex conditions that similar results may be produced by processes which are not exact equivalents.

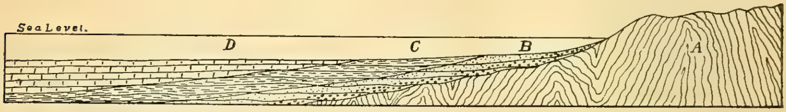


FIGURE 1.

At the present time it is generally conceded that all the great sedimentary formations were laid down around the margins of great ocean bodies and upon a gradually sinking land surface. In the generally accepted hypothesis of the formation of sedimentary deposits along the margin of a slowly sinking land area what may be termed the normal distribution of material, supplied by the waste of that land area and by which the sedimentary formations are built up, will be the formation of arenacious deposits (including, for convenience in discussion, the coarser varieties, breccias and conglomerates), at or near the shore line. As distance from the shore line increases (temporarily assuming a gradually deepening of the water seaward) these arenacious materials will grade gradually through areno-argillaceous to argillaceous, and thence through argillo-caleareous to caleareous, as the distance from the shoreline increases. In Figures 1, 2, and 3 (omitting zones of transition) A represents the sinking oldland upon which the sediments are being laid down and from which the detritus is derived, B represents the arenaceous zone, C the argillaceous, and D the caleareous, the relatively narrower transition zones between B and C, and between C and D, being conveniently represented by lines. During the course of time these deposits become more or less coherent, according to the conditions to which they may be subjected. In the subsequent discussion these separate zones of deposition may be referred to as the sandstone, the shale or the limestone zone, it being, however, recognised that there are also zones of transition between adjacent pairs.

It would seem that any given stratum must have three synchronous members, each merging gradually into the adjacent member or members. The beds composed of strata, which have been deposited successively must also each consist of these three members. The fact that the thickness of the stratum must, in each of the zones, be dependent upon the amount of material present must necessarily lead to the recognition of the other fact that under certain conditions of supply a stratum of considerable thickness might be laid down in one zone, while the strictly synchronous equivalent in either of the other zones might be represented by a very small amount of deposit, or by *none at all.* Through the operation of certain imperfectly understood causes, probably climatic, directly or indirectly, strata are found grouped together into beds, and it is conceivable, though *not always prob-*

able, that strictly synchronous beds may be found in each of the three zones, though the thickness *may vary considerably and the strata of some beds may not have synchronous representatives in the other beds.*

During the time of the formation of any given bed (or group of beds formed within a given small interval) the forms of life existing at that time will be distributed over the surface of that bed, each in its appropriate locality, the sand-loving forms in the sand zone, the mud-loving forms in the areas which afterwards become shale, and the forms which thrive best in deeper or clearer water, beyond. At the transition zones where there is a merging of conditions there will be a merging of forms. It may happen also that a form normally a habitant of one zone is accidently carried to another. These may be regarded as accidents in the normal distribution. Occasionally a form migrating from one zone to another will, in the process of its migration, take on different features because of its environment, eventually undergoing such changes that it would be classed as a species different from the descendants of its parent forms which remained in the original habitat. Some few forms may exist in all three zones, and fossil forms of these types will be of special value in the correlation of beds of different zones. It must be noted, however, that in the study of fossil forms which are fonnd common to all three zones the question whether the forms have migrated during the course of time from one zone to another must be considered, and the beds in which such similar forms are found need not necessarily be of the same age, but may be successively older or younger than the bed in which the like forms are found.

In the production of a series of deposits the final product is the function of many varying factors. The two most important of these factors, and which for this reason may be termed primary factors, are the *Rate of Depression of the Land* and the *Rate of Supply of Detritus.* Such a factor as the *Character of the Material* may, by contrast, be considered of secondary importance, while the factors which determine the character of the material as to kind (source) and as to condition (processes of erosion and transportation) may be regarded as factors of a third order. It is easily seen that factors of a fourth or even higher order are in constant operation in the actual formation of sedimentary deposits, and that the complete consideration of the history of an area involves the consideration of diverse and complex factors ; and although the final result of the operation of these factors is apparent, the share to be assigned to each is often indeterminate.

Considering now the two primary factors, *Rate of Depression* of the Land and *Rate of Supply* of detritus, we find that the former may be *uniform,* while the latter is either *uniform* or *variable,* or the rate of depression may be *variable,* while the rate of supply of detritus is either *uniform* or *variable.* In each of the four possible relations one of three results must obtain, according to the interrelations existing between the two factors. The ocean over the area of deposition may be *gradually deepening,* may retain a *constant depth,* or it may be becoming *gradually shallower.* In the first case, for convenience in discussion, the rate of depression will be said to be *greater than the rate of supply of detritus,* in the second *to equal it,* and in the third *to be less than it.* The first six of this series of twelve possible relationships which may thus exist between these two factors may be tabulated thus:—

1. The uniform Rate of Depression may be greater than the Rate of Supply of Detritus which is uniform.
2. The uniform Rate of Depression may be greater than the Rate of Supply of Detritus which is variable.
3. The uniform Rate of Depression may be equal to the Rate of Supply of Detritus which is uniform.
4. The uniform Rate of Depression may be equal to the Rate of Supply of Detritus which is variable.
5. The uniform Rate of Depression may be less than the Rate of Supply of Detritus which is uniform.

6. The uniform Rate of Depression may be less than the Rate of Supply of Detritus which is variable.

The remaining six relationships, when the Rate of Depression is not uniform but variable, may also be tabulated in a similar way; or all twelve relationships may be indicated graphically, thus:—

$$\begin{array}{c}\text{Rate}\\ \text{of}\\ \text{Depression.}\end{array}\left\{\begin{tikzcd} \text{Uniform} \gtreqless \arrow[r] \arrow[dr] & \text{Uniform} \\ \text{Variable} \gtreqless \arrow[r] \arrow[ur] & \text{Variable} \end{tikzcd}\right\}\begin{array}{c}\text{Rate}\\ \text{of}\\ \text{Supply}\\ \text{of}\\ \text{Detritus.}\end{array}$$

When there is uniform rate of depression and uniform rate of supply of detritus, the rate of the latter being less than the rate of depression, the seaward zones will gradually encroach upon the shoreward zones, the materials of the shale and sand zones will become commingled, and it may even happen that the limestone will be deposited directly upon what was the oldland surface. In this latter event the lower beds would be apt to become caleareous grits or conglomerates. Such conditions seem to have existed at one time in the vicinity of Kingston Mills, Ontario, where a calcareous conglomerate of Black River age, carrying angular quartz fragments, casts of a Cameroceas, and fragments of crinoid stems is found resting directly upon an Archean red granite.[1] Similar conditions seem to have existed in the Hudson Bay Basin during a portion of Devonian time. Parks describes the occurrence of certain Devonian corals in the basin of the Moose River with their bases attached to an Archean boss.[2] In the instance cited the boss of Laurentian gneiss probably formed an island in the Devonian sea at some distance from the shore of the oldland. The rate of depression was slow enough for the formation of a sandstone conglomerate near the shore.

1 Wilson, Phys. Geol., Central Ontario, Can. Inst., Trans., vol. VII., p. 148.
2 Parks in Report of the Bureau of Mines, Ontario, 1899, p. 188.

Where the rate of depression is equal to the rate of supply of material, whether each is uniform, or whether they vary, provided they vary by the same amount and in the same sense, there will be a uniform shoreward overlap of the zones of deposition. (Figure 1.) Such an equality between the two primary factors seems to have existed in many localities during the periods of deposition of the various sedimentary deposits as we find a gradual encroachment of the limestone upon the shales and of the shales upon the sandstones.

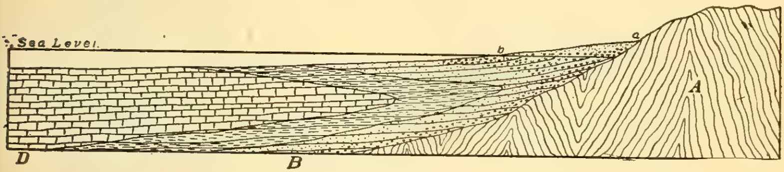


FIGURE 2.

If the rate of depression is uniform or variable but less than the rate of supply of detritus, there will be a continuous overlap, but in the opposite sense, i.e., seaward, and it may even happen that a series of land deposits overlying the older marine deposits may be formed. (Figure 2, ab.) These conditions are also frequently represented in the palaeozoic and later sediments of central North America and elsewhere. In Ontario and New York the conditions cited in the two previous paragraphs seem to have existed until the close of the Trenton, when there was a gradual shallowing of the water (accompanied probably by climatic changes), as indicated by the overlap of the Utica shales upon the Trenton limestones. This shallowing continued for a considerable length of time, so that during the Medina we find there were, in certain areas, broad tidal flats on which more or less arenaceous deposits were laid down. The fact that the argillaceous beds are separated by layers of more or less arenaceous material indicates that there were slight oscillations in the operation of one or other of the two primary factors concerned in their deposition. Whether, under these conditions of a more rapid rate of supply of detritus than rate of depression, it happened that a series of land deposits, the shoreward extension of the sandstones, was formed, is at present doubtful. It seems, however, that when there were such broad sandy tidal flats as existed during the Medina, dry at least at low water, as shown by the mud cracks, that the lighter siliceous sands may have been blown up on the beach in the form of sand dunes, leaving the heavier ferruginous sands as a residuum. Such a suggestion may possibly account for the single band of grey sandstone, usually called the grey band which extends across Ontario from Niagara Falls to near Collingwood. This band caps the Medina deposits, and is a fine textured compact sandstone, with an average thickness of about twelve feet. It is traceable from east of the Niagara gorge to Hamilton, and thence northward it is seen at intervals from Flamborough West to Nottawasaga, varying in thickness from ten to twelve feet, but preserving a nearly uniform lithological character. On lot 24, concession 10, of Nottawasaga, the maximum thicknesss of thirty-five feet is reached. West of the townships of Nottawasaga and Collingwood the grey band is wanting and the Clinton is found in several places to rest directly upon the red and green shales of the Medina. Where the surface of the band is uncovered (and it may be seen in many places, as the softer overlying Clinton has been eroded away) it presents a peculiar undulating surface quite comparable to that found at the present day in localities from which a sand dune has recently migrated. In one locality at least, in a cutting transverse to the grey band, by which a roadway ascends the Niagara escarpment, near Grimsby, the band shows excellent cross bedding on a very much larger scale than is usually seen in typical water laid deposits of similar texture. (See figure 3.) The occurrence of this large scale cross bedding, the undulatory character of its surface, the irregularity of its thickening, and the fact that westward of the Niagara escarpment, near Collingwood, the beds, which further east and south overlie the band, are found to rest directly on the red shales and sandstones of the Medina,[1] suggest that this grey band may be an old sand-dune belt subsequently evened off by the Clinton sea—the landward extension of the Medina beds found

The top of the "Grey Band near Grimsby, Ontario, showing cross-bedding. The hammer is leaning against the lowest member of the Clinton, and rests upon the top of the Medina.

FIGURE 3.

further west beneath the overlying Clinton and Niagara. In Ontario a very few fossils have been found in the band but whether their position was such as to indicate that the band must have been formed under water is unknown. Modern forms are frequently found in modern sand-dune

1 The sandstone has not yet been examined microscopically to determine the character of the grains.

belts along the seashore, and along the lake shores (Ontario and Erie);—we should expect the supposed dune belt to carry fossils in its upper portion since it was manifestly transgressed by the ocean.

During the course of time the rate of depression may vary to the opposite sense, i. e., the land may begin to rise. Under these circumstances the landward end of the strata previously deposited will be subjected to erosion. During a subsequent depression the new deposits would rest uncomformably upon them, while further seaward, where the earlier deposits had not emerged, there would be structural conformability. Such conditions seem to have existed during a portion of Palæozoic time in eastern and central North America, where, in the east, unconformities are found between the various formations making up the Palæozoic series, while further west the various members of the whole series are found with the younger conformably overlying the older, indicative of the fact that there was here continuous deposition.

Relatively slight variations of either factor, alone, or of both in opposite senses willl produce interdigitation of the three principal members along the lines of the transition zones.

The individual consideration of the remaining combinations is unnecessary as the final results will be similar to those produced by the variations already considered. Inequalities in the supply of material in the different zones to synchronous portions of the same bed (or series of beds), will lead to many irregularities in the thickness of the bed in its different parts. The final product may thus be very complex, though the general principles will still be applicable.

In the previous discussion it has been tacitly assumed that the material supplied from the oldland area is of such a nature that all three zones, including their transition phases, will receive each its quota of deposit. Material suitable to fulfil this condition will normally be supplied by an oldland area whether it be a region of metamorphosed rocks, such as we find in the great Archean areas of Canada, or by an oldland area consisting of sediments deposited at some preceding time, but subsequently uplifted. In this latter case there may be temporary irregularities in the supply of material for any one or two of the different zones, and it is quite probable that the coarser material in its $(n + 1)th.$ transportation, assuming that the sedimentary beds supplying it represent the *nth* series of beds of which it has formed a part, will be in a somewhat finer state of division. Hence that material which in the *nth* series of sedimentaries occurs in the shore zone, may in the $(n + 1)th$ series be found in part, at least, in the two outer zones. Quite frequently also, material derived from beds formed in a preceding cycle of deposition will retain, in its new position, certain characteristics (of color, form, structure, content) which make it possible to recognize that it belonged to a preceding cycle of sedimentation. On the other hand, it will often lose these characteristics, and then it will be impossible to infer the number of cycles of sedimentation through which it has passed to its present resting place.

Directly or indirectly, the materials which go to form the sub-aqueous deposits are derived chiefly from the waste of the land. In the case of the limestones of various types and, in part, of some of the shales, the material of which they are composed is less often a direct derivative of the waste of the oldland, more frequently it is a secondary product due to the intervention of organic life or to chemical action. In the previous discussion reference was made to the normal existence of a zone in which limestone would be formed. When we consider the usual manner of the formation of this limestone it became necessary to *modify*, to a certain extent, our primary theoretical concept. Along the margin of the land within the zones of deposition of sands and shales, the materials being deposited, are, to a large extent, inimical to the existence of abundant organic life, but in the clearer waters beyond these zones, provided there is a sufficient food supply, various forms will normally, be more abundant. These types, by the growth of their hard parts and the subsequent comminution of these, transfer the lime from a solution of calcareous compounds in the sea water to the ocean floor to eventually form limestones. Again, under certain conditions the calcareous materials are deposited without the intervention of organic forms. For the formation of limestone beds in these ways *deep* water is thus *not always essential* (and, in the former case, beyond a certain maximum depth, fixed by the depth of water at which a fauna can thrive, detrimental). So long as the lime-producing forms are not hindered in their growth by deleterious material or lack of food supply, they will continue to grow. Hence, under favourable oonditions, there will be frequently formed off-shore reefs, usually chiefly of corals, but many other forms will also thrive here, *e.g.*, Barrier reefs of Australasia. These reefs may also be covered with comparatively shallow water, and the older parts might in places be exposed. Under these conditions, the action of the wind and waves will lead to the comminution of the materials of which they are composed and the formation of all the various types of limestone rock, included within the types recently designated calcirudite, calarenite, calcilutite by Grabau.[1] The distribution of these various types of rock will bear the same relation to their source, the coral reefs, as does the normal distribution of sedimentary formations to their source, the oldland. Such conditions seem to have prevailed during the period of the formation of the Silurian and the Devonian limestones in New York and elsewhere.

Still another secondary consideration now suggests itself. If the supply of material detrimental to the existence of a great abundance of organic forms diminishes or

1 Bull. Geol. Soc. Amer. Vol. XIV., 1903, p. 349.

ceases, other conditions remaining constant, one naturally expects that the forms will spread from many centres outward, or towards the land at least, and that during the continued depression of that land area the sea may transgress upon it and the material formed by the comminution of the hard parts of these organic forms will form a series of deposits resting directly upon the oldland. Such formations are now being formed along parts of the Florida coast at the present day. It seems quite probable that such also, on a somewhat greater scale, may have been the condition of affairs during Devonian time when the corals, which Parks found with the bases attached to an Archean boss, were living in the Hudson Bay basin, and such was the case in many other localities. In the case of the example cited as occurring at Kingston Mills, the fragments of the crinoid stems are sometimes several inches in length. The pebbles of the conglomerate with which these and the Camoceras casts are associated vary in size up to about two inches in diameter, and the fossils are found in the beds not only quite close to the Archean, but also in the upper beds some distance above it. That under these conditions the forms were not comminuted suggests that here at least the water must have been comparatively quiet, and hence we may draw the not unnatural inference that the waters were moderately deep. The calcareous material was probably derived from the comminution of organic forms elsewhere, or it may be in part a chemical precipitate.

A consideration of the foregoing propositions indicates that a feature which one would expect to find in any series of deposits is a zonal arrangement of the various members. Not only may there be two lithological extremes and a mean of synchronous beds (or series of strata) but during the period of continuous depression and deposition there may be formed a continuous band of each of the lithological types, and each of these bands will be composed of beds and each bed may contain forms successively older or younger than the beds of the same zonal band above and below. When there has been (more or less) continuous depression of the land for a long interval, with (more or less) continuous supply of material suitable for all three zones, then subsequent uplift and erosion over extensive areas, the formation resting upon the oldland surface will normally be a sandstone. The earlier formed portion of this sandstone will naturally carry fossil forms appropriate to the age in which they lived, and the later formed likewise. Ami has recently drawn attention to arenaceous character of the formations resting upon the older rocks, along the axis of the Appalachian system, and to the progressive change in faunas from Cambrian types in New Jersey northward to Ordovician types in Canada, as illustrating the progressive depression of the land areas during the progress of early palaeozoic time.[1]

Further, it must be noted that, although the normal type of deposits would show the threefold lithological grouping, yet irregularities in the supply of material and variations in the character of that which is supplied, variations which will be of very frequent occurrence, will mean that in the field truly *contemporaneous beds in the three zones will be rare,* that *all three types of deposit* may be composed of the *same kinds* of material, a feature frequently seen in the limestone deposits, and, thirdly, that *one or more* of the types may be *completely wanting.*

After a long interval of time during which a succession of deposits has been formed under varying conditions, the sea bottom becomes uplifted, and the new formed rocks are subjected to long continued disintegration, degradation, and dissection. The greater part of the deposits are worn away; fragments only remain here and there, scattered over the area where they were once continuous,

1 Ami, Geo. Soc. Amer., Winter meeting 1902-03, "The Eparchean Formation." See Bull., G.S.A., Vol. 14.

this being especially true along the ancient shore-line which probably emerged first. If the erosion continues long enough, the complete series of products formed under a certain series of uniform conditions may entirely disappear, or, if the uplift is not great enough, only their shoreward ends may vanish.

In either case, their removal must expose the shoreward ends of strata belonging to an earlier cycle of deposition. The later (as regards exposure, earlier as regards deposition) deposits may themselves be also more or less dissected, and the different portions remaining will be thus more or less isolated. Such, indeed, seems to be the relations existing between the limestones belonging to the Trenton area, found in the Province of Ontario on both sides of the Frontenac axis (and in New York State to the south), and some of the associated sandstones which were until quite recently usually designated Potsdam.

Where these fragments of the old beds are distributed along the line of the ancient land from which the material was derived, it will happen that portions of synchronous deposits occur in widely separated districts. For example, a small amount of sandstone might remain in a protected hollow near B (Figure 1.), and all the rest of the deposit be eroded away, as far back as D, where the limestones would form an infacing escarpment, the lower deposits being covered with soil. The limestone, which was synchronous with the sandstone left at B, may carry fossils, while the small remnant of sandstone is destitute of them, or carries forms of a different type, due to the different environment when the forms were living, as suggested in a preceding paragraph.

It may happen that at the base of the cliff the earlier sandstone beds can be found. Now in the cliff alone evidently the limestone is younger than the immediately underlying sandstone. This underlying sandstone may be lithologically identical with that at B, since they come from the same source, and may even contain similar fossils. Still it would be obviously incorrect to say that the two sandstones were of the same age. This would be equally true were each of the beds represented in the figure a series of similar beds, instead of a single one.

When the exposures are far removed from the oldland shore, and there is very little doubt that the old landward extension of the beds is completely gone, the order of superposition in the cliff, or across country in a region of lightly inclined dips, may be taken as the order of succession. Such a series as that represented by the Medina-Niagara series in Central Ontario and Western New York will serve as a case in point. In areas *adjacent* to the margin of the ancient sea the correlation of the widely separated deposits on lithological or even palæontological grounds must be made with great care. Where lithologically similar deposits carry similar fossils contemporaneity of epoch may generally be postulated. If, on the contrary, the forms are not identical, and the deposits are lithologically unlike, they may still be contemporaneous deposits of different zones.

Where a small exposure of rock is found carrying fossils which are normally considered to be characteristic of two different terranes, and as a consequence the beds are inferred to be transitional ones between the two terranes, it must also be recognized that this portion of the bed may mark a transition in a horizontal direction, being but a portion of a synchronous bed of varying members.

Applying these considerations to the correlation of the sedimentary deposits along the margin of the Frontenac axis, so far as the writer is aware, no single bed has been traced through various zones. Whether it is possible to do this is problematical, because of the discontinuity of the outcrops. Inasmuch as this has not been done, there must be a factor of uncertainty in any conclusions which may be reached. There remains, however, the question as to what interpretation does the balance of probabilities tend, a balance upon which, in the incompleteness of the geological record, the solutions of many problems depend.

Because of the uneven character of the floor upon which the sediments are laid down the dips of the beds near the floor are unreliable as criteria with reference to the general dip. Where there is evidence that the sediments are some distance vertically above the crystalline floor the dip may be measured with some degree of certainty that it represents the average dip of the sediments in that locality.

Near Battersea, at which place some of the sandstones are found, the average dip is a little over half a degree to the east of south. What the gradient of the floor upon which they rest may be is not known. It possibly is the same as that of the overlying sediments, it may be even inclined towards them, or what seems to be the more justifiable assumption, it may dip in a similar direction at a somewhat greater angle. If the generally accepted interpretation as to the method of the formation of deposits is correct, the sandstone beds whose shoreward ends are here exposed will gradually merge into argillaceous beds and finally into calcareous members. The argillaceous beds which vertically overlie them will also merge into the limestones further out from the oldland shore. In many of the localities, because of the unevenness of the floor these sandstones are not thick enough to pass over the crystalline ridges, but are limited by them. In some cases at least the sandstones are probably subaerial deposits rather than subaqueous.[1]

In the vicinity of Kingston the limestones are found to rest directly upon the crystallines, which, from their associations probably formed islands in the Palaeozoic sea. Between Kingston Mills and Gananoque there are a number of Archean exposures, some of them several square miles in area. Between them and the main crystalline area to the north the sediments rest in more or

1 Wilson, Phys. Geol., Central Ontario, Tran. Can. Inst., Vol. VII., p. 159, 1901.

less ellipsoidal basins. Across the basins, though the average depth has been stated to be half a degree, because of the unevenness of the floor, the actual inclinations vary considerably. This local variation, combined with the discontinuity of the outcrops, renders exact correlation exceedingly difficult, if not impossible.

In any attempted correlation of widely separated beds by aid of their inclination it must not be forgotten that the beds originally existed, each as a continuous sheet over large areas, *in toto* probably lens shaped, and not only must the maximum inclination or dip be known, but the inclination in the direction of the line between the two beds whose correlation is attempted must be ascertained. The evidence at present available makes even a correlation of this kind in the area under discussion impossible.

With our present available knowledge it cannot be proven that the limestones or argillaceous beds in the one locality are synchronous or contemporaneous with the sandstone in the other ; nor can it be proven that the sandstones antedate the limestones, except in the few places where both occur together, in which event it becomes necessary to show that these limestones are also younger than the sandstones elsewhere.

To the writer the possibility that the sandstones in one locality are synchronous with the argillaceous beds and the limestones in another seems more plausible than that they antedate them. This interpretation also obviates the necessity of assuming a time interval of some duration between the deposition of the sandstones and the Black River limestone, during which interval the Calciferous and the Chazy were deposited elsewhere, and during which the non-fossiliferous beds below the Black River and above the sandstone may have been deposited here.

Were fossils present in the sandstone this possibility would be in no way diminished by the fact, even were some of them Potsdam forms. In the locality east of the axis, in the township of Landsdown and elsewhere where the Potsdam types of fossils are found associated with types characteristic of the Calciferous, the portion of the bed in which they occur may justifiably be considered as a transitional phase in a horizontal as well as a vertical direction towards the latter formation. To make the proposed tentative interpretation clearer, Fig. 4 diagramitally represents a portion of an ellipsodial basin in which deposition, accompanied by slow depression of the oldland surface, has been going on for some time. The earlier shore lines are shown in cross-

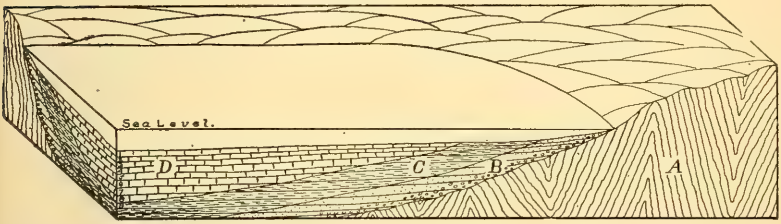


FIGURE 4.

section at the points where the younger strata overlap them to rest upon the crystalline area. Subsequently in the history of the basin the land may rise somewhat, and may be even slightly tilted, and the sea withdraws. During the progress of degradation the greater portion of the sediments are removed; but suppose small remnants of these are still to be found, it can readily be seen that a small portion of the shales or limestones of, say, bed number five might be left along the front of the section of the basin, while towards the back a portion of the sandstone of bed number three remains in a protected hollow among the crystallines. It would be exceedingly difficult, if not impossible, to correlate the two, particularly if they were some miles apart. But since the sandstones beneath the remnant of bed number five are identical in composition with the remnant of bed number three, because formed from the same source, these two which are not synchronous but successive would in the usual practice be correlated. The same would be true if each bed, as shown in the diagram, represented a series of similar beds.

The writer would then suggest that that there is a strong a priori reason for assuming that these beds are contemporaneous with the beds of limestone and argillaceous shales below the Trenton, and probably synchronous with some of them. From the general direction of the dips there is a remote possibility of some of the more distant outliers to the north being synchronous with the lowest beds of the Trenton, but this cannot be proven.[1]

Naturally the question might be asked, would you make all Potsdam contemporaneous with the lower Trenton? Certainly not. Potsdam, as a formational name, was introduced to denote a horizon which is supposed to be geologically older than the Trenton and which possesses certain definite types of fossils, and should be limited in its use to horizons where these two relations are proven to hold. The extension of the term to horizons in areas where the relations do not hold is apt only to lead to confusion. At present in Ontario much that has been classed as Potsdam, particularly on lithological grounds, is probably contemporaneous with limestones referred to later horizons now exposed elsewhere. The Potsdam sandstone undoubtedly should merge into limestone horizontally, unless our ideas of the processes of deposition are incorrect. Where the line of division comes in it would be difficult to say.

1 Wilson, Phys. Geol. Central Ontario. In this paper, on the basis of the above deductions, the writer advanced the views outlined here in more detail. Subsequently Dr. Ami, of the Geological Survey Department, described the Rideau Formation, which is made to include the formations here referred to, but the greater part of which lies to the east of the Frontenac axis, as being the shoreward extension of the Calciferous and Chazy. Dr. Ami's paper (Geol. Soc. Amer., Rochester, 1902.) has not yet come to hand, but the writer understands that the results of his studies on the eastern side of the axis in general confirm the conclusions reached by the writer after a study of the smaller exposures on the west. The latter the writer considers as probably the shoreward extension of the early Black River rather than the Chazy.

Proceedings of Natural History Society.

Annual Meeting.

The adjourned annual meeting of the Natural History Society of Montreal was held in the hall of the Society on Monday evening, June 8th, 1903, the President, Dr. C. W. MacBride, in the chair. There was also present among others the following members: Hon. Justice Wurtele, C. S. J. Phillips, H. Holden, J. Harper, J. A. U. Beaudry, A. E. Norris, J. Stevenson Brown, Joseph Fortier, W. Smaill, Prof. Bemrose, C. E. Phillips and F. W Richards, the Secretary.

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

Reports covering the year's work were presented by the Council, the House Committee, the Editing and Exchange Committee, the Lecture Committee, the Librarian, the Curator and the Treasurer.

On motion of Mr. Joseph Fortier, seconded by J. A. U. Beaudry, the several reports were adopted, with the request that they be published in the Record of Science.

The President then delivered his annual address, taking for his subject "Heredity."

A vote of thanks to the President, moved by Mr. C. J. S. Phillips, seconded by Hon. Justice Wurtele, was carried unanimously.

The election of officers then took place, and resulted as follows:

President—E. W. MacBride, M.A., Sc.D.

Vice-Presidents—F. D. Adams, Ph.D., F.R.S.C., Rev. Robt. Campbell, M.A., D.D., Dr. Wesley Mills, B. J. Harrington, Ph.D., F.R.S.C., A. Holden, Hon. Justice Wurtele, J. H. Joseph, Prof. D. P. Penshallow, Hon. J. K. Ward.

Hon. Recording Secy.—F. W. Richards.

" Corresponding Secy.—C. E. H. Phillips.

" Treasurer—J. A. U. Beaudry.

Hon. Curator—A. E. Norris.

Members of Council—C. T. Williams, J. S. Buchan, K.C., B.C.L., Alex. Robertson, John Harper, Edgar Judge, H. McLaren, C. S. J. Phillips.

Superintendent—Alfred Griffin.

REPORT OF COUNCIL.

To the Officers and Members of the Natural History Society of Montreal:—

Ladies and Gentlemen,—

Your Council would submit the following report for the year ending May 31st, 1902:

The usual meetings of the Council have been held, and the business intrusted to its care has been attended to regularly.

We regret to report the removal by death of three members of the society, Messrs. E. L. Clarke, W. A. Hastings and Mr. H. J. Tiffin. Seven new members have been added to the roll during the year. The Council would suggest that our members bear in mind the fact that a large part of the regular income of the society depends upon its membership, and much help in this direction could be given by the members of the society.

We are glad to report increased attendance at the various meetings of the society during the year, and the Somerville course of lectures, and the Saturday afternoon talks to the young people have been particularly well patronized.

The following is a list of the papers presented at the various monthly meetings:

Oct. 27. "Some Mushrooms of the Island of Montreal."—Rev. Robert Campbell, D.D.

Nov. 24. "Studies in the History of the Sea Urchin."—Prof. E. W. MacBride, M.A., D.S.C.

Jan. 26. "Reptilia of the Island of Montreal."—Mr. J. Simpson, of McGill Zoological Laboratory.

Feb. 23. "Trematode Parasites of Man and the other Vertebrates."—J. Stafford, M.A., Ph.D., McGill Zoological Laboratory.

Mar. 30. "The Lichens of the Island of Montreal."—Rev. G. Osborne Heine, B.A.

"Some additional Notes on the Flora of Montreal."—Rev. Robt. Campbell, D.D.

Apr. 27. "Native Arsenic discovered in Montreal."—Prof. Norton Evans, M.A., Sc.

"Some Rare Nova Scotia Plants."—Rev. Robert Campbell, D.D.

The Annual Field Day Excursion was held on June 14th to Piedmont. It was quite successful as regards attendance, although the enjoyment of the day was a good deal marred by the rain.

The attendance on the Musem has been better through the year than usual, and lack of space for the proper display of the specimens and room for visitors has been very apparent.

Taken as a whole, we have had a very successful year, receipts from membership showing an increase, with an improved income from rentals.

A short time ago the society was approached on the question of selling its property, but after due consideration the Council felt that it would be impossible to place it in an equally good position elsewhere for any amount of money that would be offered, and therefore has taken no steps in the matter.

During the year the Microscopical Society has become a part of the Natural History Society, and your Council would suggest to this meeting the propriety of appointing a special committee of microscopical work. Arrangements have also been completed with the committee of the teachers' course of lectures, for the amalgamation of the Teachers' and Somerville courses under conditions that were mutually satisfactory.

It will be well for the incoming Council to consider whether it is possible to add to the accommodation, and therefore to the finances of the society, by a re-arrangement or addition to the present rooms occupied. The church authorities who now occupy rooms in our building, are asking for more space, and are ready to increase the rental if they can be accommodated. As these parties are very desirable tenants, the Council is anxious to do what it can to meet their wishes.

Your Council is glad to bear testimony to the zeal and faithfulness of Mr. and Mrs. Griffin in caring for the work of the society.

Respectfully submitted,

C. T. Williams,
Chairman of Council.

REPORT OF THE EDITING AND EXCHANGE COMMITTEE.

Your Editing and Exchange Committee beg to report that two numbers of the Record of Science were issued in the year just ended, one in July, 1902, and the other in January of this year. At least they were nominally issued on those dates, although very undesirable delays occurred in giving them to the members of the society delays which, in future, we must try to avoid. The July number of 1902 completed Volume VIII. of the new series. The number last issued was the commencement of Volume IX. Much valuable matter reached the scientific world through those two issues, consisting mainly of the papers read before the society at its monthly meetings.

The Exchange list remains in about the same condition that it was in twelve months ago. Many of the reports and publications received have been of great value.

In name of the Publication Committee.

ROBERT CAMPBELL,
Chairman.

MUSEUM REPORT—SESSION 1903-1904.

MR. PRESIDENT, LADIES AND GENTLEMEN,—I have the honor to submit the following statement concerning the Museum: The number of visitors has increased over last year. Several schools came, and the crowds of children present, especially on Saturdays, afford evidence that there is something beyond mere play that can attract and hold their interest, even in these days of commercialism.

All of the birds have been cleaned and treated with benzine, a task that occupied Mr. A. Griffin with assistance nearly four months. The birds require usually more attention than any other department. It would be a great advantage to have the Museum lighted by two arc lights. The present gas system dries up the cases, and the effect on all specimens is bad.

The donations of the past season have been varied, and are recorded in the minutes. We especially call attention to the large additions to the Botanical department by the Rev. Dr. Robert Campbell. Owing to want of space many of the donations cannot be exhibited to the best advantage, and the donors are liable to feel hurt at not seeing their gifts in place. I must again direct your attention to the fact that the windows require painting white to prevent the sun's bleaching the specimens.

Respectfully submitted,

A. E. NORRIS,
Honorary Curator.

REPORT OF THE LECTURE COMMITTEE.

In the absence of the acting chairman of the Lecture Committee, it falls to me to report on behalf of the Committee.

The two series of lectures arranged for the last season were of the usual high class, and were duly appreciated by the patrons of the Natural History Society. The Somerville Course of six lectures dealt with different aspects of human Physiology, a subject which always calls forth a large measure of popular interest. The subjects were treated by several of the rising young physicians of the city, and the attendance throughout the season was very good. The thanks of the society are eminently due to the lecturers for the time and thought bestowed on their treatment of the several subjects covered by the course, given without fee or reward, for the benefit of the public.

Perhaps the Saturday afternoon talks to children did even more than the Somerville Course to promote the objects aimed at by the Natural History Society. These half hour talks, seven in all, drew large crowds of young people, with a sprinkling of older folk among them. The keenest interest was displayed by the children in the several topics discussed. Good seed was sown at these meetings, and it may reasonably be hoped that not a few young persons may have got started on a career of scientific study that will hereafter reflect credit on the Natural History Society.

In name of the Lecture Committee.

ROBERT CAMPBELL,
Chairman.

International Catalogue of Scientific Literature.

First Annual Issue, M. Botany, Part I., Vol. I., 1902 (May), Harrison and Sons, London, pp. XIV.+378.

The great and increasing rapidity with which scientific literature accumulates, and the consequent difficulty which investigators everywhere experience in maintaining familiarity with the literature of their specialities, has given rise to various efforts for the systematic and complete arrangement of titles in such a way as to render them directly available. Perhaps the most recent of these efforts is that represented by the newly reorganized *Botanisches Centralblatt,* which represents a complete summary of current botanical literature, together with short reviews indicative of the nature of the contents of each article. A somewhat earlier and more comprehensive effort is that represented by the present volume which expresses the final development of an idea, the origin of which carries us back very nearly half a century.

In 1855, Prof. Joseph Henry, of the Smithsonian Institution at Washington, U.S.A., suggested to the Glasgow meeting of the British Association for the Advancement of Science, the desirability of publishing a catalogue of scientific papers. This suggestion bore fruit in the Catalogue of Scientific Papers issued by the Royal Society, the first of which appeared in 1867. This exceedingly useful publication now comprises twelve large quarto volumes, covering the period from 1800-1883, while the period embraced in the years 1884-1900 will be covered by volumes now in course of preparation. It soon came to be felt, however, that the scope of the work was much too restricted, and it was recognized that (1) an author's catalogue could not supply the requisite information, (2) that it was essential that scientific workers should be kept fully and quickly informed of all new discoveries by means of subject indexes, and (3) that such a work was beyond the resources of the Society or of any single body. These considerations gave rise to the idea of international co-operation which, first suggested in 1893, was given a practical bearing through a conference held in London in 1896, at which there were present delegates from twenty-one countries, including Canada. The important work of this first conference was extended and brought to completion by successive conferences, until at the first meeting of the International Council held in London in December, 1900, it was decided to commencc the preparation of the Catalogue from January, 1901. The plan as finally matured, contemplated the formation of Regional Bureaus for each country represented, the duty of such a bureau being to assume responsibility for the cataloguing of all scientific literature within its region, and to arrange for the distribution of catalogues. At present twenty-nine such regional bureaus have been formed under the directorship of H. Forster Morley, M.A., D.Sc., London, while the Director of the Regional Bureau for Canada, is Dr. J. G. Adami, McGill University, Montreal.

A very large amount of labor was expended in arranging and determining the subject headings of the catalogue, with the result of an efficient completeness which is most gratifying. The branches of science represented are Mathematics, Mechanics, Physics, Chemistry, Astronomy, Meteorology (including terrestrial magnetism), Mineralogy including Petrology and Crystallography), Geology, Geography (Mathematical and Physical), Palaeontology, General Biology, Botany, Zoology, Human Anatomy, Physical Anthropology, Physiology (including experimental Psychology), Pharmacology and experimental Pathology and Bacteriology. Each complete annual issue therefore comprises seventeen volumes. In order to meet any preference the scientific workers may have for a particular language, and also to remove any doubt which may attach to the meaning of a word, or expression, the index and schedule of classification are presented in English, French, German and Italian, while entries in the subject indexes may be in the language of the original paper, provided it is in either Latin or one of the four languages specified above.

The original scheme of the catalogue contemplated that it should comprise all original contributions to the various branches of science coming within its scope, whether published in periodicals, in the journals of societies, or as independent pamphlets, memoirs or books. While this feature is realized in the present volume, financial considerations have necessitated a limitation of the number of subject entries. It is much to be regretted that circumstances impose this necessity upon the bureau, and it is to be hoped that the difficulty may eventually be overcome. This can certainly be accomplished if the various periodicals would uniformly adopt the suggestion that, as is now the practice with some, all should carefully index each article at the time of publication. This is a very reasonable suggestion and one which, if carried out, would not only enhance the value of the Journal for scientific purposes, but would also greatly facilitate the work of preparing the catalogue, and prove of great advantage to scientific workers generally.

The present volume embraces a total of XIV. + 373 pages, including special instructions to those who have occasion to make use of it, and it gives great promise of the wide usefulness which such a publication may attain to.

In Canada, the Dominion Government has arranged for the purchase of seven copies of the Catalogue for deposit in the libraries of the leading universities and the Parliamentary Library at Ottawa. Individual subscribers may obtain the complete set at a cost of £18, while separate volumes may be had at prices ranging from ten to thirty-five shillings, according to size.

D. P. PENHALLOW.

Catalogue of Canadian Birds.

CATALOGUE OF CANADIAN BIRDS, PART I.—WATER BIRDS, GALLINACEOUS BIRDS and PIGEONS, including the following orders: PYGOPODES, LONGIPENNES, TUBINARES, STEGANOPODES, ANSERES, HERODIONES, PALUDICOLÆ, LIMICOLÆ, GALLINÆ and COLUMBÆ. By JOHN MACOUN, M.A., F.R.S.C., Naturalist to the Geological Survey of Canada Ottawa: 1900. Price, Ten Cents.

Also PART II.—BIRDS OF PREY, WOODPECKERS, FLY-CATCHERS, CROWS, JAYS and BLACKBIRDS, including the following orders: RAPTORES, COCCYGES, PICI, MACROCHIRES, and part of the PASSERES. By the same Author. Ottawa: 1903. Price, Ten Cents.

Not students of Ornithology alone and sportsmen, but bird-lovers generally, and their name is legion, will be delighted at the appearance of these latest contributions of the veteran Naturalist to the Geological Survey of Canada to the science of the Dominion. Professor Macoun tells us in his preface that he has been collecting materials for these publications since 1879. They are all the more valuable on this account. It was possible to bring together so much information about the birds found in Canada, only after a series of observations continued for many years, by a large number of interested persons, spread over the entire northern half of the continent. The author in this study on Canadian birds has made use of the matter furnished by every other writer on the ornithology of our country, as in his larger works on botany he embodied the published lists of all the plant collectors of Canada, crediting each with what he had appropriated. In addition, he has been fortunate enough to be able to enlist individual observers throughout the Dominion who have furnished him with information not hitherto given to the public, regarding the birds frequenting their neighbourhood. The aggregate result is that we have mentioned in the two parts of the catalogue indicated above, a complete list of the bird fauna of the Dominion, including Newfoundland, in the several families embraced in these publications.

Part III. to complete the catalogue, with an index, it is promised, will be issued shortly.

There are described in Parts I. and II., altogether, the habits, nests and eggs of 463 kinds of birds, 307 in Part I. and 156 in Part II. They are numbered in the catalogue to correspond with the numbers employed in the check-list of the American Ornithologists' Union, for the sake of identification by the ornithologists of the continent. All the species embraced in the afore-mentioned check-list, included in Part I., are found in Canada, with 51 exceptions; but in addition there are 42 varieties listed. In Part II. there are, of the species numbered in the check-list, 100 represented in Canada, but 88 are unrepresented, but in addition there are 56 varieties. It is interesting to note that the birds that have to do with water are so largely represented in the Dominion—divers, swimmers, waders and shore birds, no doubt owing to the vast solitudes, with enormous sheets of water, embraced in our section of the continent, affording safe nesting retreats and ample stores of fish food for the young. On the other hand, birds of prey, crows, jays, blackbirds and kindred species find better provision for their needs in the settled districts of the continent.

On the whole the bird-lover has ample cause of satisfaction with the number of species to be found in our country. Many of them, of course, are only birds of passage, going north in spring to the extensive breeding fields in the covered rocks of Hudson's Bay, Labrador and Greenland, returning south with their broods later in the season. But not a few remain for the summer in our orchards and in the woods bordering on cultivation, to cheer us with their airy forms, bright plumage and sprightly movements. More persons take delight in birds than in any other natural objects, animate or inanimate, because of these qualities which our winged friends possess. The interest of the sportsman and the pot-hunter is of another kind ; but both of these classes will also rejoice to own copies of Professor Macoun's lists. There is no country lad or backwoodsman who does not possess a considerable stock of bird-lore ; and no rural delight is equal to that of roaming through the forests with gun in hand in pursuit of the ruffed grouse, that gamiest of birds. One noticeable fact is that the passenger pigeon which used to migrate in millions, as late as the fifties, in the last century, going north in the spring and south in the fall, are no longer seen within our borders. It is also matter of unfeigned regret that the superb bird, the wild turkey, has become extinct in Canada.

The notes accompanying the mention of each species are of an extremely interesting character, and the fact that the common names of birds obtain the highest prominence will go to make Professor Macoun's catalogue most popular with the masses. Our readers cannot do better than each order a copy of the two parts of the catalogue already issued, which they may secure for the modest sum of twenty cents. For this trifle they will be in possession of a list of the birds to be found between Newfoundland and Labrador on the East, to British Columbia and Alaska on the West, and from the parallel of 43° on the South to Hudson's Bay and the Yukon on the North. And should they visit Ottawa they will be able to gratify their curiosity by inspecting the specimens of the birds and their eggs, of which detailed mention is made in these most readable publications.

R. C.

RY, 1903.

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

D	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY.	65	....	....	....	1 ....SUNDAY
	20	....	2 4	0.30	2
	23	....	0.8	0.16	3
	..	0.40	4.3	1.04	4
	..	....	0.6	0.08	5
	82	....	....	....	6
	55	....	....	....	7
SUNDAY.	..	....	12.0	1.41	8 ....SUNDAY
	41	....	1.7	0.10	9
	02	....	....	....	10
	..	0.53	....	0.53	11
	61	0.34	...	0.34	12
	..	....	0.0	0.00	13
	81	....	....	....	14
SUNDAY.	..	....	....	....	15 ....SUNDAY
	00	....	1.6	0.12	16
	..	....	1.2	0.16	17
	..	....	0.0	0.00	18
	91	....	....	...	19
	68	....	...	....	20
	..	....	0.5	0.04	21
SUNDAY.	47	....	....	....	22 ....SUNDAY
	..	....	1.1	0.11	23
	64	....	....	....	24
	85	....	....	....	25
	87	....	....	....	26
	36	....	....	....	27
	..	0.89	....	0.89	28
Means...	32.7	2.16	26.2	5.28	................Sum.
29 Year for and in this mont	¶ 41.2	0.81	23.6	3.16	29 Years means for and including this month.

Direction	-level and
Miles ...	ken from
Duration	being 100. ours.
Mean vel	
Greatest	ro on the
Greatest	ero on the 8.3°.
x Estima	

Warmest day was the 28th. Coldest day was the 19th.

Highest barometer reading was 30.41 on the 14th; lowest barometer was 28.97 on the 28th, giving a range of 1.44 inches.

Minimum relative humidity observed was 45 on the 19th.

Rain fell on 4 days. Snow fell on 12 days.

Rain and snow on 1 day.

Fog on 1 day.

No. inches snow on ground 20.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1903.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	16.1	21.8	10.1	11.7	30.05	30.13	29.97	.16	78	xE.	....	65	....	....	....	1..........SUNDAY
2	19.2	22.1	14.5	7.6	29.88	29.99	29.65	.34	94	xN.	....	20	....	2.4	0.30	2
3	25.4	33.3	18.0	15.3	29.96	30.05	29.65	.40	91	xS.	....	23	....	0.8	0.16	3
4	24.0	31.4	17.2	14.2	29.42	29.92	29.14	.78	95	N.	x 12.	..	0.40	4.3	1.04	4
5	18.2	21.6	13.3	8.3	29.39	29.76	29.14	.62	86	N.W.	x 15.	..	....	0.6	0.08	5
6	15.3	18.9	9.0	9.9	30.03	30.11	29.76	.35	85	S.W.	x 10.	82	....	....	....	6
7	13.6	19.0	8.2	10.8	30.32	30.39	30.09	.30	86	S.W.	x 10.	55	....	....	....	7
SUNDAY........ 8	10.4	22.0	— 0.5	22.5	29.90	30.37	29.42	.95	87	xN.	...	..	....	12.0	1.41	8..........SUNDAY
9	20.7	25.1	15.8	9.3	29.74	30.04	29.41	.63	83	W.	x 10.	41	....	1.7	0.10	9
10	25.7	32.8	10.0	22.8	30.06	30.12	29.99	.13	91	S.W.	x 8.	02	....	....	....	10
11	34.8	39.6	21.0	18.6	29.68	29.99	29.24	.75	88	S.W.	x 21.	..	0.53	....	0.53	11
12	31.8	37.2	23.0	14.2	29.56	29.97	29.14	.83	91	S.W.	29.2	61	0.34	....	0.34	12
13	14.7	24.9	8.0	16.9	30.09	30.14	29.97	.17	74	xN.	14.1	..	....	0.0	0.00	13
14	7.4	15.0	0.8	14.2	30.34	30.41	30.14	.27	65	xS.W.	25.4	81	....	....	....	14
SUNDAY........15	10.2	14.8	3.3	11.5	30.21	30.39	29.93	.46	77	xW.	4.8	..	....	....	....	15..........SUNDAY
16	12.1	16.8	7.1	9.6	29.77	29.93	29.65	.28	81	xE.	11.1	00	....	1.6	0.12	16
17	—1.1	13.2	—9.0	22.2	29.55	29.76	29.43	.33	63	xN.E	21.9	..	....	1.2	0.16	17
18	1.1	9.3	—11.0	20.3	29.80	29.95	29.72	.23	72	xS.W.	20.1	..	....	0.0	0.00	18
19	—2.2	5.6	—11.8	17.4	30.29	30.37	29.95	.42	57	W.	27.0	91	....	....	....	19
20	11.4	18.0	0.8	17.2	30.35	30.39	30.32	.07	82	S.W.	18.7	68	....	....	....	20
21	18.5	25.9	10.0	15.9	30.18	30.39	30.03	.36	85	S.	14.7	..	....	0.5	0.04	21
SUNDAY...... 22	20.2	25.7	16.0	9.7	30.18	30.31	30.05	.26	75	S.W.	21.0	47	....	....	....	22..........SUNDAY
23	26.7	30.6	18.0	12.6	30.18	30.29	30.10	.19	88	S.W.	20.7	..	....	1.1	0.11	23
24	23.7	29.6	18.8	10.8	30.20	30.27	30.12	.15	83	S.W.	11.3	64	....	....	....	24
25	24.1	28.0	20.2	7.8	30.19	30.25	30.12	.13	84	S.W.	26.5	85	....	....	....	25
26	30.5	35.9	23.9	12.0	30.23	30.31	30.18	.13	87	S.W.	32.9	87	....	....	....	26
27	35.9	41.0	29.1	11.9	30.10	30.26	29.84	.42	68	S.W.	23.2	36	....	....	....	27
28	40.1	46.5	37.0	9.5	29.28	29.84	28.97	.87	94	S.W.	32.3	..	0.89	....	0.89	28
Means......	18.86	25.2	11.5	13.7	29.962	30.146	29.754	.392	81.2	S 37° W.	18.4	32.7	2.16	26.2	5.28	...............Sum.
29 Years means for and including this month	15.73	23.5	7.8	15.8	30.009	......	......	.309	80.7	....	§ 18.2	¶ 41.2	0.81	23.6	3.16	29 Years means for and including this month.

ANALYSIS OF WIND RECORD FROM 12th TO 28th.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	356	526	266	27	755	4938	1368	280	
Duration in hrs..	27	24	24	3	51	187	87	13	2
Mean velocity....	13.2	21.9	11.1	9.0	14.8	26.4	14.6	21.5	

Greatest mileage in one hour was 55 on the 28th.

Greatest velocity in gusts was 72 on the 28th.

x Estimated. m For 17 days only.

Resultant mileage, x9,100.

Resultant direction, S 37° W.

Total mileage, m8,516.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 16 years only.

The greatest heat was 46.5 above zero on the 28th. The greatest cold was 11.8 below zero on the 19th, giving a range of temperature of 58.3°.

Warmest day was the 28th. Coldest day was the 19th.

Highest barometer reading was 30.41 on the 14th; lowest barometer was 28.97 on the 28th, giving a range of 1.44 inches.

Minimum relative humidity observed was 45 on the 19th.

Rain fell on 4 days. Snow fell on 12 days.

Rain and snow on 1 day.

Fog on 1 day.

No. inches snow on ground 20.

H, 1903.

7 feet. C. H. McLEOD, *Superintendent.*

D	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY.	87	....	0.4	0.03	1 .... SUNDAY
	20	....	0.1	0.01	2
	33	....	0.0	0.00	3
	17	....	0.3	0.03	4
	..	....	2.3	0.23	5
	84	....	....	....	6
	44	0.05	....	0.05	7
SUNDAY..	..	0.54	....	0.54	8 .... SUNDAY
	84	....	....	....	9
	15	....	....	....	10
	30	0.39	....	0.39	11
	56	....	....	....	12
	01	....	....	....	13
	20	....	....	....	14
SUNDAY..	82	....	....	....	15 .... SUNDAY
	10	0.01	....	0.01	16
	..	0.25	....	0.25	17
	..	....	....	....	18
	49	0.02	....	0.02	19
	..	0.01	....	0.01	20
	..	0.26	....	0.26	21
SUNDAY..	49	0.04	....	0.04	22 .... SUNDAY
	..	1.15	....	1.15	23
	..	0.35	....	0.35	24
	54	0.00	0.0	0.00	25
	80	....	....	....	26
	22	0.12	....	0.12	27
	18	....	0.0	0.00	28
SUNDAY..	86	....	....	....	29 .... SUNDAY
	61	....	....	....	30
	51	....	....	....	31
Means....	34	3.19	3.1	3.49	.... Sum.
29 Years for and inc this month	¶ 45.4	1.39	23.2	3.87	29 Years means for and including this month.

	a-level and
Direction.	
Miles	aken from
Duration i	being 100. hours.
Mean veloc	
Greatest m	zero on the
Greatest v	zero on the 2.6°.

Warmest day was the 19th. Coldest day was the 3rd.

Highest barometer reading was 30.71 on the 3rd; lowest barometer was 29.38 on the 1st, giving a range of 1.33 inches.

Minimum relative humidity observed was 46 on the 31st.

Rain fell on 13 days. Snow fell on 7 days.

Rain and snow on 1 day.

Fog on 2 days.

Snow only here and there in places.

ABSTRACT FOR THE MONTH OF MARCH, 1903.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	18.1	38.2	9.8	28.4	29.91	30.24	29.38	.86	63	S.W.	27.0	87	....	0.4	0.03	1..........SUNDAY
2	21.1	28.7	9.2	19.5	30.34	30.64	30.18	.46	78	S.W.	16.3	20	....	0.1	0.01	2
3	10.2	18.3	—0.6	18.9	30.58	30.71	30.37	.34	76	N.E.	12.8	33	....	0.0	0.00	3
4	28.4	36.0	13.6	22.4	30.33	30.37	30.30	.07	92	S.W.	17.7	17	....	0.3	0.03	4
5	32.6	34.3	30.4	3.9	30.16	30.34	30.02	.32	98	S.W.	8.7	..	....	2.3	0.23	5
6	29.5	34.4	24.8	9.6	30.41	30.52	30.10	.42	73	N.W.	11.7	84	....	....	....	6
7	32.4	40.8	19.0	21.8	30.34	30.52	30.09	.43	78	S.E.	22.0	44	0.05	...	0.05	7
SUNDAY........ 8	40.2	42.5	37.3	5.2	30.17	30.35	30.03	.32	83	S.W.	19.2	..	0.54	....	0.54	8..........SUNDAY
9	34.5	40.0	30.2	9.8	30.57	30.61	30.35	.26	82	N.E.	24.9	84	....	....	....	9
10	33.9	38.7	29.1	9.6	30.46	30.59	30.31	.28	81	N.E.	13.6	15	....	....	....	10
11	38.0	42.6	32.1	10.5	30.23	30.32	30.12	.20	86	S.W.	11.0	30	0.39	....	0.39	11
12	37.7	41.5	34.9	6.6	30.28	30.33	30.20	.13	86	S.W.	26.4	56	....	....	....	12
13	36.3	39.0	33.6	5.4	30.23	30.27	30.19	.08	86	S.W.	17.2	01	....	....	....	13
14	36.2	39.0	33.3	5.7	30.26	30.35	30.32	.13	87	S.W.	16.3	20	....	....	....	14
SUNDAY........15	28.5	38.8	23.7	15.1	30.47	30.52	30.35	.17	86	N.E.	19.5	82	....	....	....	15..........SUNDAY
16	33.1	42.1	22.1	20.0	30.33	30.45	30.15	.30	68	S.	15.0	10	0.01	....	0.01	16
17	38.4	41.7	35.7	6.0	30.18	30.34	30.11	.23	93	S.W.	12.3	..	0.25	....	0.25	17
18	36.1	44.4	29.0	15.4	30.34	30.42	30.20	.22	87	N.E.	14.2	..	....	....	....	18
19	53.3	62.0	37.0	25.0	30.10	30.20	30.00	.20	81	S.W.	19.9	49	0.02	....	0.02	19
20	38.3	60.0	31.6	28.4	30.05	30.10	30.00	.10	93	N.E.	20.8	..	0.01	....	0.01	20
21	35.0	40.2	30.9	9.3	29.95	30.00	29.91	.09	96	N.E.	11.4	..	0.26	....	0.26	21
SUNDAY........22	38.3	43.4	31.6	11.8	30.21	30.29	29.98	.31	68	W.	13.9	49	0.04	....	0.04	22..........SUNDAY
23	36.5	39.0	33.8	5.2	30.05	30.29	29.81	.48	95	N.E.	15.8	..	1.15	....	1.15	23
24	37.1	44.0	33.8	10.2	29.93	30.00	29.85	.15	98	S.W.	11.5	..	0.35	....	0.35	24
25	36.5	41.3	32.8	8.5	29.77	29.91	29.68	.23	72	W.	25.0	54	0.00	0.0	0.00	25
26	37.9	45.5	28.5	17.0	29.92	30.00	29.86	.14	67	S.W.	28.8	80	....	....	....	26
27	39.1	42.0	31.0	11.0	29.92	30.10	29.76	.34	77	S.W.	15.3	22	0.12	....	0.12	27
28	31.2	36.5	27.0	9.5	30.18	30.38	30.10	.28	77	N.E.	12.8	18	....	0.0	0.00	28
SUNDAY........29	28.7	35.0	21.8	13.2	30.52	30.61	30.38	.23	65	W.	10.7	86	....	....	....	29..........SUNDAY
30	38.0	47.2	26.2	21.0	30.14	30.46	29.85	.61	65	S.	12.9	61	....	....	....	30
31	43.4	52.7	35.0	17.6	29.61	29.85	29.49	.36	65	S.W.	13.1	51	....	....	....	31
Means........	34.15	40.96	27.36	13.60	30.188	30.325	30.043	.282	80.7	S 64° W.	16.7	34	3.19	3.1	3.49	..............Sum.
29 Years means for and including this month	25.00	32.08	17.64	14.45	29.978	......	......	.274	77.3	....	§ 17.7	¶ 45.4	1.39	23.2	3.87	29 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	730	3049	170	658	1311	3796	2129	576	
Duration in hrs..	59	184	18	46	87	194	118	38	
Mean velocity....	12.4	16.6	9.4	14.3	15.1	19.6	18.0	15.2	

Greatest mileage in one hour was 42 on the 1st.

Greatest velocity in gusts was 60 on the 1st.

Resultant mileage, 2,695.

Resultant direction, S 64° W.

Total mileage, 12,419.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 16 years only.

The greatest heat was 62.0 above zero on the 19th. The greatest cold was 0.6 below zero on the 3rd, giving a range of temperature of 62.6°.

Warmest day was the 19th. Coldest day was the 3rd.

Highest barometer reading was 30.71 on the 3rd; lowest barometer was 29.38 on the 1st, giving a range of 1.33 inches.

Minimum relative humidity observed was 46 on the 31st.

Rain fell on 13 days. Snow fell on 7 days.

Rain and snow on 1 day.

Fog on 2 days.

Snow only here and there in places.

ʟ, 1903.

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

	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	73	....	....	....	1
	..	0.08	....	0.08	2
	..	0.61	1 2	0.84	3
	..	....	2.8	0.35	4
SUND	87	....	....	....	5..........SUNDAY
	..	....	....	....	6
	..	0.79	....	0.79	7
	27	0.13	....	0.13	8
	86	0.00	....	0.00	9
	41	....	....	....	10
	78	....	....	. ..	11
SUND	85	....	....	....	12..........SUNDAY
	70	....	....	....	13
	64	....	....	....	14
	76	....	....	....	15
	..	0.00	....	0.00	16
	52	....	....	....	17
	05	....	0.3	0.03	18
SUND	23	....	....	....	19..........SUNDAY
	42	....	....	....	20
	29	....	....	....	21
	..	....	....	....	22
	07	....	....	....	23
	63	....	....	....	24
	67	....	....	....	25
SUND	27	....	....	....	26..........SUNDAY
	90	....	....	....	27
	80	....	....	....	28
	52	....	....	....	29
	62	....	....	....	30
Mean	43.0	1.61	4.3	2.22	................Sum.
29 Y for an this m	¶ 50.1	1.737	5.06	2.258	29 Years means for and including this month.

-level and	Warmest day was the 30th. Coldest day was the 5th.
Direc / ken from	Highest barometer reading was 30.48 on the 6th; lowest barometer was 29.34 on the 3rd, giving a range of 1.14 inches.
Miles / Dura being 100. ours.	Minimum relative humidity observed was 33 on the 26th.
Mean	Rain fell on 6 days. Snow fell on 3 days.
	Rain and snow on 1 day.
	Fog on 1 day.
Great ero on the	Thunderstorm on 2nd.
Great zero on the ·4°.	No snow on ground.

ABSTRACT FOR THE MONTH OF APRIL, 1903.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	41.2	49.8	36.6	13.2	29.91	30.05	29.67	.38	59	N.W.	15.7	73	....	....	....	1
2	43.8	53.5	31.8	21.7	29.86	30.10	29.54	.56	61	S.E.	23.0	..	0.08	....	0.08	2
3	45.8	55.1	30.8	24.3	29.41	29.54	29.34	.20	91	N.E.	21.0	..	0.61	1.2	0.84	3
4	23.9	40.2	20.0	20.2	29.75	30.04	29.44	.60	75	N.	20.5	..	....	2.8	0.35	4
SUNDAY........ 5	21.9	28.6	12.8	15.8	30.30	30.40	30.04	.36	83	S.W.	19.5	87	....	....	....	5...........SUNDAY
6	30.7	36.2	21.0	15.2	30.35	30.48	30.17	.31	67	S.E.	10.8	..	....	....	....	6
7	40.2	44.5	33.0	11.5	29.87	30.17	29.73	.44	95	S.	20.8	..	0.79	....	0.79	7
8	46.6	56.1	38.0	18.1	29.80	29.84	29.75	.09	73	S.W.	15.1	27	0.13	....	0.13	8
9	45.3	53.3	36.2	17.1	29.81	29.86	29.77	.09	74	W.	11.8	86	0.00	....	0.00	9
10	44.3	52.6	38.8	13.8	30.03	30.16	29.84	.32	65	N.E.	11.6	41	....	....	....	10
11	41.3	48.0	33.8	14.2	30.15	30.21	30.11	.10	60	N.	11.0	78	....	....	....	11
SUNDAY........12	44.0	54.7	34.5	20.2	29.99	30.11	29.88	.23	55	N.E.	12.4	85	....	....	....	12...........SUNDAY
13	43.3	54.1	32.4	21.7	29.96	30.00	29.92	.08	73	N.E.	17.0	70	....	....	....	13
14	48.6	59.5	36.8	22.7	29.92	29.96	29.89	.07	63	E.	15.4	64	....	....	....	14
15	47.0	54.4	39.5	14.9	29.89	29.94	29.85	.09	67	N.E.	19.1	76	....	....	....	15
16	45.4	51.8	39.5	12.3	29.82	29.85	29.78	.07	65	N.E.	18.2	..	0.00	....	0.00	16
17	42.1	52.1	32.5	19.6	29.79	29.88	29.67	.21	54	N.	18.4	52	....	....	....	17
18	39.5	46.0	31.0	15.0	29.62	29.68	29.54	.14	61	N.W.	17.5	05	....	0.3	0.03	18
SUNDAY........19	40.1	49.5	33.9	15.6	29.67	29.70	29.62	.08	53	N.W.	18.3	23	....	....	....	19...........SUNDAY
20	38.0	46.0	30.2	15.8	29.71	29.74	29.67	.07	64	N.W.	13.8	42	....	....	....	20
21	39.0	46.7	30.9	15.8	29.75	29.80	29.72	.08	67	W.	11.9	29	....	....	....	21
22	46.5	52.6	40.8	11.8	29.83	29.87	29.80	.07	61	N.	10.1	..	....	....	....	22
23	47.1	54.2	42.0	12.2	29.91	29.99	29.86	.13	63	S.W.	7.1	07	....	....	....	23
24	47.2	57.2	38.8	18.4	29.93	29.97	29.88	.09	57	S.W.	16.0	63	....	....	....	24
25	43.7	52.0	35.1	16.9	30.03	30.10	29.97	.13	49	N.	13.1	67	....	....	....	25
SUNDAY...... 26	45.5	54.4	32.9	21.5	30.09	30.16	30.02	.14	50	N.E.	5.1	27	....	....	....	26...........SUNDAY
27	52.5	64.0	37.0	27.0	30.14	30.18	30.05	.13	49	S.W.	12.9	90	....	....	....	27
28	58.6	69.8	42.5	27.3	29.89	30.17	29.81	.36	53	S.W.	30.1	80	....	....	....	28
29	63.7	73.0	54.9	18.1	29.99	30.02	29.83	.19	55	S.W.	17.0	52	....	....	....	29
30	65.2	82.2	47.9	34.3	29.70	29.94	29.42	.52	50	S.W.	18.7	62	....	....	....	30
Means......	44.06	53.07	34.86	18.21	29.895	29.997	29.786	.211	63.8	N 51° W.	15.75	43.0	1.61	4.3	2.22	................Sum.
29 Years means for and including this month	40.84	49.27	33.03	16.24	29.961	......	......	.201	66.7	....	§ 16.25	¶ 50.1	1.737	5.06	2.258	29 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	2223	1734	597	503	982	2259	1489	1554	
Duration in hrs..	146	109	52	25	61	117	117	90	3
Mean velocity....	15.2	16.0	11.5	20.1	16.1	19.3	12.7	17.3	

Greatest mileage in one hour was 48 on the 30th.

Greatest velocity in gusts was 72 on the 30th.

Resultant mileage, 2,574.

Resultant direction, N 51° W.

Total mileage, 11,341.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 16 years only.

The greatest heat was 82.2 above zero on the 30th. The greatest cold was 12.8 above zero on the 5th, giving a range of temperature of 69.4°.

Warmest day was the 30th. Coldest day was the 5th.

Highest barometer reading was 30.48 on the 6th; lowest barometer was 29.34 on the 3rd, giving a range of 1.14 inches.

Minimum relative humidity observed was 33 on the 26th.

Rain fell on 6 days. Snow fell on 3 days.

Rain and snow on 1 day.

Fog on 1 day.

Thunderstorm on 2nd.

No snow on ground.

Y, 1903.

37 feet. C. H. McLEOD, *Superintendent.*

D	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	67	....	....	....	1
	57	....	....	....	2
SUNDAY	25	0.00	....	0.00	3..........SUNDAY
	41	0.00	....	0.00	4
	87	....	....	....	5
	80	....	....	....	6
	09	....	....	....	7
	94	....	....	....	8
	92	....	....	....	9
SUNDAY	57	....	....	....	10..........SUNDAY
	38	....	....	....	11
	76	....	....	....	12
	64	....	....	....	13
	22	0.02	....	0.02	14
	67	....	....	....	15
	92	....	....	....	16
SUNDAY	87	....	....	....	17..........SUNDAY
	52	0.00	....	0.00	18
	43	0.00	....	0.00	19
	64	0.00	....	0.00	20
	55	0 07	....	0.07	21
	91	....	....	....	22
	98	....	....	....	23
SUNDAY	92	....	....	....	24..........SUNDAY
	90	....	....	....	25
	43	....	....	....	26
	29	0.02	....	0.02	27
	31	0.00	....	0.00	28
	65	....	....	....	29
	72	....	....	....	30
SUNDAY	87	....	....	....	31..........SUNDAY
Means.	63.5	0.11	....	0.11	....
29 Ye for and this mo	¶ 51.3	2.84	....	2.85	29 Years means for and including this month.

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aken from

Miles ..

Duratio being 100. hours.

Mean v

Greates zero on the

Greates e zero on the 56.9°.

x Estin

Warmest day was the 18th. Coldest day was the 1st.

Highest barometer reading was 30.52 on the 2nd; lowest barometer was 29.58 on the 1st, giving a range of .94 inches.

Minimum relative humidity observed was 33 on the 2nd.

Rain fell on 9 days.

ABSTRACT FOR THE MONTH OF MAY, 1903.

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

DAY	THERMOMETER.				* BAROMETER.				‡Mean relative humidity.	WIND.		Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour.					
1	36.8	73.0	31.3	41.7	30.15	30.46	29.58	.88	71	N.W.	27.4	67	....	....	....	1
2	42.0	52.8	27.9	24.9	30.41	30.52	30.26	.26	45	S.E.	11.9	57	....	....	....	2
SUNDAY........ 3	49.9	57.4	40.0	17.4	30.09	30.26	29.93	.33	52	S.E.	24.5	25	0.00	....	0.00	3............SUNDAY
4	48.6	55.6	44.0	11.6	30.16	30.32	29.94	.38	68	S.W.	20.8	41	0.00	...	0.00	4
5	49.8	61.3	36.2	25.1	30.28	30.36	30.22	.14	56	N.E.	14.9	87	....	....	....	5
6	54.2	67.0	38.9	28.1	30.14	30.24	30.01	.23	58	N.E.	7.0	80	....	....	....	6
7	53.7	65.5	41.7	23.8	30.01	30.10	29.97	.13	68	N.E.	10.5	09	....	....	....	7
8	60.5	69.2	48.3	20.9	30.16	30.23	30.10	.13	46	S.W.	14.0	94	....	....	. ..	8
9	63.2	76.0	50.0	26.0	30.16	30.24	30.08	.16	52	S.W.	11.6	92	....	....	....	9
SUNDAY........10	64.8	76.7	53.1	23.6	30.12	30.16	30.07	.09	51	S.W.	20.6	57	....	....	....	10..........SUNDAY
11	66.4	74.7	52.5	22.2	30.21	30.25	30.13	.12	54	S.W.	16.5	38	....	....	....	11
12	63.7	78.2	50.8	27.4	30.28	30.35	30.21	.14	69	N.E.	7.8	76	....	....	....	12
13	61.5	75.5	45.8	29.7	30.15	30.24	30.03	.21	62	S.W.	15.4	64	....	....	....	13
14	50.2	66.0	43.6	22.4	30.05	30.15	29.94	.21	73	N.E.	13.8	22	0.02	....	0.02	14
15	60.4	73.5	46.8	26.7	29.96	30.07	29.91	.16	58	S.W.	12.7	67	....	....	....	15
16	58.5	73.8	41.2	32.6	30.15	30.23	30.07	.16	59	N.E.	10.7	92	....	....	....	16
SUNDAY........17	69.7	80.5	55.0	25.5	30.05	30.13	29.95	.18	62	S.W.	19.6	87	....	....	....	17 ....SUNDAY
18	70.6	82.0	60.2	21.8	29.94	30.00	29.87	.13	62	S.W.	15.4	52	0.00	....	0.00	18
19	70.2	84.8	56.4	28.4	29.85	29.91	29.77	.14	65	S.W.	13.8	43	0.00	....	0.00	19
20	66.4	82.6	48.8	33.8	29.81	29.85	29.74	.11	69	S.W.	16.0	64	0.00	....	0.00	20
21	67.1	79.2	55.8	23.4	29.85	29.90	29.77	.13	65	S.W.	13.0	55	0.07	....	0.07	21
22	59.9	66.0	52.2	13.8	29.91	30.01	29.79	.22	58	N.W.	12.5	91	....	....	....	22
23	48.6	57.2	39.8	17.4	30.11	30.18	30.01	.17	48	N.E.	12.1	98	....	....	....	23
SUNDAY...... 24	48.5	58.0	36.8	21.2	30.20	30.27	30.15	.12	52	N.E.	8.6	92	....	....	....	24..........SUNDAY
25	54.7	64.4	40.0	24.4	30.26	30.34	30.22	.12	53	S.E.	6.3	90	....	....	....	25
26	60.7	71.2	45.7	25.5	30.17	30.26	30.08	.18	51	S.	13.6	43	....	....	....	26
27	66.0	75.7	54.8	20.9	29.97	30.09	29.85	.24	72	S.	17.5	29	0.02	....	0.02	27
28	69.3	78.9	54.1	24.8	29.83	29.92	29.79	.13	70	......	....	31	0.00	....	0.00	28
29	51.2	68.0	41.1	26.9	30.13	30.19	29.92	.27	63	......	....	65	....	....	....	29
30	51.1	60.0	42.0	18.0	30.17	30.23	30.12	.11	56	......	....	72	....	....	....	30
SUNDAY....... 31	53.6	62.5	42.8	19.7	30.30	30.34	30.23	.11	63	......	....	87	....	....	....	31..........SUNDAY
Means......	57.79	69.91	45.73	24.18	30.097	30.19	29.99	.20	59.7	S. 46° W.	14.38	63.5	0.11	....	0.11	....
29 Years means for and including this month	54.77	64.14	45.81	18.34	29.935	......	......	.177	66.2	......	§ 14.27	¶ 51.3	2.84	....	2.85	29 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	525	1825	71	796	995	3764	470	873	
Duration in hrs..	48	144	14	52	76	215	36	63	
Mean velocity....	10.9	12.7	5.1	15.3	13.1	17.5	13.1	13.9	

Greatest mileage in one hour was 52 on the 1st.
Greatest velocity in gusts was 72 on the 1st.

x Estimated. *m* For 27 days only.

x Resultant mileage, 2,932.
Resultant direction, S 46° W.

m Total mileage, 9,319.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 16 years only.

The greatest heat was 84.8 above zero on the 19th. The greatest cold was 27.9 above zero on the 2nd, giving a range of temperature of 56.9°.

Warmest day was the 18th. Coldest day was the 1st.

Highest barometer reading was 30.52 on the 2nd; lowest barometer was 29.58 on the 1st, giving a range of .94 inches.

Minimum relative humidity observed was 33 on the 2nd.

Rain fell on 9 days.

E, 1903.

7 feet. C. H. McLEOD, *Superintendent.*

	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	81	....	....	....	1
	88	....	....	....	2
	20	....	....	....	3
	21	....	....	....	4
	71	....	....	....	5
	67	....	....	....	6
SUNDA	11	....	....	....	7..........SUNDAY
	12	0.04	....	0.04	8
	33	....	....	....	9
	25	0.00	....	0.00	10
	30	0.20	....	0.20	11
	..	1.49	....	1.49	12
	01	0.17	....	0.17	13
SUNDA	51	....	....	....	14..........SUNDAY
	39	0.00	....	0.00	15
	44	0.02	....	0.02	16
	75	0.23	....	0.23	17
	25	0.23	....	0.23	18
	58	0.03	....	0.03	19
	70	0.00	....	0.00	20
SUNDA	..	1.56	....	1.56	21..........SUNDAY
	41	....	....	....	22
	24	0.00	....	0.00	23
	05	0.18	....	0.18	24
	14	0.12	....	0.12	25
	51	0.44	....	0.44	26
	66	....	....	....	27
SUNDA	93	....	....	....	28..........SUNDAY
	25	....	....	....	29
	01	0.05	....	0.05	30
Means.	38	4.76	....	4.76	.......Sums.........
29 Ye for and this mo	¶ 53.7	3.65	....	3.65	29 Years means for and including this month.

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Directi aken from

Miles ..

Duratio being 100. hours.

Mean v

Greates y.

Greates

m Total

The greatest heat was 84.2 above zero on the 6th. The greatest cold was 46.5 above zero on the 1st, giving a range of temperature of 37.7°.

Warmest day was the 6th. Coldest day was the 21st.

Highest barometer reading was 30.38 on the 1st; lowest barometer was 29.58 on the 12th, giving a range of .80 inch.

Minimum relative humidity observed, was 20 on the 4th.

Rain fell on 17 days. Lightning on 5 days.

Thunderstorms on the 18th and 26th.

ABSTRACT FOR THE MONTH OF JUNE, 1903.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	60.9	73.1	46.5	26.6	30.31	30.38	30.23	.15	47	x N.W.	....	81	....	....	....	1
2	63.9	73.7	53.2	20.5	30.22	30.31	30.08	.23	44	x W.	....	88	....	....	....	2
3	65.6	78.2	55.3	22.9	30.03	30.13	29.98	.15	46	N.W.	18.0	20	....	....	....	3
4	58.0	67.0	49.3	17.7	30.27	30.33	30.13	.20	47	N.W.	11.8	21	....	....	....	4
5	64.0	77.3	57.9	29.4	30.29	30.35	30.21	.14	77	S.W.	10.3	71	....	....	....	5
6	71.2	84.2	58.8	25.4	30.15	30.23	30.07	.16	66	S.W.	17.0	67	....	....	....	6
SUNDAY....... 7	68.7	79.9	56.6	23.3	29.99	30.08	29.89	.19	61	S.W.	11.0	11	....	....	....	7..........SUNDAY
8	68.2	75.4	64.0	11.4	29.84	29.91	29.79	.12	86	S.W.	14.8	12	0.04	....	0.04	8
9	70.8	80.5	62.0	18.5	29.83	29.87	29.80	.07	81	S.W.	9.5	33	....	....	....	9
10	70.6	76.9	65.2	11.7	29.93	29.96	29.86	.10	78	N.E.	12.3	25	0.00	....	0.00	10
11	66.2	76.5	58.0	18.5	29.96	30.02	29.90	.12	70	N.E.	11.4	30	0.20	....	0.20	11
12	61.5	66.3	55.1	11.2	29.75	29.90	29.58	.32	93	S.E.	17.0	..	1.49	....	1.49	12
13	62.7	67.1	58.0	9.1	29.70	29.74	29.65	.09	91	S.	11.0	01	0.17	....	0.17	13
SUNDAY.......14	61.8	67.2	54.0	13.2	29.76	29.77	29.73	.04	73	S.	8.1	51	....	....	....	14..........SUNDAY
15	62.1	72.4	55.9	16.5	29.80	29.86	29.76	.10	78	N.E.	15.2	39	0.00	....	0.00	15
16	58.7	66.5	52.9	13.6	29.86	29.90	29.82	.08	75	N.E.	13.7	44	0.02	....	0.02	16
17	61.3	72.0	51.3	20.7	29.84	28.88	29.80	.08	69	S.E.	11.3	75	0.23	....	0.23	17
18	57.1	62.8	50.2	12.6	29.90	29.93	29.88	.05	81	S.W.	7.4	25	0.23	....	0.23	18
19	60.2	70.0	52.1	17.9	29.83	29.88	29.80	.08	72	S.W.	7.0	58	0.03	....	0.03	19
20	62.6	72.5	52.8	19.7	29.80	29.83	29.75	.08	70	S.E.	6.0	70	0.00	....	0.00	20
SUNDAY.......21	56.1	66.0	54.0	12.0	29.80	29.89	29.75	.14	97	S.E.	12.9	..	1.56	....	1.56	21..........SUNDAY
22	61.4	69.7	51.8	17.9	29.93	29.98	29.89	.09	70	S.E.	8.5	41	....	....	....	22
23	62.0	69.4	56.5	12.9	29.91	29.95	29.88	.07	58	S.E.	15.0	24	0.00	....	0.00	23
24	57.2	63.8	51.5	12.3	29.98	29.04	29.93	.11	75	S.E.	11.8	05	0.18	....	0.18	24
25	57.8	65.6	50.8	14.8	29.93	29.98	22.88	.10	85	S.E.	11.1	14	0.12	....	0.12	25
26	62.6	72.5	55.6	16.9	29.91	29.97	29.86	.11	84	W.	11.5	51	0.44	....	0.44	26
27	62.0	66.0	59.9	6.1	29.91	29.96	29.86	.10	62	N.W.	11.4	66	....	....	....	27
SUNDAY.......28	65.0	75.2	53.1	22.1	29.86	29.89	29.82	.07	64	S.W.	12.3	93	....	....	....	28..........SUNDAY
29	64.7	74.2	55.6	18.6	29.85	29.87	29.83	.04	67	x S.E.	....	25	....	....	....	29
30	62.8	69.5	57.9	11.6	29.80	29.86	29.75	.11	87	......	....	01	0.05	....	0.05	30
Means........	62.90	71.7	54.9	16.8	29.931	29.99	29.87	.12	70.5	m S. 1° E.	m 11.81	38	4.76	....	4.76	.......Sums.........
29 Years means for and including this month......	64.73	73.5	56.21	17.3	29.903	......	......	.16	70.4	......	§ m 11.92	¶ 53.7	3.65	....	3.65	29 Years means for and including this month.

m ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	112	1345	175	1906	626	1990	568	644	
Duration in hrs..	10	101	18	174	59	164	45	53	
Mean velocity....	11.2	13.3	9.7	11.0	10.6	12.1	12.6	12.2	

Greatest mileage in one hour was 31 on the 12th.
Greatest velocity in gusts was 36 on the 6th and 12th.
m Total mileage, 7,366.

x Resultant mileage, 2,148.
Resultant direction, S 1° E.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 16 years only.

x Estimated. *m* For 26 days only.

The greatest heat was 84.2 above zero on the 6th. The greatest cold was 46.5 above zero on the 1st, giving a range of temperature of 37.7°.

Warmest day was the 6th. Coldest day was the 21st.

Highest barometer reading was 30.38 on the 1st; lowest barometer was 29.58 on the 12th, giving a range of .80 inch.

Minimum relative humidity observed, was 20 on the 4th.

Rain fell on 17 days. Lightning on 5 days.

Thunderstorms on the 18th and 26th.

Y, 1903.

87 feet. C. H. McLEOD, *Superintendent.*

DA	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	20	0.01	....	0.01	1
	82	0.89	....	0.89	2
	96	....	....	....	3
	96	....	....	....	4
SUNDAY..	36	0.04	....	0.04	5..........SUNDAY
	77	0.00	....	0.00	6
	65	0.00	....	0.00	7
	81	....	....	....	8
	85	....	....	....	9
	66	....	....	....	10
	75	....	....	...	11
SUNDAY..	70	0.01	....	0.01	12..........SUNDAY
	86	....	....	....	13
	80	....	....	....	14
	61	0.08	....	0.08	15
	49	0.01	....	0.01	16
	91	....	....	....	17
	65	....	....	....	18
SUNDAY..	..	0.22	....	0.22	19..........SUNDAY
	13	0.13	....	0.13	20
	07	0.00	....	0.00	21
	05	0.06	....	0.06	22
	17	0.22	....	0.22	23
	90	....	....	....	24
	11	0.26	....	0.26	25
SUNDAY..	64	0.09	....	0.09	26..........SUNDAY
	82	....	....	....	27
	44	....	....	....	28
	..	0.18	....	0.18	29
	29	0.67	....	0.67	30
	82	....	....	....	31
Means...	56.0	2.87	....	2.87	.......Sums.........
29 Year for and in this month	¶ 58.9	4.20	....	4.20	29 Years means for and including this month.

a-level and

Direction aken from

Miles ....

Duration being 100. hours.

Mean velo

Greatest r y.

Greatest

*m*Total m

The greatest heat was 88.0 above zero on the 9th. The greatest cold was 54.0 above zero on the 28th, giving a range of 34.0 degrees.

Warmest day was the 10th. Coldest day was the 27th.

Highest barometer reading was 30.16 on the 31st; lowest barometer was 29.46 on the 2nd, giving a range of .70 inches.

Minimum relative humidity observed, was 41 on the 26th.

Rain fell on 17 days.

Thunder and lightning on 4 days.

ABSTRACT FOR THE MONTH OF JULY, 1903.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	69.0	77.6	60.0	17.6	29.69	29.78	29.52	.26	89	x S.W.	....	20	0.01	....	0.01	1
2	72.0	78.2	65.1	13.1	29.60	29.81	29.46	.35	67	x N.W.	....	82	0.89	....	0.89	2
3	65.0	72.8	54.7	18.1	29.91	29.99	29.81	.18	64	x W.	....	96	....	....	....	3
4	66.1	75.7	60.3	15.4	30.08	30.11	29.99	.12	62	x S.E.	....	96	....	....	....	4
SUNDAY....... 5	68.6	76.8	59.0	17.8	30.07	30.13	29.99	.14	73	S.E.	7.2	36	0.04	....	0.04	5..........SUNDAY
6	71.9	80.0	64.4	15.6	30.01	30.04	29.98	.06	73	N.W.	11.7	77	0.00	....	0.00	6
7	74.4	81.6	69.0	12.6	30.05	30.13	29.95	.18	60	S.W.	15.6	65	0.00	....	0.00	7
8	75.3	84.5	66.8	17.7	29.88	30.00	29.80	.20	71	W.	25.7	81	....	....	....	8
9	78.8	88.0	70.0	18.0	29.84	29.87	29.82	.05	69	W.	20.0	85	....	....	....	9
10	79.7	86.9	70.6	16.3	29.72	29.82	29.65	.17	69	W.	23.9	66	....	....	....	10
11	74.6	80.5	69.0	11.5	29.71	29.75	29.66	.09	73	W.	13.3	75	....	....	....	11
SUNDAY........12	70.1	76.3	62.4	13.9	29.67	29.69	29.66	.03	70	W.	14.5	70	0.01	....	0.01	12..........SUNDAY
13	68.7	76.2	61.9	14.3	29.69	29.70	29.66	.04	67	W.	13.1	86	....	....	....	13
14	64.4	72.3	57.7	14.6	29.72	29.75	29.70	.05	71	W.	14.2	80	....	....	....	14
15	61.6	69.2	55.2	14.0	29.72	29.74	29.70	.04	82	N.W.	13.4	61	0.08	....	0.08	15
16	64.8	74.0	57.8	16.2	29.79	29.88	29.74	.14	72	N.W.	14.0	49	0.01	....	0.01	16
17	68.5	78.0	59.3	18.7	29.93	29.97	29.87	.10	64	W.	10.7	91	....	....	....	17
18	68.9	79.9	58.0	21.9	29.84	29.94	29.77	.07	63	S.W.	8.1	65	....	....	....	18
SUNDAY....... 19	63.6	70.2	61.6	8.6	29.78	29.80	29.77	.03	86	N.E.	8.0	..	0.22	....	0.22	19..........SUNDAY
20	64.5	71.8	58.9	12.9	29.82	29.85	29.77	.08	84	E.	5.4	13	0.13	....	0.13	20
21	66.1	73.0	62.0	11.0	29.87	29.92	29.84	.08	87	S.E.	6.0	07	0.00	....	0.00	21
22	67.0	73.3	60.6	12.7	29.88	29.97	29.88	.09	89	S.E.	6.4	05	0.06	....	0.06	22
23	65.7	69.5	63.4	6.1	29.99	29.90	29.85	.05	91	N.E.	7.1	17	0.22	....	0.22	23
24	67.2	76.0	59.1	16.9	29.91	30.06	29.90	.16	58	N.W.	11.1	90	....	....	....	24
25	67.5	78.1	60.0	18.1	29.93	30.02	29.83	.19	82	N.W.	13.1	11	0.26	....	0.26	25
SUNDAY....... 26	64.2	72.0	54.8	17.2	29.85	29.94	29.79	.15	64	N.W.	13.0	64	0.09	....	0.09	26..........SUNDAY
27	57.2	65.3	46.9	18.4	30.00	30.03	29.94	.09	57	N.W.	15.8	82	....	....	....	27
28	61.4	68.0	54.0	14.0	30.01	30.05	29.93	.12	63	N.W.	7.9	44	....	....	....	28
29	62.4	68.6	56.3	12.3	29.73	29.93	29.62	.31	96	S.W.	10.8	..	0.18	....	0.18	29
30	69.6	77.2	64.1	13.1	29.63	29.68	29.59	.09	87	S.W.	15.2	29	0.67	....	0.67	30
31	62.1	69.1	55.4	13.7	29.94	30.16	59.68	.48	64	N.W.	16.1	82	....	....	....	31
Means.......	67.72	75.50	60.59	14.91	29.847	29.916	29.782	.135	73.1	N. 84° W.	12.64	56.0	2.87	....	2.87	.......Sums.........
29 Years means for and including this month	....	77.22	60.79	16.43	29.897	......	......	.143	71.8	......	§ 12.91	¶ 58.9	4.20	....	4.20	29 Years means for and including this month.

m ANALYSIS OF WIND RECORD.

Direction.......	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	503	284	320	244	316	1193	3627	1705	
Duration in hrs..	46	41	57	36	42	78	228	120	
Mean velocity....	10.9	6.9	5.6	6.8	7.5	15.3	11.5	14.2	

Greatest mileage in one hour was 33 on the 8th.
Greatest velocity in gusts was 48 on the 8th.
mTotal mileage, 8,192.

x Resultant mileage, 5,754.
Resultant direction, N 84° W.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 17 years only.

x Estimated. m For 27 days only.

The greatest heat was 88.0 above zero on the 9th. The greatest cold was 54.0 above zero on the 28th, giving a range of 34.0 degrees.

Warmest day was the 10th. Coldest day was the 27th.

Highest barometer reading was 30.16 on the 31st; lowest barometer was 29.46 on the 2nd, giving a range of .70 inches.

Minimum relative humidity observed, was 41 on the 26th.

Rain fell on 17 days.

Thunder and lightning on 4 days.

ST, 1903.

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

D	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	86	0.00	....	0.00	1
SUNDAY	66	....	....	....	2..........SUNDAY
	80	....	...	....	3
	..	0.08	....	0.08	4
	17	....	....	. ..	5
	02	0.03	....	0.03	6
	50	....	....	....	7
	78	....	....	....	8
SUNDAY	..	0.71	....	0.71	9..........SUNDAY
	75	...	....	....	10
	07	0.32	....	0.32	11
	62	....	....	....	12
	68	....	....	....	13
	60	....	....	....	14
	62	0.01	....	0.01	15
SUNDAY	32	....	....	....	16..........SUNDAY
	84	....	....	....	17
	30	0.03	....	0.03	18
	22	0.06	....	0.06	19
	..	0.70	....	0.70	20
	83	....	....	....	21
	84	0.57	....	0.57	22
SUNDAY	81	....	....	....	23..........SUNDAY
	80	....	....	....	24
	..	0.17	....	0.17	25
	76	....	....	....	26
	77	....	....	....	27
	66	....	....	...	28
	25	....	....	....	29
SUNDAY	..	0.30	....	0.30	30..........SUNDAY
	..	0.19	....	0.19	31
Means.	47.1	3.17	....	3.17	.......Sums.........
29 Ye for and i this mon	¶ 57.5	3.59	....	3.59	29 Years means for and including this month.

-level and	The greatest heat was 80.2 above zero on the 22nd. The greatest cold was 50.0 above zero on the 1st, giving a range of 30.2 degrees.
Directio ken from	Warmest day was the 19th. Coldest day was the 31st.
Miles ..	
being 100. Duratio hours.	Highest barometer reading was 30.43 on the 2nd and 3rd ; lowest barometer was 29.45 on the 22nd giving a range of .98 inches.
Mean ve	Minimum relative humidity observed, was 47 on the 8th and 23rd.
Greatest	Rain fell on 13 days.
Greates	Thunder and lightning on 5 days.
Resulta	

ABSTRACT FOR THE MONTH OF AUGUST, 1903.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	61.9	69.5	50.0	19.5	30.25	30.32	30.21	.11	64	N.W.	9.5	86	0.00	....	0.00	1
SUNDAY....... 2	63.2	70.0	57.1	12.9	30.40	30.43	30.32	.11	62	N.E.	7.5	66	....	....	....	2..........SUNDAY
3	62.2	68.7	54.5	14.2	30.35	30.43	30.23	.20	67	N.E.	6.0	80	....	...	. .	3
4	59.3	67.8	54.2	13.6	30.12	30.23	30.05	.18	86	S.E.	10.0	..	0.08	....	0.08	4
5	62.0	68.9	56.1	12.8	30.00	30.05	29.94	.11	74	S.E.	9.2	17	....	....	. ..	5
6	62.9	69.8	58.2	11.6	29.79	29.95	29.68	.27	81	S.E.	15.8	02	0.03	....	0.03	6
7	59.4	64.0	54.9	9.1	29.79	29.93	29.67	.26	72	W.	14.6	50	....	....	....	7
8	61.3	70.8	51.0	19.8	29.87	29.93	29.82	.11	59	S.W.	16.6	78	....	....	....	8
SUNDAY........ 9	60.2	67.0	54.5	12.5	29.78	29.86	29.73	.13	93	S.W.	11.3	..	0.71	....	0.71	9..........SUNDAY
10	64.1	71.6	56.8	14.8	29.91	29.96	29.77	.19	77	W.	8.7	75	...	....	....	10
11	61.2	68.0	56.5	11.5	29.82	29.96	29.70	.26	89	S.W.	10.4	07	0.32	....	0.32	11
12	61.3	66.2	56.5	9.7	29.80	29.91	29 72	.19	74	N.W.	15.7	62	....	....	....	12
13	59.8	68.5	51.1	17.4	30.00	30.06	29.91	.15	72	N.W.	14.9	68	....	....	....	13
14	61.5	70.5	53.6	16.9	30.07	30.11	30.04	.07	68	W.	11.5	60	....	....	....	14
15	64.6	74.3	56.1	18.2	30.09	30.13	30.06	.07	80	N.W.	8.2	62	0.01	....	0.01	15
SUNDAY....... 16	64.0	74.8	54.6	20.2	30.04	30.07	30.00	.07	73	N.W.	5.5	32	....	....	....	16..........SUNDAY
17	64.7	73.9	57.1	16.8	29.99	30.02	29.95	.07	76	N.W.	9.8	84	....	....	....	17
18	62.0	70.4	52.0	18.4	29.96	30.04	29.84	.20	83	....	....	30	0.03	....	0.03	18
19	69.0	77.0	62.7	14.3	29.77	29.84	29.73	.11	80	S.W.	....	22	0.06	....	0.06	19
20	65.5	74.2	61.7	12.5	29.72	29.79	29 69	.10	89	N.W.	8.6	..	0.70	....	0.70	20
21	63.1	69.8	53.5	16.3	29.86	29.96	29.71	.25	68	S.W.	11.9	83	....	....	....	21
22	68.6	80.2	61.0	19.2	29.57	29.73	29.45	.28	61	S.W.	23.6	84	0.57	....	0.57	22
SUNDAY...... 23	61.8	70.1	52.8	17.3	29.79	29.87	29.77	.10	59	N.W.	12.6	81	....	....	....	23..........SUNDAY
24	59.6	67.4	43.3	24.1	29.96	29.99	29.87	.12	63	N.W.	6.5	80	....	....	....	24
25	57.7	61.1	53.5	7.6	29.91	29.99	29.85	.14	82	N.E.	6.8	..	0.17	....	0.17	25
26	61.4	69.0	53.4	15.6	29.97	30.02	29.90	.12	69	N.E.	6.3	76	....	....	....	26
27	61.8	69.6	52.7	16.9	30.05	30.08	30.02	.06	68	N.E.	6.2	77	....	....	....	27
28	61.3	69.4	51.6	17.8	30.10	30.12	30.07	.05	67	N.W.	11.2	66	....	....	...	28
29	60.9	68.1	53.8	14.3	30.14	30.17	30.11	.06	76	N.W.	6.1	25	....	....	....	29
SUNDAY........30	59.0	64.2	56.0	8.2	30.13	30.16	30.10	.06	79	N.E.	8.7	..	0.30	....	0.30	30..........SUNDAY
31	56.3	60.2	51.8	8.4	30.01	30.10	29.94	.16	93	N.E.	6.0	..	0.19	....	0.19	31
Means......	62.00	69.52	54.60	14.92	29.969	30.006	29.898	.108	74.3	N. 87° W.	10.30	47.1	3.17	....	3.17	.......Sums ....
29 Years means for and including this month	66.55	74.78	58.68	16.10	29.942	......	......	.133	73.6	......	§ 11.91	¶ 57.5	3.59	....	3.59	29 Years means for and including this month.

m ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	106	695	326	583	486	1699	1098	2303	
Duration in hrs..	16	104	46	54	41	121	111	215	
Mean velocity....	6.6	6.7	7.0	10.8	11.9	14.9	9.9	10.7	

Greatest mileage in one hour was 39 on the 22nd.
Greatest velocity in gusts was 42 on the 22nd.
Resultant mileage, 2,701.

Resultant direction, N 87° W.
Total mileage, 7,296.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 17 years only.

m For 29½ days only.

The greatest heat was 80.2 above zero on the 22nd. The greatest cold was 50.0 above zero on the 1st, giving a range of 30.2 degrees.

Warmest day was the 19th. Coldest day was the 31st.

Highest barometer reading was 30.43 on the 2nd and 3rd; lowest barometer was 29.45 on the 22nd giving a range of .98 inches.

Minimum relative humidity observed, was 47 on the 8th and 23rd.

Rain fell on 13 days.

Thunder and lightning on 5 days.

ɅBER, 1903.

7 feet. C. H. McLEOD, *Superintendent.*

D	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	2	.15	....	.15	1
	76	....	....	....	2
	47	.00	....	.00	3
	63	.12	....	.12	4
	74	.02	....	.02	5
SUNDAY	53	....	....	....	6..........SUNDAY
	80	....	....	....	7
	89	....	....	....	8
	67	....	....	....	9
	64	.01	....	.01	10
	89	.00	....	.00	11
	86	....	....	....	12
SUNDAY	70	....	....	....	13..........SUNDAY
	61	....	....	....	14
	12	.05	....	.05	15
	72	...	....	....	16
	19	.35	....	.35	17
	74	....	....	....	18
	90	....	....	....	19
SUNDAY	84	....	....	....	20..........SUNDAY
	86	....	....	....	21
	90	....	....	....	22
	88	....	....	....	23
	65	.04	....	.04	24
	35	....	....	....	25
	84	....	....	....	26
SUNDAY	33	.53	....	.53	27..........SUNDAY
	40	.00	....	.00	28
	57	....	....	....	29
	60	....	....	....	30
Means.	64	1.27	....	1.27	.......Sums.........
29 Ye for and this mo	¶ 54.15	3.21	....	3.21	29 Years means for and including this month.

Directi
Miles ..
Duratio
Mean v
Greates
Greates
Resulta

a-level and
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being 100.
hours.
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ve zero on

Warmest day was the 13th. Coldest day was the 29th.

Highest barometer reading was 30.43 on the 19th and 20th ; lowest barometer was 29.48 on the 17th, giving a range of .95 inches.

Minimum relative humidity observed, was 39 on the 7th.

Rain fell on 11 days.

Thunder and lightning on 2 days.

Fog on 1 day.

Auroras on 2 nights.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1903.

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

DAY	THERMOMETER.				* BAROMETER.				‡Mean relative humidity.	WIND.		Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour.					
1	62.4	68.1	57.6	10.5	29.98	30.03	29.94	.09	91	S.E.	5.2	2	.15	....	.15	1
2	67.6	74.0	60.0	14.0	30.07	30.10	30.03	.07	78	S.E.	10.4	76	....	....	....	2
3	68.3	75.0	59.9	15.1	30.08	30.14	30.00	.14	80	S.E.	9.2	47	.00	....	.00	3
4	68.8	79.0	62.7	16.3	29.93	30.00	29.84	.16	79	S.E.	12.5	63	.12	....	.12	4
5	58.9	66.4	54.3	12.1	29.99	30.03	29.95	.08	66	S.W.	8.7	74	.02	....	.02	5
SUNDAY....... 6	55.3	62.0	47.4	14.6	30.06	30.10	30.02	.08	61	S.W.	8.0	53	....	....	....	6...........SUNDAY
7	53.0	59.0	48.2	10.8	30.21	30.30	30.13	.17	54	W.	5.5	80	...	....	...	7
8	53.9	61.5	44.8	16.7	30.34	30.39	30.30	.09	65	N E.	5.0	89	....	....	....	8
9	58.1	68.0	45.0	23.0	30.24	30.32	30.11	.21	73	E.	10.3	67	....	....	....	9
10	67.7	75.0	59.0	16.0	29.95	30.11	29.83	.28	83	E.	13.5	64	.01	....	.01	10
11	66.5	71.2	60.6	10.6	30.08	30.19	29.89	.30	72	S.	12.5	89	.00	....	.00	11
12	65.5	74.0	57.0	17.0	30.21	30.27	30.14	.13	70	S.E.	9.5	86	....	....	....	12
SUNDAY........13	72.5	83.0	60.9	22.1	30.00	30.14	29.87	.27	69	S.E.	19.7	70	....	....	...	13...........SUNDAY
14	68.1	76.4	61.2	15.2	30.05	30.11	29.93	.18	62	S.W.	10.2	61	....	....	....	14
15	65.1	68.8	62.5	6.3	30.08	30.12	30.03	.09	84	N.W.	8.5	12	.05	....	.05	15
16	69.9	81.2	60.0	21.2	29.98	30.09	29.86	.23	82	E.	8.8	72	...	....	....	16
17	66.7	74.8	57.9	16.9	29.65	29.86	29.48	.38	87	S.E.	19.6	19	.35	....	.35	17
18	50.1	59.0	45.1	13.9	30.07	30.24	29.75	.49	75	S.E.	17.0	74	....	....	....	18
19	52.1	59.0	43.1	15.9	30.38	30.43	30.24	.19	71	S.E.	11.8	90	....	....	....	19
SUNDAY........20	55.6	65.0	45.1	19.9	30.35	30.43	30.27	.16	74	E.	5.9	84	....	....	....	20...........SUNDAY
21	61.0	68.8	49.0	19.8	30.13	30.27	30.02	.25	72	S.E.	15.3	86	....	....	....	21
22	62.9	68.2	58.5	9.7	30.11	30.17	30.02	.15	54	S.W.	15.0	90	....	....	....	22
23	65.5	76.3	52.0	24.3	29.82	30.06	29.58	.48	64	S.E.	21.6	88	....	....	....	23
24	49.5	66.7	44.5	22.2	29.82	29.94	29.63	.31	69	S.W.	18.7	65	.04	....	.04	24
25	49.7	55.5	43.2	12.3	30.01	30.06	29.94	.12	69	S.E.	12.0	35	....	....	....	25
26	58.8	70.1	46.0	24.1	29.98	30.06	29.90	.16	75	E.	15.8	84	....	....	....	26
SUNDAY........27	59.7	71.2	49.0	22.2	29.79	29.91	29.68	.23	83	S.E.	25.8	33	.53	....	.53	27...........SUNDAY
28	46.7	58.0	42.0	16.0	30.00	30.18	29.86	.32	75	S.W.	17.5	40	.00	....	.00	28
29	45.3	50.5	39.6	10.9	30.24	30.28	30.18	.10	65	S.W.	17.5	57	....	....	....	29
30	54.3	64.0	43.2	20.8	30.22	30.30	30.15	.15	67	S.E.	22.1	60	....	....	....	30
Means.............	59.99	68.32	51.98	16.34	30.062	30.15	29.95	.20	72.3	S. 32° E	13.1	64	1.27	....	1.27	.......Sums.........
29 Years means for and including this motnh......	58.63	66.63	50.95	15.69	30.016	......	......	.186	76.2	......	§ 12.55	¶ 54.15	3.21	....	3.21	29 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	45	79	1439	4691	1049	1649	149	324	
Duration in hrs..	9	15	115	304	69	136	30	42	
Mean velocity....	5.0	5.3	12.5	15.4	15.2	12.1	5.0	7.7	

Greatest mileage in one hour was 37 on the 17th.
Greatest velocity in gusts was 48 on the 27th.
Resultant mileage, 6,141

Resultant direction, S. 32° E.
Total mileage, 9,425.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 17 years only.

The greatest heat was 83.0 above zero on the 13th. The greatest cold was 39.6 above zero on the 29th, giving a range of 43.4 degrees.

Warmest day was the 13th. Coldest day was the 29th.

Highest barometer reading was 30.43 on the 19th and 20th; lowest barometer was 29.48 on the 17th, giving a range of .95 inches.

Minimum relative humidity observed, was 39 on the 7th.

Rain fell on 11 days.

Thunder and lightning on 2 days.

Fog on 1 day.

Auroras on 2 nights.

ɜER, 1903.

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

I	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	08	.22	....	.22	1
	94	.05	....	.05	2
	69	....	....	....	3
SUNDAY	....	.11	....	.11	4..........SUNDAY
	52	.10	....	.10	5
	93	....	....	....	6
	....	.44	....	.44	7
	....	.35	....	.35	8
	....	.85	....	.85	9
	32	.03	....	.03	10
SUNDAY	92	....	....	....	11..........SUNDAY
	08	....	....	....	12
	87	....	....	....	13
	58	....	....	....	14
	74	....	....	....	15
	04	.03	....	.03	16
	23	.65	....	.65	17
SUNDAY	29	.20	.00	.20	18..........SUNDAY
	....	.03	.00	.03	19
	39	....	....	....	20
	68	....	....	....	21
	63	.29	....	.29	22
	....	.06	....	.06	23
	01	....	....	....	24
SUNDAY	03	.03	....	.03	25..........SUNDAY
	52	.05	1.5	.20	26
	13	....	.00	.00	27
	45	....	....	....	28
	69	....	....	....	29
	76	....	....	....	30
	27	.07	....	.07	31
Means	38.4	3.56	1.5	3.71	.......Sums.........
29 Y for and this m	¶ 41.3	3.03	1.0	3.13	29 Years means for and including this month.

a-level and	Warmest day was the 5th. Coldest day was the 27th.
Direct ken from	Highest barometer reading was 30.41 on the 3rd; lowest barometer was 29.42 on the 18th, giving a range of .99 inches.
Miles being 100.	
hours.	Minimum relative humidity observed, was 34 on the 2nd.
Durati	
Mean	Rain fell on 17 days.
	Snow fell on 4 days.
Greate zero on the	Rain and snow on 3 days.
ve zero on	
Greate ure of 41.6	Lunar halos observed on 2 nights
Result	Auroras were observed on 3 nights.

ABSTRACT FOR THE MONTH OF OCTOBER, 1903.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	59.1	65.0	51.0	14.0	30.03	30.14	29.96	.18	91	S.E.	17.5	08	.22	....	.22	1
2	56.2	64.5	49.0	15.5	30.26	30.38	29.97	.41	65	N.W.	14.4	94	.05	....	.05	2
3	56.3	65.6	44.0	21.6	30.31	30.41	30.17	.24	70	N.E.	7.9	69	....	....	....	3
SUNDAY....... 4	57.3	60.1	53.8	6.3	30.05	30.17	29.97	.20	81	S.E.	17.8	....	.11	....	.11	4...........SUNDAY
5	61.1	66.8	57.4	9.4	29.99	30.08	29.96	.12	73	S.E.	15.7	52	.10	....	.10	5
6	55.0	64.0	47.0	17.0	30.19	30.22	30.08	.14	64	N.W.	9.0	93	....	....	....	6
7	56.1	65.2	46.0	19.2	30.09	30.21	29.98	.23	70	N.E.	15.3	....	.44	....	.44	7
8	56.2	65.1	49.2	15.9	29.88	29.98	29.79	.19	88	N.E.	18.4	....	.35	....	.35	8
9	51.7	54.9	49.0	5.9	30.00	30.07	29.94	.13	97	N.W.	6.6	....	.85	....	.85	9
10	51.2	55.6	46.0	9.6	30.20	30.29	30.07	.22	77	N.W.	17.4	32	.03	....	.03	10
SUNDAY........11	49.2	54.1	42.0	12.1	30.20	30.28	30.09	.19	74	N.W.	22.0	92	....	....	....	11...........SUNDAY
12	51.1	56.7	44.8	11.9	30.05	30.09	30.01	.08	75	N.W.	18.8	08	....	....	....	12
13	52.8	59.5	45.5	14.0	30.05	30.14	29.96	.18	74	S.W.	13.3	87	....	....	....	13
14	51.2	56.4	46.2	10.2	29.95	30.01	29.91	.10	64	S.W.	11.0	58	....	....	....	14
15	47.8	54.0	40.4	13.6	30.03	30.10	29.94	.16	63	N.E.	7.9	74	....	....	....	15
16	54.3	59.3	47.0	12.3	29.89	29.96	29.83	.13	89	S.E.	15.3	04	.03	....	.03	16
17	56.6	64.0	52.2	11.8	29.70	29.84	29.49	.35	96	S.E.	15.0	23	.65	....	.65	17
SUNDAY........18	44.2	57.8	33.9	23.9	29.63	29.91	29.42	.49	64	S.W.	18.5	29	.20	.00	.20	18...........SUNDAY
19	36.8	47.3	30.1	17.2	29.88	29.96	29.74	.22	85	S.E.	12.1	....	.03	.00	.03	19
20	52.0	60.7	42.2	18.5	29.69	29.95	29.55	.40	59	S.E.	20.0	39	....	....	....	20
21	40.9	51.5	34.5	17.0	30.13	30.24	29.95	.29	63	S.W.	11.8	68	....	....	....	21
22	46.9	57.0	35.5	21.5	29.99	30.26	29.71	.55	71	S.E.	22.2	63	.29	....	.29	22
23	45.7	57.0	39.2	17.8	29.94	30.07	29.80	.27	79	S.W.	12.3	....	.06	....	.06	23
24	34.7	43.3	30.0	13.3	30.07	30.12	30.02	.10	67	S.W.	13.6	01	....	....	....	24
SUNDAY........25	40.2	47.0	30.0	17.0	29.80	30.02	29.57	.45	80	S.E.	14.3	03	.03	....	.03	25...........SUNDAY
26	33.0	45.0	28.0	17.0	29.76	29.92	29.57	.35	77	S.W.	24.7	52	.05	1.5	.20	26
27	31.7	34.9	29.0	5.9	30.05	30.11	29.92	.19	86	S.W.	22.1	13	....	.00	.00	27
28	32.0	37.8	25.2	12.6	30.08	30.12	30.05	.07	68	S.W.	16.5	45	....	....	....	28
29	43.6	56.2	30.6	25.6	29.94	30.06	29.81	.25	78	S.E.	26.3	69	....	....	....	29
30	50.6	58.2	43.0	15.2	30.00	30.05	29.90	.15	77	S.	25.3	76	....	....	....	30
31	51.2	58.5	45.3	13.2	30.03	30.10	29.97	.13	77	S.E.	25.0	27	.07	....	.07	31
Means......	48.58	56.2	41.5	14.7	29.995	30.10	29.87	.23	74.6	S. 8° W	16.4	38.4	3.56	1.5	3.71	.......Sums.........
29 Years means for and including this month......	45.99	53.0	39.1	13.9	30.013	......	......	.22	77.0	......	§ 13.4	¶ 41.3	3.03	1.0	3.13	29 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	265	848	541	3096	2320	2577	997	1579	
Duration in hrs..	37	59	32	168	116	143	91	98	
Mean velocity....	7.2	14.4	16.9	18.9	20.0	18.0	10.9	16.1	

Greatest mileage in one hour was 35 on the 29th.
Greatest velocity in gusts was 48 on the 29th.
Resultant mileage, 4,392

Resultant direction, S. 8° W.
Total mileage, 12,223.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 17 years only.

The greatest heat was 66.8 above zero on the 5th. The greatest cold was 25.2 above zero on the 28th, giving a range of temperature of 41.6 degrees.

Warmest day was the 5th. Coldest day was the 27th.

Highest barometer reading was 30.41 on the 3rd; lowest barometer was 29.42 on the 18th, giving a range of .99 inches.

Minimum relative humidity observed, was 34 on the 2nd.

Rain fell on 17 days.

Snow fell on 4 days.

Rain and snow on 3 days.

Lunar halos observed on 2 nights

Auroras were observed on 3 nights.

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VOLUME IX. NUMBERS 3 & 4.

THE CANADIAN RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF

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AND REPLACING

THE CANADIAN NATURALIST.

CONTENTS.

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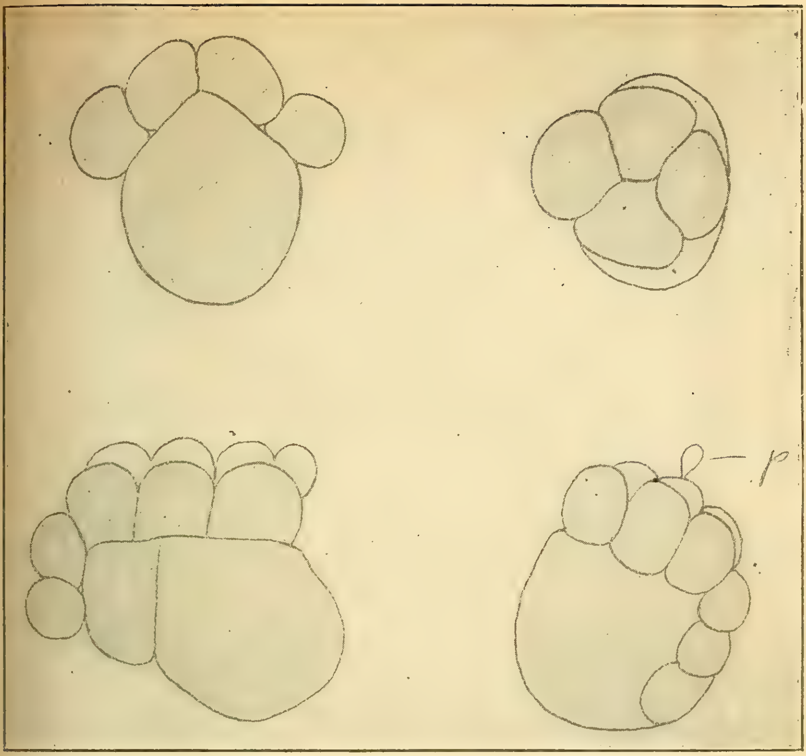


Fig. 1.—Segmenting Eggs of the Canadian Oyster.
p., polar globule.

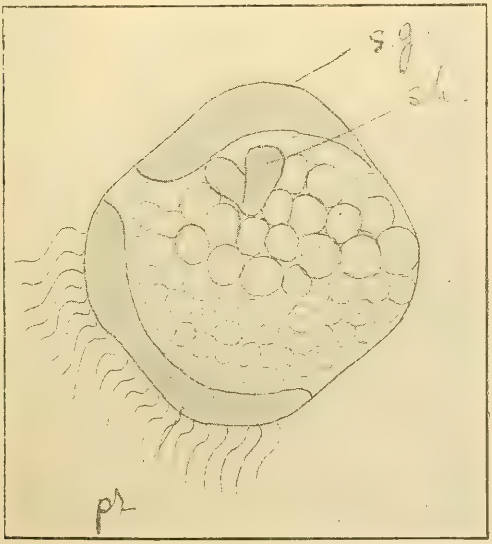


Fig. 2.—Larva of Malpeque Oyster, 24 hours old.
pr., prototroch. *s.g.*, everted shell-gland. *sh.*, rudiment of shell

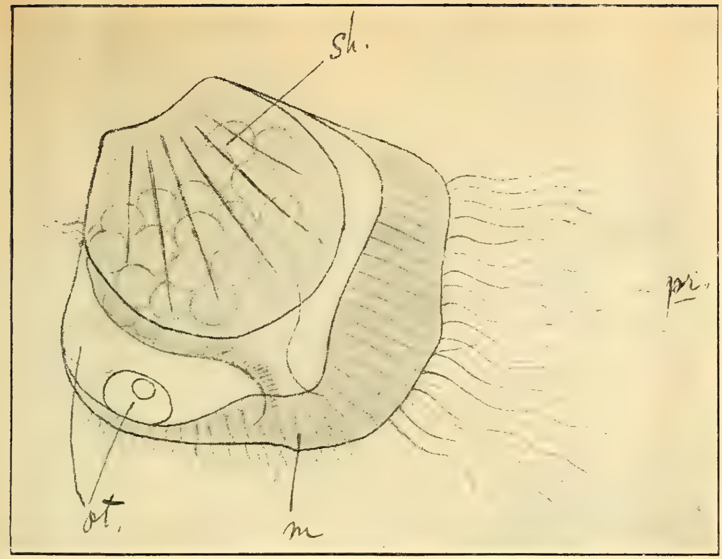


Fig. 3.—Larva of Oyster, 6 days old.
pr., prototroch. *m.*, mouth. *sh.*, shell, *oi.*, otocysts.

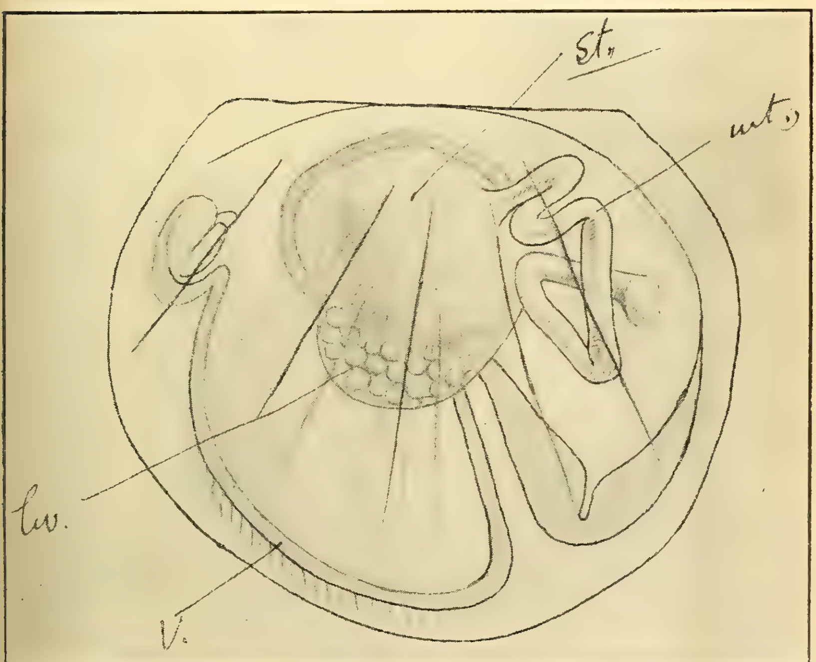


Fig. 4.—Date Larva of the Oyster captured by the Surface-net.
v., velum. *st.*, stomach. *int.*, intestine. *liv.*, liver.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. IX. JULY, 1904. Nos. 3 and 4.

The Canadian Oyster.

(Read before the Natural History Society of Montreal, February 1, 1904.)

The following paper contains some impressions on the Oyster Fishery of Canada, gained during a six-weeks' sojourn at the Canadian Marine Biological Station at Malpeque, P.E.I., during the summer of 1903. The Oyster, as most are aware, belongs to the bivalve section of the Mollusca or shell-fish, and is a relative of the Clam. This division of the Mollusca is usually designated Lamellibranchiata from the lamellar (plate-like) character of the gill. The shell is secreted by a fold of skin hanging down freely at the side of the body, termed the *mantle*, and the bivalve character of the shell is due to the fact that in Lamellibranchiata the mantle consists of a right and left fold, each of which secretes one valve of the shell, whilst the flexible horny hinge which unites the two valves is secreted by the skin of the back of the animal, just between the points of origin of the two folds constituting the mantle.

The Oyster however differs from the Clam and indeed from most of the Lamellibranchiata in several important respects. As a rule in bivalve Mollusca both valves are precisely similar in size and shape, and the animal during life assumes an upright position with the valves resting on their edges. To maintain this position it is necessary that the bivalve should be partially or completely buried in the sand or mud of the bottom on which it lives. Through this material it slowly moves by means of a muscular projection of the under surface of the body shaped somewhat like a ploughshare, called the *Foot*. The Lomellibranchiata are sometimes termed Pelecypoda, literally axe-footed Mollusca, on account of the shape of the foot. The exceptional character of the Oyster is at once seen when we state the foot is entirely atrophied and the animal lies on one side on the superfical layer of the bottom. The valve on which it lies is differently shaped from the other, being usually flat or slightly convex whilst the upper valve may be slightly concave. To a certain extent the edible character of the Oyster is due to the absence of a foot, for this organ with its tough muscles is often found to be a somewhat indigestible morsel in the case of other Mollusca which are used for food.

However different in appearance, practically all Lamellibranchiata have the same method of gaining their food. They all depend for a livelihood on the small organisms which swim or float in the sea and which are swept into their gaping mouths by the currents produced by the cilia which cover the gills and certain folds near the mouth termed the palps. Feeding and breathing are, one may say, performed at the same time, for the inrushing water brings also the oxygen, without which no animal can live.

It will, therefore, be seen that the Oyster is a peculiarly helpless Mollusc, for if it be situated in a place where the water is poor in food material, it is unable to leave it and starves to death. But a far greater danger is that of suffocation. If the water be too muddy, the particles of silt swept in will clog the interstices of the delicate gills; and the deposition of mud may soon bury the animal alive. In the case of other bivalves, no such catastrophe can occur, for they can move so that the hinder part of the shell through which the current enters always protrudes into clean water. The only resource left to the Oyster when it finds itself on a muddy bottom, and the mud is being deposited slowly, is to maintain upward growth of the edges of the mantle and shell, so that the gaping slit between them is kept above the mud level. In this way is to be explained the curious crimped and curved edges of the so-called Mud-oysters, which form a considerable proportion of the Malpeque Oysters, and which since they are very difficult to open do not fetch so high a price as those of more regular shape grown on clean hard ground.

But other dangers besides starvation and suffocation threaten the Oyster. The starfish is a deadly enemy. This animal has the power of turning the stomach inside out, and of digesting alive anything with which this organ comes into contact. When the starfish gets the chance of introducing his out-turned stomach between the valves of an Oyster's shell it is all over with the Oyster.

To guard against the danger the Oyster has the power of closing the valves of the shell by means of a powerful muscle, the adductor, which runs straight across from one valve to the other. Closing the valves is equivalent to what in Man is holding the breath, but the Oyster can hold its breath for several days without suffering damage. This, nevertheless, requires a continuous effort on the part of the Oyster, for the "hinge" which unites the two valves is so placed with reference to the teeth with which the one valve articulates on the other, that it is compressed when the valves are closed, and its elastic recoil tends to open the valves as soon as the pull of the adductor muscle is relaxed.

In most Lamellibranchiata there are two adductors, but the anterior one has been lost in the Oyster; the hinge, too, is usually so placed that it is stretched and not compressed when the valves are closed, but of course the effect is the same.

Everyone knows that it is necessary to cut the adductor in order to "open" a live oyster. When, however, the Oyster, placed under unfavourable circumstances, spontaneously opens, it is a sign that it is dead. But here several questions may be asked; for instance how does the Oyster know that a starfish is coming? And if it is able to know and to shut up, how do starfish live?

Oysters are apparently devoid of sense organs; nevertheless if the edge of the mantle be examined it will be found to be fringed with innumerable little tentacles in which there is deposited a certain amount of pigment. If now a healthy Oyster be observed whilst it is feeding with open valves in a tank, it will be seen that when the slightest shadow falls on these tentacles the valves are instantly closed. The tentacles enable their possesser to distinguish between light and shade, and it, is by means of its sensitiveness to slight shadows, that the Oyster learns to close in time.

The starfish, however, manages to destroy quite a large number of Oysters. Armed as this creature is with thousands of minute suckers, it is able whilst holding firmly on to the ground with some of these to forcibly raise the upper valve of its victim by means of the remainder which adhere firmly to the ground in the neighbourhood. It seems incredible, when one reflects what force is necessary to insert a knife between the valves of a closed oyster, that a starfish should be strong enough to forcibly pull them apart. But it is nevertheless true, for the starfish has staying power, and the long steady pull lasting for a quarter of an hour or more, effectively overcomes the resistance of the oyster, although the latter is able to withstand a much greater force if exerted for a shorter time. Nevertheless, the bigger the Oyster the bigger must the starfish be which opens it, and from the size of the starfish found on the Malpeque beds it is not probable that they can do much damage to the larger Oysters, and we may perhaps conclude that the Oysters are safe from their attack once they have passed their third or fourth year.

The Oyster possesses a simple alimentary canal. A short gullet leads into the stomach into which two groups of branched tubes, termed the *liver* empty their contents, and following the stomach is a coiled intestine opening by an anus situated posteriorly above the gills. The so-called liver really secretes the digestive juice; and the Oyster has an amazingly good digestion, for its rate of growth is astonishing. At the end of the first year of its life it is about an inch in length, at the close of the second year it has reached between two and three inches, whilst in five years it may attain a length of five to six inches.

The organs by means of which the Oyster creates the current which brings it its food are, as already mentioned, the gills and the palps. The first-named are familiary known as the "beard" of the Oyster, they each consist of a long axis fringed on each side with a number of filaments hanging down parallel to one another, and all thickly clothed with cilia. The ends of these filaments are turned up and fastened to the mantel-lobes in the case of the outer ones, and to the corresponding filaments of the other gill in the case of the inner ones. In most Lamellibranchiata the filaments of one row are welded together so as to form a coherent plate or lamelle, from which circumstance indeed the term "lamelle-brandicate" is derived, but in the Oyster the filaments of the same row cohere only by means of the entanglement of their cilia, so that a touch is all that is necessary to disengage them and hence the comparison of the gill to a frill of hairs or beard. The palps are two pairs of triangular folds situated one pair above and the other below the mouth; they are furrowed by a large number of parallel grooves lined with cilia. It used to be supposed that their purpose was to direct the current of water into the mouth, but it is now known that their chief purpose is to remove the surplus food that the Oyster cannot swallow. Even the appetite of the Oyster it would seem has its limits.

Situated in front of the adductor muscle is a cavity covered on each side with a thin membrane, which is generally torn in carelessly opening the Oyster. This cavity is the body-cavity or *pericardium* of the animal, and contains the heart. This organ consists of a single pear-shaped *ventricle* above, from which arises an artery which divides into anterior and posterior branches, and supplies the whole body with blood. The blood enters the ventricle from below through a pair of auricles (partly communicating with each other) which receives it from the gills. The blood is colourless, and there are no regular veins, the arteries opening into irregular spaces amongst the organs.

Beneath the body cavity on each side is situated the kidney. This organ has the appearance of a membranous sack—difficult to see except when a perfectly fresh Oyster is examined under water, when one can distinguish it by the yellowish green colour of its contents. It is then seen that it sends out a number of branches radiating out over the surface of the liver. The kidney has two openings, one leads into the body-cavity, the other to the exterior underneath the adductor.

Radiating out over the surface of the liver and intermingling to a certain extent with the branches of the kidney are another series of tubes which, gradually uniting with one another, form a duct which opens by the same aperture as the kidney. These tubes are the organs of sex, and at the period of sexual maturity they assume a milky white colour owing to the colour of their contents. In the European Oysters the same tube produces in succession milt and spawn, and the animals are therefore hermaphrodite; but in the Oyster that inhabits the Canadian and American coasts, the sexes are separate, although it is almost impossible to detect them by the naked eye. There is no difference in colour, but there is a slight difference in the amount of branching of the reproductive tubes, and after some practice it becomes possible to be pretty certain about the sex of an individual even before the test of the microscope is applied.

There is another most important difference between the Canadian and the European Oysters. In the latter the milt alone is discharged into the sea; the eggs are retained within the folds of the gills of the parent and there fertilized. The young Oyster undergoes the first stages of its development there, and when cast forth has a well-developed shell, and has only an adventurous life of 24—48 hours to undergo before settling down.

It is far otherwise with the Canadian Oyster. The eggs are very much smaller than those of its European cousin, and they are discharged into the sea, and there fertilized, and in 24 hours enter on their free-swimming life. How long this lasts it is impossible at present to say, but it must be a considerable time—a fortnight at least—so that the young may in this time travel very far from the parent. Prof. Brookes, of Baltimore, who was the first to artificially rear the larvae, was able to keep them alive for six days, and I was able to repeat this experiment at Malpeque. At the end of this period there is a well-developed shell, but judgfng from the size of free-swimming larvae caught by the tow-net, at least a week or ten days more must have been required by these to attain their size, taking the size of the artificially raised larvae as a point of departure.

It was my special object at Malpeque to determine the time at which the Oyster became sexually mature, as it is the object of the Government so to frame its regulations as to protect the oyster during this period of its existence.

The summer of 1903 was a somewhat cool one in the Maritime Provinces, so that it is possible that the period of ripeness was unduly delayed, but however that may be, the following were the facts which I determined. When I commenced to take observations in the end of July, only those oysters which inhabited the shallow water at the depth of 1—2 fathoms were ripe. As August progressed, those at Curtain Island at a depth of from 5—6 fathoms became ripe, and towards the end of the month only the Oysters taken from the greatest depths in Malpeque Bay were still emitting spawn; all the rest were spent. During the latter part of the month the waters were swarming with larvae which, from their exact agreement in shape and appearance with the larvae of the European Oyster, were doubtless the later stages of the free-swimming young of the Malpeque Oyster. It is evident then that the attainment of sexual maturity is dependent on the temperature of the water; for the deeper the water, the more slowly it becomes heated up.

The fact that by the end of August in a cool summer the spawning was over seems to show that the oyster could be fished without damage to the spawn in September, and that the close season is unnecessarily long.

I was not able to secure enough material for a thorough study of the development owing chiefly to the absence of proper facilities for rearing the larvae at the station, but some of the facts gleaned may be of interest. The egg when shed out is pear-shaped—when fertilized it becomes round and separates off two polar globules. These globules are by many eggs—notably those of the sea-urchin—separated out before fertilization and as concidently with their separation the nucleus of the egg loses its distinct membrane and shrinks in size, it becomes possible to discriminate ripe eggs from unripe ones. This is impossible in the case of the Oyster—the only available test is fertilization: if the eggs do not develop they are unripe. After fertilization, the eggs divides into a number of sequents termed blastomeres and out of these the future organs of the animal are built up.

It is characteristic of the eggs of all Mollusca, so far examined, that a number of smaller blastomeres should be budded off from one pole of the egg, out of which are formed the skin and nervous system. In the Oyster this is well seen; the peculiarity to notice is that the rest of the egg remains undivided as one large blastomere, whereas in other Mollusca the whole egg first divides into four equal parts when then bud off smaller blastomeres. The larger blastomere however divides later and forms a central mass of cells the rudiment of the gut and internal organs, and this central mass covered by the smaller cells. Soon the little larva rises to the top and begins to swim, and it is then seen that there is a hat-shaped anterior part surrounded by a thickened belt of skin armed with powerful cilia. This organ is termed the *prototroch*, and is found in the young stages of nearly all Mollusca and worms. About this time the rudiment of the shell becomes visible. The first trace is a large pit called the shell-gland on the back of the animal, mistaken by Brookes for the gut. This pit flattens out and forms on the second day a saddle-shaped area, at the sides of which two small calcareous particles (Fig. 2) show the incipient shell.

The shell grows larger day by day till on the sixth day it half covers the animal. On this day, the last to which the artificially reared larvae lived, the solid mass of cells originating from division of the larger blastonieres becomes hollowed out, and constitutes the stomach, and the mouth opening can be seen. There can also be seen behind the mouth on each side a little hollow vessel with a vibrating sphere within it. These are the otocysts, the so-called ears, which are found throughout all Mollusca in the region of the foot. As the Oyster has no foot they are not found in it when adult, and it is an interesting fact here recorded, so far as I am aware for the first time, that they are found in the larvae. They are called ears, but their principal function is not hearing, but keeping the animal informed of its position with regard to the vertical, and so enable it to balance itself. One is reminded of the fact that the semi-circular canals in the human ear have a similar function. The later larvae which were captured by the tow-net are characterised by possessing a straight hinge to the shell totally unlike the hinge of the adult. The front part of the animal can now be completely withdrawn within the valves. The ridge of skin bearing the powerful cilia, the prototroch, has grown into a pair of lobes and is now termed the "velum." It is suspected that the velum is later transformed into the palps when the Oyster settles down, but this so far as I know, has never been proved. The beginnings of the liver, as two yellowish outgrowths from the sides of the stomach can be seen, and also the intestine can be made out.

A few words on the general situation of the Oyster Fishery in Canada may now be in place. Abundant oysters constitute one of the many gifts of Providence which made Canada a desirable place to live in.

"Natives," as they are termed in England, are a delicacy confined to the table of the rich, here they are within the reach of all.

Like so many of the magnificent natural resources of this country, the Oyster Fishery is being most wastefully carried out, and we may before long regret in vain the time when Malpeque oysters sold for 25 cents a dozen.

Richmond Bay or Malpeque Bay, as it is sometimes called, is a somewhat quadrangular inlet of the Gulf of St. Lawrence on the North Coast of Prince Edward Island. It is roughly about ten or twelve miles long by about nine in width, and is throughout comparatively shallow, never more than about 7 or 8 fathoms in depth, for the most part 2—4 fathoms. The bay is studded with islands, of which Curtain Island, which has given its name to the best variety of the Malpeque Oyster, is one. To the north, where it opens into the Gulf of St. Lawrence, the entrance is obstructed by islands, and navigable channels are very few in number, for great sand flats and shoals connect up the islands with one another.

The whole North Coast of Prince Edward Island is fringed by a series of parallel sand-bars, and it is owing to this circumstance that the oyster is able to flourish there. All who know the coast of the Gulf of St. Lawrence are aware that the water even in summer is very cold; so cold indeed that though the adult Oyster could live in it, it could not reproduce itself, for the larvae would perish. But as the Gulf water flows over the sand-bars and shoals alluded to, it becomes heated up by the summer sun, and reaches a temperature which permits, in favourable years at least, of successful spawning. Oysters are accordingly confined to such places on the coast of Canada, as present conditions similar to those mentioned above. They exist in the Baie de Chaleur, in some of the shallower inlets on the New Brunswick Coast, at a few points on both shores of Prince Edward Island, and on the Northern Coast of Nova Scotia. In every case, however, we have to do with isolated colonies inhabiting warm spots surrounded by a great belt of cold water, so that although the larvae could be carried to great distances in the fortnight of their free-swimming life, they are all killed off by the cold. Consequently it follows that if in any place the Oysters are destroyed or fished out, no natural re-stocking will take place; and large heaps of oyster-shells where there are now no oysters testify to the fact that this has often taken place. In the natural home of the Oyster, the coast of Virginia, the water everywhere is warm, and if the Oysters are exterminated at one spot sooner or later larvae from adjoining beds will settle and found new colonies. It is supposed that the Oyster must have reached Canada in pre-glacial times, when the water was warm, and that the few colonies remaining are remnants from the time when a mild sub-tropical climate reached to Greenland.

Now the great dangers to which the Canadian fishery are exposed are over-fishing, and the use of Oyster shells as a fertilizer. As the demand increases so does the number of boats crowding into Richmond Bay, and inevitably the oyster-supply will grow less. There exists in the minds of the oyster fishermen a tremendous prejudice against permitting the cultivation of Oysters, an industry which has reached great proportions both in England and France. No more unreasonable prejudice could well be conceived. It is not for a moment suggested that the natural Oyster beds should be made private property, but if permission were given to private individuals to control small stretches of the foreshore now barren of oysters, the expenditure of a little capital might lead to the formation of a new Oyster bed. The larvae, which are scattered by the million from the natural beds, doubtless settle everywhere, but only when they reach a suitable substratum can they survive. Suitable "spat catchers" as they are called are made by planting in stakes of birchwood. The larvae, or "spat," settle on these, and when the little Oyster has reached a size of an inch or so in length it can easily be removed, and laid in a sheltered pool, where it will fatten. The Mic-mac Indians, who have a reservation on one of the islands of Richmond Bay, collect what are called "seed-oysters," adhering to the stones of the gravel beaches of Ram Island, and lay them on their own beds. One farmer, who is fortunate enought to have a tidal pool enclosed by his grounds, has done the same, and these people have shown the way. It is unfortunate that whilst the regulation of the Fishery is in the hands of the Dominion Government, the ownership is in the hands of the Island Government, and the pressure exerted on the local house by the oyster fishermen is very strong.

A still greater danger than over-fishing is however the use of Oyster shells as fertilizer. Prince Edward Island is almost wholly composed of New Red Sandstone—a formation almost unknown elsewhere in Canada, found only at Richibucto in New Brunswick, Pictou in Nova Scotia, and one or two other points on the coast immediately opposite the Island. This rock consists of a soft red shale, too soft indeed to deserve the name of rock, which is very deficient in lime. In the winter, therefore, when Richmond Bay is frozen over, the farmers go out with teams on the ice, cut holes in it, and using a kind of dredge similar to that used in dredging the River St. Lawrence, but worked by their horses, scoop up masses of Oyster shells. If the Oysters happen not to be dead no doubt they make the better manure. Attempts are made by the Dominion authorities to confine the farmers to places where they will do least damage, but as old Oyster shells make the best possible substratum for the extension of the beds, it is difficult to see how damage can be avoided. One sees in such actions the same thoughtless and improvident spirit, which destroyed so much valuable timber by fire, and which in utter heedlessness of the future of the country, sees only the immediate profit of to-day. It surely is the duty of the Government, to whom the care of the future is committed, to prevent such waste of the country's resources, and it is satisfactory to learn that negotiations are proceeding between the Dominion and the Island Governments to buy out the interest of the latter, and so gain the means of effectively controlling the fisheries.

Some Mushrooms Found in Canada [1]

By Mary Van Horne.

A few years ago an article written by William Hamilton Gibson, on Mushrooms and Toadstools, appeared in Harper's Magazine. This article created such an interest in the subject, or met a need so long felt, that the author was induced to publish a book, which came out a little later under the title of "Our Edible Mushrooms and Toadstools," and proved a most delightful introduction to the study of this form of plant life.

The book is well illustrated with many colored plates, the descriptions are carefully written and are very clear. As the species described are comparatively few, and those which are quite common, abundant and widely distributed, we were enabled to identify a number of them very quickly, which added keenness to our interest.

Gibson also gives a long list of works on the various forms of fungi, most of which were published years ago in England, France and Germany, and which describe plants peculiar to those countries, but as the same or nearly allied species are often found in America, these books are of some use to the student in this country.

Some articles on the American species had been written previous to this time, but as most of them were published in the reports of the Natural History Societies of various States, they were available to the few only.

Professor Peck, the State Botanist of New York, has made extensive research in this branch of Botanical Study, and is reported the best authority on the subject of the American species.

In his various reports, particularly in that for 1895, are many descriptions and illustrations.

1 Being a communication to the Natural History of Montreal by the late Miss Mary Van Horne, April 2, 1902.

He has also published a little book describing all the Boleti at present known.

We owe him many thanks for naming for us difficult specimens which we have sent him.

I would also call attention to a little book called "British Fungi," by M. C. Cook, which, although describing plants found in the British Isles, is very useful to the student in Canada, as many of the same species are found here, and it has the further merit of being small enough to be carried with one on excursions in search of specimens.

Another useful and interesting book is "Fungi, their Nature and Uses" of the International Scientific Series.

A work by Professor Farlow, of Harvard, has been promised for some years past, but has not yet appeared. It is to be on a large scale, and the illustrations will be remarkably fine, as you may see from some plates of the illustrations I have been so fortunate as to secure.

Among the books spoken of by Gibson, was a French work "Les Champignons," by Moyen which contains a most satisfactory Analytical Key which we have found very useful, and which we still continue to use, although we have now the two latest American publications which claim to have good keys.

These two American books, published in 1900, are "Studies of American Fungi: Mushrooms, Edible, Poisonous, &c.," by George Francis Atkinson, and "One Thousand American Fungi," by Charles McIlvaine. The former is the smaller, handier and less expensive of the two but, of course, does not describe so large a number as the latter.

The lantern slides I have to show you to-night have been prepared from the illustrations in Professor Atkinson's work, which, having been made from photographs give very true impressions of the plants.

I have selected from the illustrations only such as show the species which we have found in Canada, and only representation types of these.

I hoped, before preparing a paper on the subject, to have colored slides of the actual specimens found, but have not been able to get them prepared.

My brother, Sir William Van Horne, made a few photographs of some varieties, but the plates were not available at the time these slides were prepared. He has, however, made some very fine water-color drawings of a number of plants, which, with some less perfect ones by my niece and myself, I have here to show you.

We found in trying to preserve specimens according to the usual instructions for drying and pressing, or preserving them in formaline, they lost so many of their characteristics that they did not pay for the trouble, so have decided that the best way to preserve a record of our work is:—

First, to make a water-color drawing of the plant as a whole, then of one or two sections.

Second, to make a good spore-print.

Third, to preserve a few spores on a glass slide for the microscope.

These with a written description are easily kept, and if systematically followed, will, I think, give a very good record.

The book by Mr. McIlvaine is a very large one, describing one thousand species with many illustrations. Of these one thousand species over seven hundred are edible, the others included have been described chiefly to warn the student against their use, or to make clear the characteristics of the edible ones.

I have given so much space to the books on Fungi, because when we began the study there were so few books available and we found it difficult to get any practical information about them, but when once well started, it was surprising to find how many persons were interested in the subject.

So far as I know there has been no record of research in this branch of Botanical study in Canada, except the publication of a "Preliminary List of Fungi" in the Report of the Natural History Society, of New Brunswick, by G. U. Hay, Esq., in 1900. This list contains the names and a few items regarding some sixty-six species found in the Province.

We shall, I hope, hear something on this subject from Professor Macoun before long, as I am told, he has given it some attention during the past three or four years.

All fungi are plants belonging to the lowest order of Cryptogams, and being devoid of chlorophyll are unable to decompose the carbon di-oxide of the atmosphere, and consequently depend upon other organisms for their carbonaceous food, and, according as these organisms are living or dead they are classed as Parasites or Saprophytes.

The number of known species in 1889, was estimated at 32,000, of these 8,500 were known as fungi imperfecti, as only certain stages of their growth were known, and it was thought they might prove to be corresponding stages in the growth of higher forms.

My remarks will be upon the higher or more conspicuous forms known as Mushrooms and Toadstools.

You will notice in all the titles of books or articles that these terms are interchangeable, as they mean exactly the same thing to the Mycologist and the Mycophagist, although those who have given no study to the subject usually restrict the term "Mushroom" to the one known as the field mushroom or to its cultivated form found in the markets. I think it would be well to use this term to indicate the edible species, and the word toad-stool to indicate those which are poisonous or otherwise unfit for food.

Perhaps I might explain here that a Mycologist is one who studies mushrooms, a Mycophagist is one who eats them. The latter term suggested to a young member of our family, the warning that we should be careful in our experiments or we might become subjects for a Sarcophagus.

We find fungi of all sizes from the minute dust-like Coniomycetes to the large Polypores which sometimes weigh many pounds, and of very great variety in form and color.

Fungi are divided into two classes; Sporifera in which the spores, which correspond to the seeds in higher plants, are naked, and Sporidifera in which the spores are enclosed in cells or cysts. The class Sporifera is divided into four cohorts; Hymenomycetes, Gasteromycetes, Coniomycetes and Hyphomycetes.

In Hymenomycetes the hymenium or spore surface is always exposed in the mature plant as in the agaric.

In Gasteromycetes the hymenium is always enclosed within a covering which bursts at maturity, as in puff balls.

In Coniomycetes there is no hymenium. The spores are produced on the ends of inconspicuous threads, free or enclosed in a bottle-like receptacle, as in rusts, smuts, &c.

In Hyphomycetes the spores are produced on conspicuous threads as in moulds, &c.

The Sporidifera are in two cohorts, Physomycetes and Ascomycetes, of which I shall have occasion to speak only of the latter, in which the spores are produced in asci formed from the fertile cells of a hymenium.

The Hymenomycetes contain by far the greatest number of large and conspicuous fungi, which are divided into six orders.

Agaricini—Gill bearing.
Polyporei—Tube bearing.
Hydnei—Spine bearing.
Auricularini—Leathery.
Clavaria—Club-bearing.
Tremellini—Gelatinous fungi.

The Agaricini are divided into five series according to the color of the spores. The names of these series differ with the different authors, but the colors of the spores are white-salmon or flesh color—rusty or tawny—brownish, purple or brown—and black, and may be determined by allowing a plant to lie with its spore surface in contact with a paper until a sufficient number of spores have been deposited to show the color.

I shall begin my descriptions with the fourth series, as that contains the well-known field mushroom or Agaricus Campestris. This is found in many parts of Canada. I have found it at Banff and am told that it grows in great profusion about Winnipeg, Toronto and Montreal, and in favorable seasons we find a great many about St. Andrews, and on a trip through New Brunswick and Nova Scotia some few years ago we saw them in abundance in many pastures.

It is the type of the Agaricaceae, and as such I shall give it a fuller description than any other.

It is the fruit of a vine-like tangle of white threads, called the mycelium which penetrates the soil just below the surface. From little joints in this mycelium, tiny white dots like pin-heads are formed, and under favourable circumstances or conditions of warmth and moisture, they develop into little button-like knobs, which push through the ground and quickly develop into the full grown mushrooms and as quickly perish, the preparation for their existence has, however, been going on for weeks or months.

The parts of an agaricus are the stem or stipe, the cap or pileus, the ring or annulus.

The cap is the expanded part which bears the hymenium or spore-surface, which in all of the Agaricaceae is on the under surface of the cap, and consists of plates or folds called gills, this in the button stage of the Agaricus and a few other genera is covered by a membrane which connects the edge of the cap with the stipe, and as the plant expands the membrane breaks away, some portions remaining attached to the stem forming the ring or annulus, and some remaining connected with the cap, giving a ragged appearance to its edges.

In the early stages the gills are pink, gradually becoming darker until they become a dark chocolate brown and later nearly black.

This change of color is caused by the gills becoming covered with the brown-purple spores.

If the stem of a mushroom is cut off and the cap is placed gills downward on a sheet of white paper and closely covered for a short time, when removed, a print of the gilled surface will be found on the paper, if this has been previously covered with a thin coat of glue and allowed to dry, before the mushroom is placed on it, a permanent print will be obtained. If left uncovered the spores are so light that they will be scattered about or fall irregularly, and a blurred print will result.

The appearance of the Agaricus campestris varies greatly, depending upon the conditions surrounding its growth. Sometimes it is quite white and again quite brown, it may be smooth or rough, but the gills should always be noted, being pink, brown or black according to age. Its season is September and October, but I have found it at St. Andrews as early as July. To the brown or purple spored group belong Agaricus arvensis, otherwise known as the Horse or Plowed-Land Mushroom, a large and coarse species, Agaricus plycomycus, and Agaricus silvicola, the two latter grow in woods. The silvicola has a very thin smooth cap. Hypholoma perplexum, which has a yellow cap tinged with red and greenish gills, also belongs to this group.

I shall now go back to the first or white-spored group, called by all authorities Leucosphoræ.

Among the white-spored agarics are the Amanitas, the earliest, most persistent, most abundant and most pernicious of all toadstools, and which should be carefully studied that their characteristics may be thoroughly learned and so one may know what to avoid. There is no rule by which one may distinguish between the harmful and harmless species, but we must learn to know them as we learn to distinguish the poison-ivy from other plants.

The Amanitas start from a mycelium, as does the Agaricus campestries, but the young button of the Amanita is entirely covered by a membrane, as well as having its cap attached to the stem by one. As the plant expands this enveloping membrane breaks away, one part remains attached to the base of the stem forming a cup which, as a warning, is called the "poison-cup." The upper part of the membrane remains attached to the cap, where it forms patches or warts upon its surface. At the same time the membrane covering the gills breaks away from the cap and forms an annulus or ring which envelops the stem like an apron or skirt. It is much more conspicuous than the ring on others.

This genus contains some edible species, but it also contains the most pernicious.

Nearly all the cases of mushroom poisoning, it is said, can be traced to two species of this genus. The chief danger lies in the fact that under some conditions they may be mistaken for agaricus campestris.

Amanita muscaria or "Fly Agaric," as it is sometimes called, a decoction for killing flies being sometimes made from it, is the most beautiful of fungi. The pileus from four to seven or more inches across, is bright yellow with dashes of crimson near the center, and scurfy or warty with the scattered remnants of the veil or volva. The flesh is white, yellow just under the skin.

The gills are free from the stem, white sometimes changing to yellow. The stem is slender, white, scaly, and has a bulbous base, which is margined by concentric scales which represent the poison cup.

In its perfect state it differs very greatly from the Agaricus, but in its button stage it may very easily be mistaken for it, and even in its later stages it may lose its scales and annulus, change in color, and if pulled carelessly, the cup may remain in the ground, so one must constantly exercise great care and learn to know it and its allied species under all their forms.

Although so poisonous, it is said to be eaten by the people of Kamschatka, and it is used as an intoxicant by the Russians in Siberia. Its narcotic properties are greatly increased by drying, and the juice of the whortle-berry, in which this substance is steeped, acquires the intoxicating properties of strong wine.

Amanita phalloides has a whitish or lemon colored cap, fewer patches on the top, white gills, stem rather smooth and bulbous, the volva or cup deeply buried in the ground, this with its variety verna, which is wholly white, is the most dangerous, because it may also be mistaken for the Agaricus campestris, and there is no known antidote for its poison, while for poisoning by Amanita muscaria, hypodermic injections of atropine have in some cases proved successful.

The effect of the poison from these is very slow in manifesting itself, sometimes no evil is felt until 16 or 20 hours after eating the toadstool, and a very tiny portion may cause serious results.

Amanita muscaria often grows in grassy places along the road side. The phalloides and verna are more frequently met with in woods.

Amanitopsis vaginata has white spores, white gills, a thin pellicle which is striate at the edges. In the variety "fulva" the color of the cap is buff, in "livida" it is gray. The stem is without a ring or bulb, is long and slender with a scurfy surface, and the base of the stem is enclosed in a volva which wraps it closely. It is an edible species, but as there is a poisonous Amanita which resembles it very closely, but differs from it in having an annulus, which, however, is wrapped so tightly about the stem as to sometimes escape notice, it is well, therefore, for the Mycophagist to pass this by.

Lepiota naucinoides is a white-gilled, white-spored mushroom, which we found last September for the first time. It was growing on the soil of a garden from which vegetables had been removed. It resembles the field mushroom, and is said to be equal to it in every way. Its gills turn to a dingy pink when full grown, and it has a ring which is double on its outer edge. McIlvaine thinks it is possible and probable that it may be cultivated and become a rival to Agaricus campestris.

Clitocybe infundibiliformis is funnel-shaped, grows in woods in summer and autumn, is pale red tinged with buff, and often has white cottomy mycelium at the base of the stem.

Clitocybe ochropurpurea grows in grassy woods and open places.

Clitocybe laccata var. pallidifolia Pk. is a very variable species.

In the genus Hygrophorus the gills become waxy with age; it has some very pretty bright colored species. We have identified Hygrophorus miniatus and Hygrophorus cantharellus.

The Lactarii form a very abundant and interesting genus. They are distinguished by having a milky juice. The gills are more or less decurrent, that is, they run down the stem when the plant is full grown, giving it a funnel shape. The spores are globose with a roughened surface.

Lactarius piperatus is white with abundant white milk, which is very acrid but does not change color.

Lactarius deliciosus is orange yellow, with zones of a darker color or shade on the cap. Milk bright orange, the gills and broken flesh turn green. It is eaten wherever it is known. Most writers claim that it is delicious, but we have not found it so.

Lactarius affinis and Lactarius theiogalis we also find; the latter has white milk which turns to sulphur yellow upon exposure to the air.

There are a great many more that we know as Lactarii but their specific names have as yet baffled us.

Closely allied to these are the Russulas, which, however, are destitute of the milky juice. Of these we find Russula alutacea, heterophylla, aurata, virescens, brevipes and emetica.

They are all rather fragile, and except the emetica, have a pleasant nutty taste when raw, and are really delicious when cooked. They appear at various times throughout the summer, but seldom in sufficient abundance at one time to make a dish, except the aurata, which grows in the woods and has a golden pileus and white or cream colored gills. Care must be taken not to mistake for it an Amanita muscaria that has lost the patches from its cap.

Russula heterophylla and alutacea are very similar to each other, the pileus varies in color from bright red to a dingy purple, the gills from a pale cream to a deep buff color. They have a thin pellicle which is easily separted from the cap, except in the centre, and it is very viscid in moist weather. The stem is white, sometimes tinged with red, and there is no ring or volva. The spores are cream color and resemble those of the Lactarii, being round and roughened.

Russula virescens differs from them only in having a greenish, mouldy looking pileus.

Russula emetica usually has a bright red cap, snow white gills, and though attractive looking should be avoided, as it might have a harmful effect. It is very peppery to the taste.

Russula brevipes puzzled us for a long time. It is very large and grows in abundance. It seems more like a Lactarius than a Russula, but has no milky juice. I think it is the species which is covered and distorted by Hypomyces lactufluorus as shown in the water color drawings. The smaller one is by Sir William, and shows the granular appearance of the surface caused by the parasite, the larger one which is about three-fourths the size of the original, shows the shape less changed.

We found these on a hillside in spruce woods near Chamcook Lake one September day, when it looked as if a cart-load of pumpkins had been overturned and broken into pieces of all sorts of shapes and sizes. I judge the host plant to be Russula brevipes, because I found portions only partly covered by the parasite, and these I thought were of the same species as the plant we found so frequently, but of which I did not then know the name.

Insects are very fond of all the Russulas, and it is difficult to find any that they have not attacked.

Another drawing shows Russula alutacea covered and changed by Hypomyces viridis. The original of this came from Metis, where my niece found this Russula and R. virescens quite abundant during a week's visit there one July.

The next genus Cantharellus differs from the other agarics in having blunt gills, which have the appearance of branching veins. It contains one of the best of edible fungi, Cantharellus Cibarius or Chantarelle, which is orange, yellow in color, looking like a patch of sunshine under the spruce trees where it grows. It is solid, irregularly funnel-shaped with a flattened top, which is sometimes slightly depressed in the center and surrounded by a fluted edge. The first time we found it we placed it in a basket with other specimens, a little later one of the party remarked there is something here which smells like apricots. This recalled a description I had read in Gibson's book, and when we returned to the house we had no difficulty in identifying it, and every summer, since making its acquaintance, we have it served at table very frequently.

Berkely and Cook say of it that it is almost universally eaten in all countries where it is found, England excepted, where it is only to be met with at the "Freemason's Tavern" on state occasions, when rare dishes are served at great cost, and at the tables of pertinacious mycophagists.

Tatternnick, a German authority, says "not only this same fungus never did any harm, but might even restore the dead," and Baltarra, another authority, says that "if properly prepared the Chantarelle would arrest the pangs of death." This is rather extravagant praise, but it certainly is a delicious mushroom.

We find three others of this genus; Cantharellus floccosus, of which I have a photograph. It is large and coarse and hardly fit for food.

Cantharellus aurantiacus is a smaller plant which might be taken for cibarius. The color of the cap is paler, varied with smoky brown tints.

Cantharellus brevipes looks like a deformed cibarius. It is short and solid, and seems as if it might be only the stem of another plant.

Marasmius oreades or the Fairy Ring Mushroom, grows on lawns and pastures where the grass is short. It is small with a buff cap and gills, leathery in substance, it dries easily, but under moisture assumes its original form. The taste when raw is pleasant and when cooked it makes a very palatable dish. Care must be taken not to confound it with Marasmius urens, which grows under nearly the same conditions, its cap is very similar, but its gills are yellow and closer together, and the base of the stem is clothed with a white down. Its taste is acrid.

Marasmius personatus is another pernicious species which resembles oreades, but as it usually grows in the woods, is not likely to be mistaken for it. The base of its stem is clothed with stiff hairs or bristles.

Of the genus Lentinus, we have Lentinus lepideus growing on the end of a log three years in succession. Its mycelium penetrates the ties of railways, upon which it frequently grows, causing them to decay.

Armillaria melleus grows in masses upon tree trunks, and its mycelium penetrating the body of the tree causes its death. Whole forests are said to be sometimes destroyed in this way.

Of the pink-spored we find Clitopilus orcella, also called the sweet-bread mushroom, and Clitopilus subvilis.

Among the rust colored spores we have the Cortinarii, which have a cob-webby membrane covering the gills in the young plant. Of these we find Cortinarius violaceus, lilacinus, armillatus and cinnamomeus, variety semi-sanguineus.

Paxillus involutus also has rust-colored spores, its peculiarity is in its anastomosing gills, which form pores near the stem. It is edible, but does not make a tempting dish.

Of the black spored agarics we find Coprinus micaceus, comatus and atramentarius.

Coprinus micaceus appears along the sides of the streets in Montreal in early June, and may be found at various times throughout the summer. When it first pushes through the ground its cap is round, of a buff color, and if closely examined may show little sparkling mica-like particles, which is a distinguishing feature and gives it its specific name. Its gills are white or grayish white, with a tinge of pink, but become black with age, when the whole plant melts away into an inky juice. Before this last stage is reached it makes a very delicious dish.

In October Coprinus comatus and Coprinus atramentarius grow in large quantities near Montreal. These are both black-spored agarics which melt away into an inky juice, which is sometimes used as ink.

Coprinus comatus, sometimes called the shaggy maned mushroom, is from three to seven inches high, oblong, becoming bell-shaped. When the deliquescing stage is reached, the cuticle of the cap splits into brownish scales which curl up, and as it hangs on its slender stem it resembles a barber's wig, which accounts for its specific name. Its gills are free from the stem, crowded, white with a pinkish tinge becoming black with age, when with the whole cap they melt away. It has a ring or annulus, but this frequently drops off as the plant develops.

I have a drawing of one, part of which was done with the juice of the original, the inky drops represented as falling from the cap are the actual spores. This juice works very much like sepia.

Both this and atramentarius are edible if used before the gills turn black. I have found the latter plant as early as July in St. Andrews, New Brunswick, where this year a few of the plants came up on the opposite side of a well beaten road, from where they grew last year. It is very like the comatus, except that the cap is more bulbous, and smooth or striate and gray in color.

One often sees growing on the trunks of trees a gilled mushroom in groups or singly; it is a Pleurotus but I have never been able to decide whether it is Pleurotus ostreatus, ulmarius or sapidus, as I have never found it in a condition to drop its spores, the color of which is a distinguishing feature.

In Polyporaceæ the hymenium consists of tubes, on the interior of which the spores are formed and escape through their mouths.

In the genus Boletus these tubes are easily separated from the hymenophore and from each other. They are fleshy putrescent fungi, most of them edible, a few are poisonous. Those having any red color about the pore surface are considered harmful. Boletus edulis has a cap, which in dry weather looks like undressed kid, its pores are at first yellow and later olive in color.

Boletus scaber has a bulbous rough stem and dingy white pores.

Boletus cyanescens has white flesh, turning a deep indigo blue when broken.

Boletus luridus has yellow flesh, turning green when broken or bruised, and has red pores and dashes of red on the stem. It is pernicious, as is also *Boletus piperatus*, which has a brown cap reddish pore surface, yellow flesh becoming red just under the skin when broken— its taste is peppery.

Boletus sub-tomentosus, bovinus, versipellus, chromapes, clintonianus and flavus are others we have found. All become infested very early by insects and worms, so that it is seldom that any are found in a fit condition for food.

Polyporus betulinus is a white fungus seen frequently on birch trees, when dry it is said to make razor strops.

Polyporus borealis is another woody species as is Polyporus lucidus, which when grown has a hard shiny surface like mahogany.

A few years ago we found a specimen of Polyporus Sulphureus on Mount Royal. It had been broken from its support and scattered about in small pieces, probably by some one imbued with the idea that all toadstools are harmful and should be destroyed. It is of a bright yellow color, is without a stem, as the cap is attached by the side to the trunk of a tree, where it grows in layers. When in the fullest vigor it is filled with a sulphur yellow milk. It has a decidedly acid taste, and is said to show phosphorescence at night. It is to be found from August to October. McIlvaine says it is a delicious fungus, and tells of a cluster on an old willow which was eighteen inches across and afforded a dozen meals. It was left attached to the tree, and portions were cut off as wanted.

The *Hydnaceae* produce their spores on spines or teeth which cover the under surface of the cap. Of these we find Hydnun repandum, rufescens, imbricatum and compactum.

The Clavariaceæ bear their spores on the entire surface of club like branches.

Of these we find Clavaria formosa, of which the water color drawing will give you some idea, although the original was a rather old and dry specimen. It is of a bright yellow color, looking under the spruce trees as the Chantarelle does like patches of sunshine. It branches somewhat like a cauliflower and is edible.

Clavaria amethystena is small and of a lilac color.

Clavaria coralloides looks like bits of branching white coral.

Spathularia clavata is a small paddle-shaped bright yellow fungus growing among moss. It belongs to the Ascomycetes, as does Peziza aurantia which has thin brittle flesh, no stem, a cup-shaped cap expanding close to the surface of whatever it grows upon. It is of a brilliant orange yellow color, with a tinge of pink.

My introduction to the study of Mycology, was the finding of a group of Morchella esculenta on Mount Royal under a group of birch trees. I had seen the description of this plant in a little leaflet we chanced to have and readily recognized it. I took the plants home to have them prepared for the table, but our cook never having seen such queer mushrooms objected to cooking them, and as I felt a little doubtful, I did not press the point, but buried them in a shady place in the yard, hoping for a future crop, when I could make further study of them or gain more confidence. However, I never saw more of those particular plants, but have found others at several places visited by the Natural History Society on its annual field day. And in Toronto I once found a group in one of the parks, and am told that it is often on sale in the markets of that place, and that it grows in abundance near Port Hope.

The Morchella when once seen will always be recognized. It has a short, rather smooth stem, surmounted by a deeply pitted bulbous cap, which gives it the name of "Honey-comb Mushroom." The whole plant is hollow. The spores are developed on the entire surface of the cap in little sacs or asci, hence it belongs to the Ascomycetes. It is very safe to use it for food, as there is no harmful one at all like it. It begins to appear in June. Two years ago I found Morchella conica on the edge of a lawn in Sherbrooke, in early June. On the same grounds and at the same time I found coprinus micaceus. My friend whom I was visiting accepted my authority for their edible qualities, and we had them served at table a number of times. The following year they again appeared and furnished an extra dish many times. Morchella conica differs from esculenta, in having a cap shaped like a bent cone and is usually smaller.

Gasteromycetes, and bear their spores within the body of the plant, something as the blossoms and seeds of the fig are born on the interior of an inflated receptacle. All puff-balls are edible when the interior is white and firm, but this soon changes to a yellow color, then to an olive, and later becomes an oozy olive mass, finally turning to a dry powder, which escapes through chinks or pores according to the nature of the species. In this state children find pleasure in stepping on them to see the smoke puff out. I remember, as a child, being warned not to allow this powder to get into the eyes as it would cause blindness. Of the Lycoperdons we have identified Lycoperdon giganteum, gemmatum pyriformæ. The two latter I have found at St. Andrews, but never the former. Two years ago a Lycoperdon giganteum was sent us from St. Anne's de Bellevue, where they were found growing on a lawn one morning. The one sent us measured thirty-eight and one-half inches in circumference, and was fourteen and one-half inches in its greater diameter. The epidermis readily peeled off and resembled a piece of heavy white kid.

Slices were cut from it and served at several meals during the week. Last year two large ones were sent us from Odelltown, Quebec, and two smaller ones from the vicinity of Montreal, and in September I purchased one which weighed six pounds when fresh. I have a newspaper clipping describing one found near Three Rivers, which measured fifty-five inches in circumference.

McIlvaine says that if a large puff-ball is left attached to the ground and a slice is taken from the top, its development will be arrested and it will remain firm and white, so that pieces may be taken from it when wanted. When sliced, seasoned, dipped in egg and fried, it is quite like a light omelette.

Scleroderma vulgare belongs to this group. It has a very tough warty brown coat, is very hard when white, and turns to a blackish slate color, when it smells quite like a tuffle; later it is filled with a dark powder, which escapes as in the puff-ball through a chink in the top. Phallus impudicus seems a quite common fungus. It is very beautiful in color and structure, but has a loathsome odor. It is commonly called the Stink-horn fungus, or Fetid Wood-witch.

We have identified about seventy species, and are able to place others in the proper genera, but have only made a beginning in the study. There is a wide field for work in this branch of Botany, particularly in this country where so little has been done as yet.

In the States a number of Mycological clubs have been formed, which are adding materially every year to the recorded knowledge on the subject.

The Boston Mycological Club sends out bulletins frequently during the year to its members, describing the various species found from time to time. Meetings are held every week during the summer months in Boston, when specimens are exhibited and lectures and talks on them are given. During the winter, meetings are held once a month. Members have the privilege of sending plants to be named or identified, and they can also obtain books on the subject to advantage, through the Cambridge Botanical Supply Co., at which place the Club Herbarium may be consulted. The annual fee is one dollar.

I have given in this paper the actual result of the work we have been doing during the last three or four summers. We have taken it up as time and opportunity presented, not always as systematically as it should have been done to lay before a Scientific Society.

Many specimens gathered have spoiled before the time could be given for their identification. Sometimes weeks passed when almost none were found, then again plants sprang up in such numbers and variety, that it seemed a hopeless task to try to make them out. We have tried to be very certain about every plant placed on the list, and before sending any away for identification, have in almost every case placed them in the proper genera.

There are many interesting items we have gleaned from the various works consulted, that might have been introduced, but as they were not connected with our own investigation, we have omitted them.

The effects of fungoid growths on other plants and on animals, as the cause of disease have only incidentally come under our observation, and we have made no practical study of them.

Some Conspicuous British Columbia Summer Plants.[1]

I had the pleasure of exhibiting to the Society and of placing in the museum specimens of plants collected in the Rocky Mountains in the summer of 1897, reported in the "Record of Science," Vol. VIII., pp. 163-192, but these were mainly found in what is known as the Arid Region, east of the Columbia river, a very few being reported from as far west as North Bend. The plants now catalogued and placed in the museum were obtained chiefly on the Pacific slope. A new and remarkable flora is encountered as soon as one gets west of the coast range of mountains. The moisture of the atmosphere and the genial climate conditioned by the Japan current produce a most luxuriant vegetation wherever the soil admits of it. Introduced plants attain vast proportions compared with those they reach in their native home. For instance, the Scotch broom (*Cytisus scoparius*), furze (*Ulex Europœus*), ivy (*Hedera helix*), foxglove (*Digitalis purpurea*) and even the daisy (*Bellis perennis*)—all of which have become naturalized and are spreading rapidly about Victoria and Vancouver—grow to twice the size they attain in Great Britain. And then the trees are phenomenally large, especially the conifers; but even the alders, which are never more than large shrubs with us in the east, are seen two or three feet in diameter, with a corresponding height. British Columbia, therefore, offers a most nviting field for botanical research. Something has been done in the way of cataloguing its flora by enthusiastic field-workers like Mr. Anderson, of the Agricultural Department of the province, and Mr. A. J. Hill, of New Westminster, over and above the information contained in the reports of the Geological Survey of the

[1] Read before the Natural History Society of Montreal, April 5th, 1904.

Dominion, under the superintendence of the Messrs. Macoun, father and son, but much in this direction remains yet to be accomplished in a territory so large and only so lately begun to be occupied. More progress has been made in the states lying to the south of British Columbia—Oregon and Washington—and the publications issued by the Agricultural Bureau of the United States are of essential help in determining the flora on the Canadian side of the International boundary. Besides, the works of Coulter and Howell, although they do not profess to give a complete list of the plants of British Columbia, are available for use in our limits, although doubtless there must be species away to the north that are not found in Oregon, Washington or California. There are not a few species west of the mountains which are common to the rest of Canada, and these are not included in the subjoined list. I have confined myself in large measure to those plants which caught my eye as unfamiliar, as they showed themselves on all hands. The collections were made in the months of June and July, 1903, for the most part by myself, although I am indebted to my friend, Mr. A. J. Hill, for a few specimens collected at a later date. The *Gramineæ* and *Cyperaceæ* which I collected I will have to report on in another paper, as well as on the Fungi, Musci and Lichenes, of which I have obtained a large number of specimens, for many of which I am indebted to the kindness of Mr. Hill.

EQUISETACEÆ.

Equisetum Telmateia Ehrh. Stanley Park, Vancouver, June.

Equisetum robustum A. Braun, Victoria, June.

POLYPODIACEÆ.

Polypodium Falcatum Kellogg. Esquimault and elsewhere, July.

LOMARIA SPICANT DEW. Stanley Park, Vancouver, June.

ASPLENIUM VIRIDE HUDSON. Sulphur Mt., Banff, July.

DRYOPTERIS OREOPTERIS SWARTZ. Stanley Park, July.

DRYOPTERIS MUNITUS KATIF. Stanley Park, June.

WOODSIA SCOPULINA EATON. Banks of Fraser River, July.

SELAGINELLACEÆ.

SELAGINELLA APUS SPRENG. Moosejaw, June.

PINACEÆ.

PINUS MURRAYANA OREGON COM. Side of mountain, near Vancouver, July.

PINUS CONTORTA LOUDON. Coast near Vancouver, July.

PINUS ENGELMANNI ENGELM. On mountain side, North Vancouver, July.

TSUGA.

TSUGA HETEROPHYLLA SARGENT. Vancouver, June.

TSUGA MERTENSIANA CARR. Vancouver, July.

ABIES AMABILIS FORBES. Cascade Mountains, July.

ABIES GRANDIS LINDL. Stanley Park, Vancouver, July.

THUJA PLICATA DON. Stanley Park, Vancouver, June.

JUNIPERUS OCCIDENTALIS HOOK. Heights near Vancouver, July.

JUNIPERUS COMMUNIS L. On heights near Esquimault, June.

TAXACEÆ.

TAXUS BREVIFOLIA NUTT. Common at Vancouver and Victoria, July.

JUNCACEÆ.

JUNCUS TRIFIDUS L. Olympia Mountains, July.

JUNCOIDES COMOSUM SHELDON. Heights near Vancouver, July.

MELANTHACEÆ.

TOFIELDIA GLUTINOSA PERS. Near Lake Louise, June.

Zygadenus Venenosus Watson. Banff, July.

Zygadenus elegans Pursh. Near Calgary, June.

STENANTHELLA.

Stenanthella occidentalis Rydberg. Vancouver, July.

Convallariaceæ.

Clintonia uniflora Kunth. Side of mountain, North Vancouver, July.

Streptopus brevipes Baker. Glacier, June.

Liliaceæ.

Frittillaria lanceolata Pursh. Park, Victoria, June.

Lilium parvum Kellogg. Esquimault, June.

Camassia esculenta Lindl. Near Victoria, June.

Brodiæa grandiflora Smith. Park, Victoria, June.

Allium acuminatum Hook. Park, Victoria, June.

Allium cernuum Roth. Medicine Hat, June.

Allium reticulatum Don. Dunmore, June.

Orchidaceæ.

Peramium Menziesii Morong. Near New Westminster, July.

Spiranthes porrifolia Kuntze. Near Coast, Vancouver, July.

Habenaria gracilis Watson. Vancouver, June.

Habenaria leuchostachys Watson. Near Washington border, July.

Habenaria elegans Bolander. Northern Vancouver, July.

Orchis Rotundifolia Pursh. Banff, July.

Cypripedium passerinum Rich. Banff, July.

Salicaceæ.

Populus trichocarpa T. & G. Near Vancouver, July.

Salix Sitchensis Sanson. North Vancouver, July.

Corylaceæ.

Corylus Californica Rose. Vancouver and Victoria, June.

CHENOPODIACEÆ.

Salsola Tragus L. Port Angeles, July.

Sarcobatus Vermiculatus Torr. Port Angeles, July.

Salicornia ambigua Michx. Vancouver, June.

POLYGONACEÆ.

Oxyria digyna Campd. Banff, July.

Rumex occidentalis Watson. North Vancouver, July.

Polygonum bistortoides Pursh. Banff, July.

PLANTAGINACEÆ.

Plantago Asiatica L. Vancouver and Victoria, June.

LABIATÆ.

Stachys ciliata Dougl. Victoria, June.

LENTIBULARIACEÆ.

Pinguicula Vulgaris L. Banff, July.

OROBANCHACEÆ.

Orobanche comosa Hook. Park, Victoria, June.

SCROPHULARIACEÆ.

Pedicularis racemosa Dougl. Banff, July.

Castilleia miniata Dougl. Victoria, June.

Castilleia hispida Benth. Near Vancouver, July.

Castilleia lutea Heller. Victoria Park, June.

Castilleia angustifolia (Nutt) Don. Victoria Park, June.

Castilleia oreopola Greenman. Olympia Mountains, Port Angeles, July.

Mimulus grandiflorus How. Port Angeles, July.

Mimulus Lewisii Pursh. Ross Peak, July.

Pentstemon deustus Dougl. Ross Peak, July.

PENTSTEMON LEWISII BENTH. Ross Peak, July.
PENTSTEMON ATTENUATUS DOUGL. Port Angeles, July.

BORAGINACEÆ.

MERTENSIA PANICULATA DON. Vancouver, June.

HYDROPHYLLACEÆ.

PHACELIA HETEROPHYLLA PURSH. Near Vancouver, July.

HYDROPHYLLUM CAPITATUM DOUGL. Vancouver, July.

POLEMONIACEÆ.

GILIA ACHILLAEFOLIA BENTH. Vancouver, July.
GILIA CAPITATA DOUGL. Park, Victoria, June,
COLLOMIA LINEARIS NUTT. Regina, July.
COLLOMIA DEBILIS GREENE. Near Vancouver, July.
LINANTHUS BOLANDERI GREENE. Port Angeles, July.

ASCLEPIADACEÆ.

ASCLEPIAS OVALIFOLIA DECAISNE. Near Vancouver, July.

ACERATES.

ACERATES VIRIDIFLORA (PAF) EATON. Stonewall, July.

VINCA.

VINCA MAJOR L. Port Angeles, July.

GENTIANACEÆ.

GENTIANA AFFINIS GRISEB. Donald, July.

PRIMULACEÆ.

TRIENTALIS LATIFOLIA HOOK. Esquimault, June.
PRIMULA CUSICKIANA GRAY. Port Angeles, July.
DODECATHEON CUSICKII GREENE. Banff, July.
DODECATHEON TETRANDRUM SUKSDORF. Banff, July.

ARMERIACEÆ.

ARMERIA VULGARIS WILLD. Seashore at Victoria, June.

PYROLACEÆ.

Chimaphila Menziesii Spreng. Near border of Washington, July.

Pyrola rotundifolia incarnata dc. Near Vancouver, July.

ERICACEÆ.

Kalmia glauca microphylla Hook. Lake Louise, July.

Arctostaphylos tomentosa Dougl. Very common near coast, June.

Arbutus Menziesii Pursh. Abundant near Victoria, June.

GAULTHERIA.

Gaultheria Shallon Pursh. Vancouver and elsewhere, June.

EPHEDRA.

Ephedra trifida Torr. Port Angeles, near the shore, July.

VACCINIACEÆ.

Vaccinium Alaskaensis How. Olympia Mountains, July.

Vaccinium Ovalifolium Smith. Near Vancouver, July.

CAMPANULACEÆ.

Campanula betonicæfolia L. Olympia Mountains, July.

Campanula prenanthoides Durand. Olympia Mountains, July.

OPUNTIA.

Opuntia polyacantha Haw. Medicine Hat, July.

MENTZELIA.

Mentzelia albicaulis Dougl. Medicine Hat, August.

CIRCÆA.

Circæa Pacifica Asch. & Mag. Victoria, June.

GAURA.

Gaura parviflora Dougl. Wolseley, July.

ANOGRA.

Anogra pallida Britton. Calgary, June.

EPILOBIUM.

Epilobium anagallidifolium Lam. Near Banff, July.

Epilobium Alpinum L. Banff, July.

CHAMÆNERION.

Chamænerion latifolium L. Field, July.

SEDUM.

Sedum stenopetalum Pursh. Sulphur Mountain, July.

Sedum spathulifolium Hook. Victoria, June.

Sedum Rhodiola, DC. Esquimault, June.

RIBES.

Ribes divaricatum Dougl. Stanley Park, June.

Ribes sanguineum Pursh. Vancouver, June.

PHILADELPHUS.

Philadelphus Lewisii Pursh. Victoria and North Bend, June.

HEUCHERA.

Heuchera glabella T. & G. Victoria, June.

Heuchera parviflora Nutt. Tunnel Mountain, July.

Heuchera micracantha Dougl. Park, Victoria, June.

TELLIMA.

Tellima grandiflora R Br. Vancouver, July.

TIARELLA.

Tiarella laciniata Hook. Victoria, June.

Tiarella trifoliata L. Esquimault, June.

SAXIFRAGA.

Saxifraga Nutkana Mocengler. Sulphur Mountain, July.

Saxifraga integrifolia Hook. Esquimault, July.

Saxifraga bronchialis L. Vancouver, July.

ARUNCUS.

Aruncus aruncus Karst. Very common, coast to Rockies, June.

SPIRÆA.

Spiræa Douglasii Hook. North Vancouver, July.

RUBUS.

Rubus ursinus Cham. Stanley Park, June.

Rubus nivalis Dougl. Stanley Park, June.

Rubus spectabilis Pursh. Vancouver and Victoria, June.

Rubus parviflorus Nutt. Very common, June.

POTENTILLA.

Potentilla glandulosa Lindl. Vancouver, July.

Potentilla gracilis Dougl. Vancouver, July.

SIBBALDIA.

Sibbaldia procumbens L. Esquimault, June.

PRAGARIA.

Fragaria Californica Cham. Common, June.

Fragaria cuneifolia Nutt. Common, June.

GEUM.

Geum triflorum Pursh. Esquimault, June.

HOLODISCUS.

Holodiscus ariæfolia How. Vancouver, July.

ROSA.

Rosa Woodsii Lindl. Banff, July.

AMELANCHIER.

AMELANCHIER ALNIFOLIA NUTT. Vancouver, July.

MALUS.

MALUS RIVULARIS ROEM. Vancouver, July.

AMORPHA.

AMORPHA CANESCENS PURSH. Near Wolseley, July.

ROBINIA.

ROBINIA VISCOSA VENT. Stanley Park, June.

LATHYRUS.

LATHYRUS LITTORALIS ENDL. Victoria, June.

HEDYSARUM.

HEDYSARUM FLAVESCENS COULT. Near Washington Border, July.

HEDYSARUM MACKENZII RICHARD. Banff and westward, July.

OXYTROPIS.

OXYTROPIS MONTICOLA GRAY. Banff, July.

ASTRAGALUS.

ASTRAGALUS HYPOGLOTTIS L. Very common, July.

ASTRAGALUS ADSURGENS PALL. Very common, July.

PSORALEA.

PSORALEA ARGOPHYLLA PURSH. Wolseley, July.

PSORALEA PHYSODES DOUGL. Columbia River, July.

KUHNISTERA.

KUHNISTERA CANDIDA (WILLD). Kuntze, Stonewall, July.

TRIFOLIUM.

TRIFLOLIUM HETERODON T. & G. Victoria, June.

TRIFOLIUM CYATHIFERUM LINDL. Victoria Park, June

ULEX.

Ulex Europæus L. Vancouver and Victoria, June.

LUPINUS.

Lupinus pusillus Pursh. Victoria, June.

Lupinus argenteus Pursh. Near Columbia River, July.

Lupinus arcticus Watson. Victoria, June.

THERMOPSIS.

Thermopsis montana Nutt. Banff, July.

ACER.

Acer Schwedleri. Agassiz, July.

Acer circinatum Pursh. Mission Junction, June.

Acer glabrum Torr. Victoria, June.

Acer macrophyllum Pursh. Mission Junction, June.

Acer Campestre L. Stanley Park, Vancouver.

GERANIUM.

Geranium pusillum L. Victoria, June.

MONTIA.

Montia parviflora Greene. Vancouver, June.

Montia minor Gmelin. Port Angeles, July.

Montia Sibirica How. Vancouver, Common, June.

CLAYTONIA.

Claytonia megarrhiza Parry. Columbia Mountains, July.

Claytonia umbellata Watson. Very common, June.

Claytonia lanceolata Pursh. Esquimault, June.

LEWISIA.

Lewisia rediviva Pursh. Cascade Mountains.

SILENE.

Silene Menziesii Hook. Very Common, June.

Silene Gallica L. Esquimault, June.

CARDAMINE.

Cardamine parviflora L. Vancouver, June.

BICUCULLA.

Bicuculla formosa DC. Port Angeles, July.

BERBERIS.

Berberis aquifolium Pursh. Field, June.

AQUILEGIA.

Aquilegia flavescens Watson. Banff, July.

RANUNCULUS.

Ranunculus Californicus Benth. Vancouver, July.
Ranunculus nivalis L. Glacier, June.

ANEMONE.

Anemone Drummondii Watson. Sulphur Mountains, Banff, July.

PLECTRITIS.

Plectritis congesta DC. Victoria Park, June.

VALERIANA.

Valeriana Sitchensis Bong. Near Vancouver, July.

XYLOSTEON.

Xylosteon involucratum Richard. Stanley Park, Vancouver, July.

LINNÆA.

Linnæa longiflora Torr. Near Vancouver, July.

SAMBUCUS.

Sambucus melanocarpa Gray. Glacier, July.

VIBURNUM.

Viburnum ellipticum Hook. Vancouver, July.

CORNUS.

Cornus Nuttalii Audubon. Hope, B.C., July.

ECHINOPANAX.

Echinopanax horridum Decaisne. North Vancouver, July.

SANICULA.

Sanicula bipinnata Hook. Victoria Park, June.

OSMORRHIZA.

Osmorrhiza nuda Torr. Victoria Park, June.

PIMPINELLA.

Pimpinella apiodora Gray. Victoria, June.

THASPIUM.

Thaspium aureum Trifoliatum C. & R. Wolseley, July.

PHELLOPTERUS.

Phellopterus littoralis Schmidt. Shore, near Port Angeles, July.

PEUCEDANUM.

Peucedanum triternatum Nutt. Victoria, June.

Peucedanum macrocarpum Nutt. Victoria, June.

Peucedanum ambiguum Nutt. Banff, July.

COMPOSITÆ.

Agoseris laciniata Greene. Vancouver and Victoria, July.

Crepis virens L. Vancouver and Victoria, July.

Hypochæris radicata L. Vancouver and Victoria, July.

Cnicus benedictus L. Port Angeles, July.

Arnica foliosa Nutt. Near Vancouver, July.

Arnica Amplexicaulis Nutt. North Vancouver, July.

Artemisia Ludivicina Nutt. Near Victoria, July.

Hymenopappus filifolius Hook. Vancouver and Victoria, July.

Gærtneria bipinnatifida O. Ktz. Port Angeles, July.

Adenocaulon bicolor Hook. Very common, July.

Gnaphalium microcephalum Nutt. Vancouver, July.

Antennaria alpina (L.) Gaertn. Banff, July.

Aster Geyeri Gray. Vancouver, July.

Aster integrifolius Nutt. Sycamous, July.

Aster foliaceus frondens Gray. Banff, July.

Bellis perennis L. Common about Vancouver and Victoria, June.

Euthamia occidentalis Nutt. Banff, July.

Solidago Californica Nutt. New Westminster, August.

Solidago elongata Nutt. New Westminster, August.

Solidago Missouriensis Nutt. New Westminster, August.

Solidago Tolmieana Gray. New Westminster, August.

Solidago confertiflora DC. New Westminster, August.

Solidago multiradiata Ait. Banff, July.

Grindelia nana Nutt. Wolseley and Winnepeg, July.

Grindelia squarrosa Dunal. Shore at Victoria, June.

Grindelia integrifolia DC. Marshy shore, Vancouver, July.

The Pleistocene of Montreal and the Ottawa Valley from a Railway Carriage.[1]

By J. S. Buchan, K.C., B.C.L.

The purpose of this paper is to give an illustration of what may be seen and observed on even so commonplace an occasion as a Railway journey from one place to another.

In carrying out this purpose, I have endeavoured to avoid any reference to detail or anything but what can be seen and observed in the ordinary course of such a journey.

Setting out from Montreal from the Bonaventure Station of the Grand Trunk Railway, we see but little of the natural features of the country until we reach St. Henry Station, the line being shut in by buildings on both sides. From St. Henry we observe that the line passes through a valley which is bounded on the Western side by a steep bluff about one hundred (100) feet in height, the top of which is level and presents a straight line to the view, and which extends almost the whole distance to Lachine, where it rises in a more gradual ascent.

The Eastern side is bounded by a hill considerably lower, and except in some places less abrupt than the West, but its appearance has evidently been somewhat changed by the excavation of the Lachine Canal close to the foot of the hill and by the large banks of earth from the Canal piled on its Western side.

The width of the valley is about half a mile, and its floor, which is almost perfectly level, is composed of a deep black soil, on which are the famous celery fields of Montreal.

In this valley are a single and a double line of steam

1 Read before the Natural History Society of Montreal, February 29th, 1904.

and one double track electric railway, the little River St. Pierre and the Lachine Canal. From the nature of the soil as well as the dead level of its surface, it is easy to conclude that at some period the land was covered with water; that, in course of time the water became a shallow lake gradually overgrown with water plants, and at length a swamp through which the small river carried all that remained of the water which formerly filled the valley.

Approaching Lachine the limit of the black soil is passed, and horizontal beds of limestone are seen reaching to the surface, which here becomes more uneven and is covered in places with loose stones interspersed with low swampy tracts; on the borders of the Town of Lachine the general surface being only slightly above the level of Lake St. Louis.

Retracing our steps we again begin our journey, this time by the Canadian Pacific Railway from the Windsor Station. Our route is now over the top of the bank which forms the Western side of the Valley, the level of which is reached at the Westmount Station.

A short distance beyond this point, at the Glen, where considerable excavations have been made, it is seen that the bank has been laid down by the agency of water, as it is composed of layers of sand and gravel with a covering of clay from which bricks are being manufactured.

To the West, a bank composed of the debris from the mountain extends to Montreal West, becoming gradually lower until it ends abruptly near the Station; this again showing the action of the currents of water which carried away the material planed off the top of the Mountain by ice-fields and strung it out in a tail several miles in length.

Looking towards the East we are surprised to find we cannot see the Valley through which we passed on the other Railway. Instead the surface of the land seems to extend without a break, and with a gentle slope to the St. Lawrence River, which can be seen in the distance, the appearance being continuous, as in Fig. 1.

Passing the Montreal West Station, we reach the point where the Valley comes into view, and here we observe that while the Easterly side is lower than the West, the slope of the surface towards the St. Lawrence is clearly produced on the Eastern side of the Valley as shown in Fig. 2.

From this we conclude that the bank, as laid down, extended to and beyond the present line of the St. Lawrence, and that the Valley was excavated by a stream of water which formed a channel or branch of the St. Lawrence, until, as the land continued to rise, the hard rock near Lachine remained firm while a break or fissure at the present Lachine rapids caused a lowering of the water which allowed it to drain off below the level of the Valley.

From Lachine to St. Anns, there are places where the limestone comes to the surface, and others where it is covered by the usual glacial drift. At Pointe Claire there is a mass of limestone, evidently in place from the markings of the stratification visible from the Railway, which rises abruptly from the plain to the height, apparently of about forty (40) feet, and through which a wide level road passes where the stone has been removed by quarrying operations.

This was doubtless left in place when the surrounding beds of limestone were removed by erosion, owing to the part where the denuding forces struck it being harder than the rest of the mass, possibly due to the presence of a trap dyke or merely a harder bed of limestone. From what remains some idea may be formed of the enormous mass of limestone which has disappeared from the surrounding country through the action of nature's forces.

Near St. Anns some rounded hills of sand and gravel show where fierce currents, carrying with them the materials which formed the sides and beds of the channel through which they flowed, cast them into an eddy which washed and heaped them up in its circular course.

At St. Anns, at the head of the Island of Montreal, the shore rises steeply from the water. The limestone extends to the surface, and at the Station has been removed to form the bed of the Railway, showing the even and regular stratification ; while for a considerable depth from the surface it is decomposed and turned into soil containing small rounded boulders of decomposition near the Station. Among other debris being removed by laborers, was a large block of conglomerate apparently identical with that on St. Helen's Island belonging to the Helderburg system.

Crossing the River by the fine steel bridge, we note the presence of a number of low, flat islands in the lake, indicating shallow water outside of the channel marked by a line of buoys.

Crossing Isle Perrot, which is alternately low, and swampy, and hilly, with small boulders, an outcrop of red sandstone belonging to the Potsdam formation may be observed ; another of the same being found near Hudson.

Passing over the branch of the Ottawa separating the Island from the mainland, which is shallow with swift currents, we reach Vaudreuil, situated on a flat alluvial plain marked to the South by a high well-defined bench, at some time the shore of the then lake.

Approaching Como the plain becomes broken and irregular with gravelly hills covered in places with boulders, and at Hudson Heights the Railway runs close to the water's edge with a bank of sand and gravel rising steeply on the south side of the line to the height of apparently over a hundred feet.

Directly across the lake which seems to be about two miles in width, there rises the mass of Mont Calvaire; while the shore on the North is seen to be a great bank similar to that on the South, stretching along the lake for a distance difficult to estimate, but apparently about the same height as the southern bank with the straight, even line of surface at the top which shows that it was carried into its position by the action of water.

Passing close to the shore for a distance of about half a mile the limit of the bank is reached, and it is then seen to sweep away from the river in a curving line until it joins the high ridge formed by the tail or continuation of Rigaud Mountain.

As the train advances and both sides of the lake come into view together, it can now be seen that there is a similarity between the banks on both sides of the water, and that they present the appearance which is seen when a railway embankment or a dam has been broken; thus giving the impression that a great bank or dam extended across the whole width of the lake, which has been broken and cut away by the water, leaving only the two ends which now form the bank on each side of it.

As it is a well-established fact that the tendency of a steep bank is to become flattened by the constant action of the ordinary forces of nature, and these banks as well as those of the St. Pierre Valley, which were first noticed, are still steep and regular, it may further be inferred that these changes took place at a comparatively recent period of geological time.

Passing quickly over another alluvial plain flanked on the South by Rigaud Mountain and crossing a small river which flows past the western end of the mountain, the country becomes uneven with rounded gravelly hills and occasional outcrops of limestone, until the half-way point between Montreal and Ottawa is reached at Van Kleek Hill, beyond which great stretches of peat bogs, bounded by well-defined raised beaches, begin and extend over almost the whole of the distance to Ottawa.

If a journey is made in the Spring, these bogs are usually covered with water for a great distance, reproducing to some extent the former conditions when this region was a vast lake extending in places to the base of the Laurentians to the north and beyond the line of vision to the south; but if made during the dry season, covered with the smoke of numerous fires where the peat is burning from which it may be inferred that in these bogs there is an inexhaustable supply of material for fuel if a proper and sufficiently economical method of manufacturing it for use can be found.

In this sketch only a few salient points have been noticed. Many others might be referred to, and if the journey is repeated on each occasion new ones may be observed.

Apart from any scientific interest, or even in its absence, there may be a moral or quasi moral side to the question. The habit of observation is a most valuable one. It stimulates and calls into action faculties which in their turn exert a most powerful influence, both mentally and physically, producing quickness and certainty of thought and action, and doubtless in many cases replacing carelessness and indifference with those qualities which go far to make the differenec between failure and success in life.

The Cambric Dictyonema Fauna of the slate belt of Eastern New York.

By Rudolf Rudemann.

[*N. York State Museum Bulletin 69, 1902 (1903)*].

This paper is of much interest to American and Canadian geologists as it contains a very full discussion of the relation of the Dictyonema Zone to the Cambrian and Ordovician systems.

The author gives an account of the position of this band in Scandinavia, and the elaborate studies Linnarsson, Tullberg, Lundgren and Brögger upon its fossils, and its relation to the Cambrian types below and Ordovician above. "The northern European paleontologists, almost without exception, have agreed" to place this band as the "termination of the primordial [Cambrian] fauna."

On the other hand the English geologists, including Prof. Geikie, still include in the Cambrian the next group (Tremadoc) above this band, though Brögger and others show that the paleontological evidence is against such a decision. This use of the term Cambrian is based on historical usage, and the acceptance of the Areing fauna as the base of the Ordovician.

Dr. Rudemann, from the conditions at Navy Island, in the St. John basin, finds evidence (shown by Matthew) that the Dictyonema Zone should be included in the Cambrian; but he holds with the continental paleontologist that the divisional line for the summit of the Cambrian should be drawn at the top of this Zone. He alludes in terms of approval to the work of Ells and Ami on the rocks of the Quebec Group in the typical region, but he probably misunderstands Ells' table of the divisions in these rocks in attributing the two lower to Lower Cambrian on account of remains of *Olenellus Thompsoni*. Ells' meaning probably is that the fossils are contained in the pebbles of the conglomerate in division 2, in which case these divisions are not necessarily Lower Cambrian.

Rudemann's result would appear not to agree with C. D. Walcott's opinion of the limit of the Cambrian (see page 953, fourth paragraph), for he, Walcott, would include the Dictyonema Zone in the Lower Ordovician. Moberg. has suggested a similar view of this Zone in Scandinavia, but, as Rudeman has shown, it does not apply in America.

Dr. Rudemann seems to think it will be possible to divide the Dictyonema Zone in America into two or three sub-zones,as has been done for that of Europe in Sweden.

Three plates are given to show the lithological aspect of the Dictyonema beds on the Hoosic R. in New York. The article is preliminary to a work on the Graptolites of New York by this author.

G. F. MATTHEW.

THE MONTEREGIAN HILLS—A CANADIAN PETROGRAPHICAL PROVINCE.[1]

GENERAL STATEMENT.

In the province of Quebec, between the enormous expanse of the Laurentian highlands to the northwest, constituting the "Canadian Shield," and the disturbed and folded tract of country to the southeast which marks the Appalachian uplift, there is a great plain underlain by nearly horizontal rocks of Lower Paleozoic age. This plain, while really showing slight differences of level from place to place, seems to the casual observer perfectly flat. Its surface is mantled with a fertile soil consisting of drift redistributed upon its surface by the sea which at the close of glacial times covered it. The uniform expanse of this plain, however, is broken by several isolated hills composed of igneous rocks, which arise abruptly from it and which constitute very striking features of the landscape. It was at the foot of one of these hills rising by the side of the river St. Lawrence, and which he named Mount Royal, that Jacques Cartier on his first visit found the Indian encampment of Hochelaga, whose site is now overspread by the city of Montreal, which has not only grown around the foot of the hill, but has extended up its sides and has reserved its summit as a park.

From the top of Mount Royal, the other hills referred to can all be seen rising from the plain to the east, while to the north the plain stretches away unbroken to the foot of the Laurentian country.

As has been remarked by Sir Archibald Geikie:[2]

[1] Read before the Natural History Society of Montreal, April 5th, 1904, and reprinted from the "Journal of Geology" by permission of the author.

[2] *Text-Book of Geology.*

The word "mountain" is properly speaking not a scientific term. It includes many forms of ground utterly different from each other in size, shape, structure, and origin. In a really mountainous country, the word would be restricted to the loftier masses of ground, while such a word as "hill" would be given to the lesser heights. But in a region of low or gently undulating land, where any conspicuous eminence becomes important, the term "mountain" is lavishly used. In eastern America this habit has been indulged in to such an extent that what are, so to speak, mere hummocks in the general landscape are dignified by the name of mountain.

The hills under consideration, while by no means "mere hummocks," being situated in such a country of low relief, seem to be higher than they really are and are always referred to locally as "mountains."

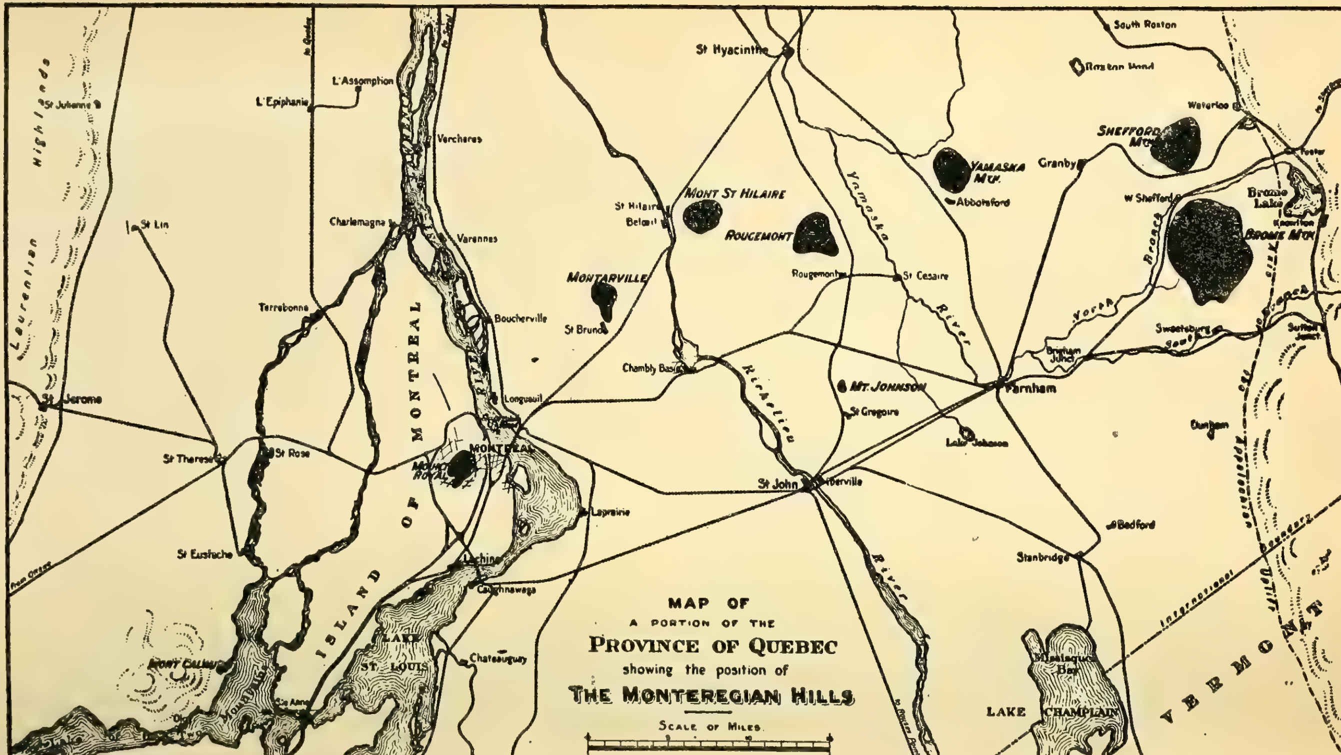
These mountains, whose positions are shown on the accompanying map (Fig 1), are eight in number, their names and their height above sea level being as follows;

Mount Royal	769.6 feet
Montarville or Boucherville mountain	Not yet accurately determined
Beloeil	1,437 feet (Leroy)
Rougemont Yamaska	Not yet accurately determined
Shefford	1,600 feet (Dresser)
Brome	1,440 feet (Dresser)
Mount Johnson or Monnoir	875 feet

Brome mountain is by far the largest of the group, having an area of 30 square miles. Shefford comes next in size, having an area of rather less than nine square miles, while Mount Johnson, which is very much smaller than any of the others, has an area of only .422 of one square mile.

Of these eight, the first six, as Logan[1] notes, "stand pretty nearly in a straight line," running approximately east and west, Mount Royal being the most westerly, and the others following in the order in which they are enumerated above, until Shefford mountain is reached, which is the most easterly member of the series. The distance from Mount Royal to Shefford is fifty miles. Mount Johnson and Brome mountain lie on a line parallel to

1 *Geology of Canada*, p. 9.



MAP OF
A PORTION OF THE
PROVINCE OF QUEBEC
showing the position of
THE MONTEREGIAN HILLS
SCALE OF MILES
Laurentian Highlands
St Julienne
L'Epiphanie
L'Assomption
Verchères
Charlemagne
Varennes
St Lin
Terrebonne
Boucherville
St Jerome
St Therese
St Rose
St Eustache
ISLAND OF MONTREAL
MONTREAL
Longueuil
Laprairie
Lachine
Caughnawaga
Chateauguay
LAKE ST. LOUIS
St Hyacinthe
MONT ST HILAIRE
St Hilaire
Belœil
ROUGEMONT
Rougemont
MONTARVILLE
St Bruno
Chambly Basin
Richelieu
Yamaska River
St Cesaire
YAMASKA MTN.
Abbotsford
Granby
MT. JOHNSON
St Gregoire
Lake Johnson
St John
Iberville
Farnham
River
SHEFFORD MTN.
Waterloo
South Roxton
Roxton Pond
W Shefford
Brome Lake
Knowlton
BROME MTN.
North Branch
Sweetsburg
Brigham Junct.
Sutton Junct.
Dunham
Bedford
Stanbridge
Missisquoi Bay
LAKE CHAMPLAIN
International Boundary
VERMONT
Foster

FIG. I.

them, but a short distance to the south, Rougemont being the nearest neighbor to Mount Johnson and Brome mountain being immediately south of Shefford. It is highly probable, in view of this distribution, that these ancient volcanic mountains are, as is usual in such occurences, arranged along some line or lines of weakness or deep-seated fracture. The "pretty nearly straight line" referred to by Logan on which the first six mountains of the group are situated must be considered either as a single line with a rather sharp curve in the middle, or as made up of two shorter straight lines, each with three mountains, which diverge from one another at an angle of about 30°, Montarville being located at the point of intersection. Mount Johnson and Brome mountain might then be considered as situated on short subsidary fractures.

Brome and Shefford, however, which are the two largest mountains of the series and which are only separated by a distance of a little over two miles, are probably connected at no great depth below the surface, forming in reality one large mass, while Mount Johnson, like the similar volcanic necks of Fife and Würtumberg, may have no direct connection with any line of fracture. It must be noted, as mentioned by Dresser[1], that while six of these mountains rise from the horizontal strata of the plain, the two most easterly members of the group, named Shefford and Brome, while still to the west of the axis of the range, lie well within the folded belt of the Appalachians, though owing to the extensive denudation from which the region has suffered, this folding has had but little influence on the local topography.

No collective name has hitherto been proposed for this remarkable group of hills.[2] From their intimate geo-

1 "On the Petrography of Shefford Mountain," *Amer. Geol.*, October, 1901.

2 The only instances in which these hills have been referred to as a geographical unit are, so far as can be ascertained, in a paper by Sterry Hunt entitled "On Some Igneous Rocks of Canada," *Amer. Jour. Science*, March, 1860, where they are called the Montreal group; and by Elie de Beaumont, who in a late edition of his *Systemes de*

logical relationship, however, constituting as they do a distinct and remarkable petrographical province, such a name is required. I propose to call them the *Monteregian Hills*, deriving their name from Mount Royal ("Mons Regius"), which may be taken as their type, being as it is the best-known member of the group.

There are certain other hills which have been considered by former workers in the geology of this district to belong to this group. Thus Logan thought that Rigaud Mountain, situated near the margin of the plain, by the river Ottawa, about forty miles west of Mount Royal, was "probably connected with" the series.[1] Ells[2] also included Mount Calvaire, a large, low mass which rises from the plain immediately to the north of the Lake of Two Mountains, near the junction of the Ottawa and the St. Lawrence.

Ells also refers to "the hills on the west side of Memphremagog lake and to the northeast toward the Chaudière river and beyond" as bearing a marked resemblance to the rocks of Mount Royal, Yamaska, etc., and as probably being of the same age.[3]

In a careful study of Rigaud mountain, recently completed by Mr. Leroy,[4] of this university, it is shown that the rocks constituting this mountain are different in character from those of the Monteregian hills, being composed of a reddish hornblende syenite and a quartz-bearing porphyry. These rocks, however, were found to be identical in character and composition with a great area of syenite, cut by porphyry, mentioned by Logan as occupying some forty square miles in the townships of Chatham and Grenville on the margin of the Laurentian

Montagnes included these hills as one of his systems, under the name of the "Système de Montréal." See PRESTWICH, *Geology, Chemical, Physical and Statigraphical*, Vol I, p. 294.

1 *Geology of Canada*, 1863, p. 9.

2 "Report on a portion of the Province of Quebec," *Ann. Rept. Geol. Surv. of Canada*, Vol. VII, Part J, 1896.

3 Eastern Townships Map (Montreal Sheet), *Ann. Rept. Geol. Surv. of Canada*, Vol. VII, Part J.

4 *Bull. of the American Geological Society*, Vol, XII, 1901.

plateau, a few miles to the north of Rigaud mountain. Owing to the drift which mantles this district, the actual contact of the igneous rock of Rigaud mountain and the Paleozoic strata of the plain is nowhere visible, so that it is impossible to determine whether the mass of Rigaud mountain cuts through the strata in question, as in the Monteregian hills, or whether it is pre-Paleozoic in age. The same is true of the mass in Chatham and Grenville, the actual contact here also being found by Mr. Leroy to be banked up with drift. The narrow margin of gneiss shown on Logan's map[1] between the Chatham syenite and the Paleozoic is also conjectural, the area being likewise drift covered. Rigaud mountain is, furthermore, of a different shape from the mountains east of Montreal, being six miles in length and only two and one-half miles wide; at the eastern end of it, moreover, there is found an occurrence of ordinary Laurentian gneiss. The abrupt and straight southern boundary of the Laurentian plateau along this part of its course probably marks a fault. Ells has noted the existence of other faults in this district, one of which he believes to follow the north side of Rigaud mountain. It is thus highly probable that the ridge known as Rigaud mountain does not belong to the Monteregian hills, but that it is a portion of the Laurentian plateau separated from the main area by faulting and stripped of its original covers of Paleozoic strata by denudation. It is probable that Mount Calvaire, as regarded by Logan, is also an outlying portion of the Laurentian plateau.

The hills on the west side of Lake Memphremagog and to the northeast toward the Chaudière river, referred to by Dr. Ells, so far as is known, are quite different in petrographical character from Mount Royal and the other members of its group They constitute a chain of hills occupying a tract of country some four miles wide and

1 Atlas to accompany the *Geology of Canada*, 1863, Map No. 2.

thirty-five miles in length, in the heart of the Appalachian uplift and following the strike of the Appalachian folding. Many of them, as Owl's Head and Orford mountain, rise to a very considerable height, these peaks having a height of about 2,400 and 2,800 feet respectively; forming, in fact, the highest elevation in this part of Canada. So far as has been ascertained, these mountains are in all cases composed of highly altered rocks. Many of them are altered diabases.[1] In other cases the alteration is so far advanced that it is impossible to determine the character of the original rock. Many of them have been completely altered to masses of serpentine. Nepheline-syenites, essexites, and similar rocks have not as yet been found anywhere in this chain of hills. A series of dyke rocks from Lake Memphremagog, examined by Marsters,[2] were found to be chiefly granites and lamprophyres, with one typical camptonite. It would seem therefore, that while our knowledge of these hills is as yet very imperfect, the evidence at our command, so far as it goes, points to them as belonging to a group quite distinct from Mount Royal and its associates. The petrographical province of the Monteregian hills may, therefore, in the present state of our knowledge, be said to comprise only the eight mountains enumerated on p. 240, together with the consanguineous dykes which at many points are found cutting the rocks of the surrounding plains.

The first description of these hills was that given by Logan and Hunt in the early years of the Canadian Survey. To Hunt especially we owe a somewhat extended description of the petrography of the group and a number of chemical analyses, more especially of the constituent minerals of certain of the rocks. These descriptions are, however, very general and often very imperfect, as must necessarily have been the case before the introduction of modern petrographical methods. Nor were certain im-

1 F. D. Adams, *Ann. Rept. Geol. Surv. of Canada*, 1880-81-82, pp. 12-13 A.
2 *American Geologist*, July, 1895,

portant petrographical relationships observed which have in later times come to be recognized. This early work, however, is of great interest, and in case of three of the mountains almost all the information which we have even at the present time, is derived from those early studies. The results of this work were brought together in the *Geology of Canada*, published by the Geological Survey of Canada in 1863, and are to be found on pp. 655–70. During the thirty years following the appearance of this volume, only three papers containing additional information concerning these rocks appeared. These were by Harrington,[1] Lacroix,[2] and the present writer,[3] respectively, all dealing with Mount Royal. In 1896 the "Montreal Sheet" of the *Eastern Townships Map*, prepared by Ells, and embracing the district of the Monteregian hills, was published by the Geological Survey of Canada and accompanied by a geological report on this portion of the province of Quebec. Four years later Principal Dresser of St. Francis College, Richmond, aided by a small grant from the Geological Survey of Canada, made a careful study of Shefford mountain, and a preliminary paper embodying the chief results of his investigations appeared in 1901.[4] Mr. Dresser last summer extended his work to Brome mountain, and has since published a brief description of this occurrence.[5] Mr. O. E. Leroy, of McGill University, is now engaged in a study of Beloeil, and I am indebted to him for the facts concerning the geology of this mountain which are here presented. Montarville, Rougemont, and Yamaska mountains still await detailed study, but it is expected that they also will before long be put in commission.

1 "On Some of the Diorites of Montreal," *Ann. Rept. of the Geol. Surv. of Canada*, 1877-78, 42 G.

2 "Description des syénites néphélinitiques de Pousac et de Montréal (Canada) et de leurs phénomènes de contact," *Bull. Soc. Geol. de France*, 3e série, tome XVIII, 1890.

3 "On a Melilite-Bearing Rock [Alnoite] from St. Anne de Bellevue near Montreal, Canada,," *Amer. Jour. of Science*, April, 1892.

4 "On the Petrography of Shefford Mountain," *Amer. Geol.*, October, 1901.

5 *Summary Report of the Geological Survey Department for* 1901, p. 183.

In the present paper it is proposed first to gather together the more important facts concerning the geology of the Monteregian hills which are scattered throughout these various publications, revising some of the earlier work and embodying the results of later personal studies, and then to describe in some detail one of these hills—Mount Johnson—of which hitherto but little has been known.

PETROGRAPHY OF THE MONTEREGIAN HILLS.

Hunt distinguished four types of igneous rocks as constituents of the Monteregian hills. These he classed as trachyte, phonolite, diorite, and dolerite, respectively. In this classification no distinction was made between rocks occurring as dykes and the great igneous intrusions which form the body of the hills; differences in structure resulting from mode of occurrence were not considered, the classification being based upon mineralogical composition alone.

Recent investigations have shown that Hunt's names do not convey an accurate idea of the petrography of these hills, nor do they set forth the interesting relationships of the various rocks composing them. It is necessary for this purpose to adopt a more modern nomenclature, for all the mountains of the group are composed of a family of consanguineous rocks, and taken together they present one of the finest examples of a petrographical province hitherto discovered. They consist, furthermore, of a rather rare class of rocks characterized by a high content of alumina and alkalies, especially soda.

The rocks forming the great intrusions which make up the mass of these mountains belong to two well-characterized types—one light in color, poor in iron-magnesia constituents, and comparatively high in silica; the other dark in color, rich in iron-magnesia constituents, and with a lower content of silica. They may be classed as follows, if Rosenbusch's nomenclature be followed:

1. Alkali-syenite, nepheline-syenite, or sodalite-syenite.
2. Essexite.

The first is an alkali-syenite, always containing a little nepheline, but this mineral in some cases becoming so abundant that the rock passes into a true nepheline-syenite, or, by the replacement of the nepheline by sodalite, into a sodalite-syenite. This in the case of Mount Johnson and Shefford mountain is represented by the variety known as pulaskite; in Brome mountain it is stated by Dresser to resemble Brögger's laurvikite,[1] while in Mount Royal and Beloeil it is a nepheline syenite. At the latter mountain a sodalite-syenite also occurs in association with the nepheline-syenite. Nepheline-syenite is also known to form part of Yamaska mountain. In addition to the syenite of the pulaskite variety, Dresser found in Shefford mountain a large development of a distinctly more acid type of the syenite magma, the rock showing occasionally a few grains of quartz. This rock he has classed as nordmarkite. These light colored syenites, together with certain dykes of bostonite having a general similarity in composition, were the rocks classed by Dr. Hunt as trachytes.

To the essexites belong the dolerites and diorites of Hunt, when he applied these terms to the great igneous intrusions of the mountains and not to mere dykes. They usually contain both hornblende and pyroxene, but the relative proportion of these two minerals varies considerably in the different occurrences. Olivine is sometimes present. Hunt did not recognize the presence of nepheline in these rocks, nor the highly alkaline character of the magma which they represent, and classified them as dolerite or diorite according to the preponderance of pyroxene or horneblende, noticing certain occurrences in which the former rock passed into a pyroxenite or peridotite.

The greater part of Mount Royal is composed of an essexite, usually very basic, the dark-colored constituents

1 *Summary Report of the Geological Survey of Canada*, 1901, p. 187.

forming a very large proportion of the whole rock. This was classed by Hunt as a dolerite, but is almost identical with the essexite of Mount Johnson, which Hunt classes as a diorite. This same rock is stated by Hunt to make up the greater part of Montarville and Rougemont and to form a portion of Yamaska mountain. An examination of thin sections of specimens of the Rougemont rock in the petrographical collection at McGill University shows it to be an essexite, rich in olivine. Dresser has found it to constitute approximately one-half of Shefford mountain and also to form large areas in Brome mountain. It makes up the greater part of Mount Johnson and forms the mass of Beloeil.

It is thus seen that the essexite magma is represented in every one of the eight mountains, and that in six of them at least it is associated with the syenite magma. The remaining two, Montarville and Rougemont, which have not been thoroughly examined as yet, while certainly composed chiefly of essexite, will probably be found, on further study, to present a development of the syenite in some portions of their mass also.

In addition to these bodies of intrusive rock which form the mass of the mountains, great numbers of dykes occur cutting both the surrounding sedimentary strata and the intrusions. These are, of course, especially numerous in and around the mountains themselves, but are also occasionally found far removed from the centers of activity. The relative abundance of these dykes in the vicinity of the several mountains varies greatly. They swarm through the Paleozoic strata about Mount Royal, cutting the limestones in all directions and also traversing, although less frequently, the igneous rock of the main intrusion as well. No less than twenty-nine dykes and flows, belonging to at least four and possibly five separate series, each cutting the preceding set, were mapped by Dr. Harrington some years ago in an excavation measuring 220 yards by 100 yards which was opened up in the

Trenton limestone on the flank of Mount Royal during the construction of the Montreal Reservoir extension. Dykes, in fact, abound wherever in the vicinity of Mount Royal the bed rock is exposed by the removal of the drift, as for instance, at the Mile End Quarries, St. Helen's Island, and in the bed of the St. Lawrence about Point St. Charles when it is exposed at low water. The whole district about the city would present a network of dykes, could the overlying drift be removed.

Dresser mentions dykes as occurring abundantly about Shefford mountain. In Mount Johnson, on the other hand, they are almost entirely absent. Only five dykes could be found after a careful exploration of the whole occurrence, and they were of insignificant dimensions. But very few dykes also occur at Beloeil mountain. A large number of the dyke rocks have been collected from the various occurrences and are now awaiting investigation in the geological department at McGill University. The work on the dykes of Mount Royal is now well advanced and, it is hoped, will be ready for publication shortly. They form a most remarkable series, comprising bostonites, tinguaites, sölvsbergites, camptonites, fourchites, monchiquites, and alnöites. Most, if not all, of the types of dyke rocks which have been described as occurring in association with the alkaline rich magmas of the theralite and nepheline-syenite groups in any part of the world are thus represented. To these dyke rocks belong Hunt's phonolite, which he considered to differ from the trachyte in that it contained a certain portion of natrolite. The two occurrences which he describes[1] are both from points near Montreal. They are nepheline bearing dykes in an advanced stage of alteration.

As has been mentioned, dyke rocks which from their composition are clearly connected with the intrusions of the Monteregian hills have been found cutting the rocks

1 *Geology of Canada*, pp. 659-61

of the plain at very considerable distances from any of the main centers of activity. Thus, in addition to occurrences of Laprairie, Lachine, Rivière des Prairies, Ste Anne de Bellevue, St. Paul's Island in the vicinity of Montreal, several dykes and flows of "trachyte" (bostonite) are noted by Hunt and Logan as occurring about Chambly, which is six miles to the south of the line of the Monteregian hills,[1] while the occurrence of a "dolerite" dyke at St. Hyacinth, ten miles north of the line is mentioned.[2]

A sheet of trap evidently connected with these intrusions also occurs at St. Lin,[3] twenty-four miles north of this line, where it alters the Chazy limestone through which it cuts into a pink marble. It is very much decomposed, but evidently belongs to some variety of the nepheline or melilite dyke rocks above mentioned.[4]

Whether the camptonite and in some cases bostonite dykes, described by several authors from various points in the states of Maine, New Hampshire and Vermont, adjacent to the Canadian line, and still more distant occurrences of similar dyke rocks in the state of New York, are connected with the Monteregian hills, is not yet known. There seem to be no intrusions of nepheline-syenite or essexite hitherto discovered with which these southern dykes can be connected in the districts in which they occur. The umptekite intrusion of Red Hill, Moltonboro, N. H., is however, closely related to the Monteregian pulaskite in character and composition, and may prove to be such a center.

STRUCTURE AND ORIGIN OF THE MONTEREGIAN HILLS.

The question of the mutual relations and relative age of the several rock types constituting these hills presents many points of interest. In the case of Mount Royal the

1 *Geology of Canada*, pp. 209 and 657. 2 *Ibid.*, p. 210. 3 *Ibid.*, p. 133.

4 F. D. Adams, "Report of Geology of Laurentian Area to the North of Island of Montreal," *Ann. Rept. Geol. Surv. of Canada*, Vol. VIII, J., p. 189. 1896.

essexite which constitutes the greater part of the mountain was the earliest intrusion. When this had become solid the nepheline-syenite broke through it, sending arms into it and catching up detached fragments of the shattered essexite. The same sequence in time is, according to Dresser, to be seen in Shefford Mountain. The basic essexite here forms the earliest intrusion, and was succeeded by the pulaskite and more acid nordmarkite. Mount Johnson, however, presents the two rocks in an entirely different relation. Here, as will be shown later, there was but a single period of intrusion. For although both rocks are present in the mountain, the essexite forms the central portion of the mass and passes over into pulaskite about the periphery of the neck. The mountain thus consists of essexite in its center, surrounded by a zone of pulaskite, the two rocks passing imperceptibly into one another. Mr. Leroy considers it probable that a similar passage takes place in the case of Beloeil mountain, but it is there difficult accurately to determine the relations of the magmas to one another on account of the covering of drift which obscures the contact.

It is thus evident that the two rock types constituting the Monteregian hills are differentiation products of a single magma, the separated magmas, however, in the case of Mount Royal and Shefford having been erupted in succession instead of simultaneously. In connection with the question of differentiation, another noteworthy fact is that the more easterly mountains contain proportionately more syenite and the western hills a greater proportion of the essexite. The bearing of this fact on the character of the differentiation which took place in the subterranean magma basin can be more profitably discussed at a later date when the precise character and relative extent of the intrusions in Yamaska, Rougemont, and Montarville have been determined.

With regard to the structure of these mountains, it may be noted that Logan, who first examined them, refers to them as "intrusive masses breaking through the surrounding Paleozoic strata"[1] They are thus represented in the geological sections of this district contained in the atlas accompanying this report. Ells refers to them simply as "eruptive mountains."[2] The more detailed studies of Shefford and Brome mountains recently carried out by Dresser, however, have led him to consider these two occurrences as uncovered laccolites. Concerning Shefford mountain he says:

> The sedimentary strata which surround the mountain . . . . are found to wrap around the igneous mass of the mountain, mantling it with a hardened contact zone to a height of 300 to 1,000 feet above the surrounding country, according to the direction of glaciation. Above the latter height the mountain rises upward of 200 feet, the summit being capped by an outlier of Trenton slate about a quarter of a mile in extent. This preserves the cleavage, dip, and strike of the similar rock at either side of the mountain and is penetrated by dykes from the underlying igneous rocks. From these facts, together with the absence of tufaceous material and the general arching of the strata around the mountain, it is inferred that Shefford mountain is an uncovered laccolite rather than the denuded neck of a once active volcano.[3]

In Brome mountain also the presence of outlying masses of the surrounding sedimentary series at high levels lying upon the igneous rock of the intrusion "seem to indicate unmistakably that Brome mountain, like Shefford, is an uncovered laccolite and has never been an active volcano."[4]

Mount Johnson, on the contrary, as will be shown, is a typical neck or plug, representing a portion of the conduit through which the magma rose, to fill laccolites above in strata which have long since been swept away by erosion, or to be poured out at the surface at volcanic vents. This is seen by the fact that the flat-lying strata all about it are not arched up, but abut sharply against the igneous core of the mountain and are cut off by it. Being shales, they are of course baked to hornstones, but show no signs

1 *Geology of Canada*, p. 655.
2 *Ann. Rept. Gel. Surv. of Canada*, Vol. VII, J., p. 71.
3 *American Geologist*, October, 1901, p. 204,
4 *Geol. Surv. of Canada, Summary Rept. for* 1901, p. 187.

of upheaval or tilting. The small size and almost circular cross-section of the mountain are a further indication of this origin; and finally there is conclusive proof that there was a vertical or upward movement of molten rock through the pipe. The mountain has been figured by Professor Davis, in his *Physical Geography*, from one of the author's photographs,as a typical example of a volcanic neck

In a recent paper by Buchan[1] the view was put forward that Mount Royal represents the remnant of a denuded laccolite—on the ground that on one side of the mountain, toward the summit, there is an isolated mass of flat-lying, altered Paleozoic limestone, evidently a part of the sedimentary strata of the plain from which the mountain rises. This alone, however, is not sufficient to establish a laccolite origin, and opposed to such an explanation is the fact that where the strata of the plain are seen along their immediate contact with the intrusion in many places, especially on the eastern and northern side of the mountain, they abut against the intrusive rock and are cut off by it instead of being uplifted, the igneous core of the mountain rising up precipitously like a wall across the truncated edge of the beds. The occurrences of the flat-lying limestone on the side of the mountain referred to above appear to represent the remnant of certain beds, beneath which a portion of the intrusive mass penetrated, after the manner of a laccolite, on one side of the mass. Their existence does not by any means indicate a laccolite structure for the mountains as a whole, or that the igneous material did not find a vent at the surface, there developing a volcano. In fact, there is evidence in the existence of a remarkable deposit of a breccia-conglomerate in several places around the mountain that it did develop as a volcano and that the materials constituting the deposit in question were ejected from it. A study of this breccia was undertaken last autumn by one of the

1 *Canadian Record of Science*, Vol. VIII, [1901], p. 321.

geological field parties of McGill University, and a description of it, with a discussion of its origin, is now in press and will appear in the *Canadian Record of Science* within the next few weeks. The other four hills have not as yet been studied in sufficient detail to enable any definite statement concerning their structure to be made.

In the Monteregian hills there are thus intrusions of the nature of laccolites, true necks, and probably also of stocks. The age of the intrusions cannot as yet be definitely determined. They are later than the lower Devonian, for some of the dykes connected with Mount Royal cut limestones which belong to the summit of the upper Silurian, while fragments of limestone which are shown by the fossils which they contain to be referable to the lowest beds of the Devonian; occur as inclusions in the volcanic breccia of agglomerate which is found about the flanks of the same mountain. The deeply eroded character of the mountains, however, shows that they are of early date, and it seems most probable that the intrusion took place somewhere in later Paleozoic time.

Having considered in a general way the character of the Monteregian hills as a whole, it may be of interest to look somewhat more closely into the structure and petrographical characters of one member of the group which has recently been studied in some detail, namely, Mount Johnson.

MOUNT JOHNSON.

Mount Johnson rises from the plain twenty-two miles east-southeast of the city of Montreal, and six miles northeast of the town of St. Johns on the Richelieu river, and twenty-five miles north of the international boundary. The little village of St. Grègoire is situated near its base. The surrounding country is perfectly flat, forming a fertile and well tilled agricultural district, the nearest mountain being Rougemont, which lies in a north-easterly direction some nine miles distant. In cross-section Mount Johnson is nearly circular. (Fig. 2.) The igneous

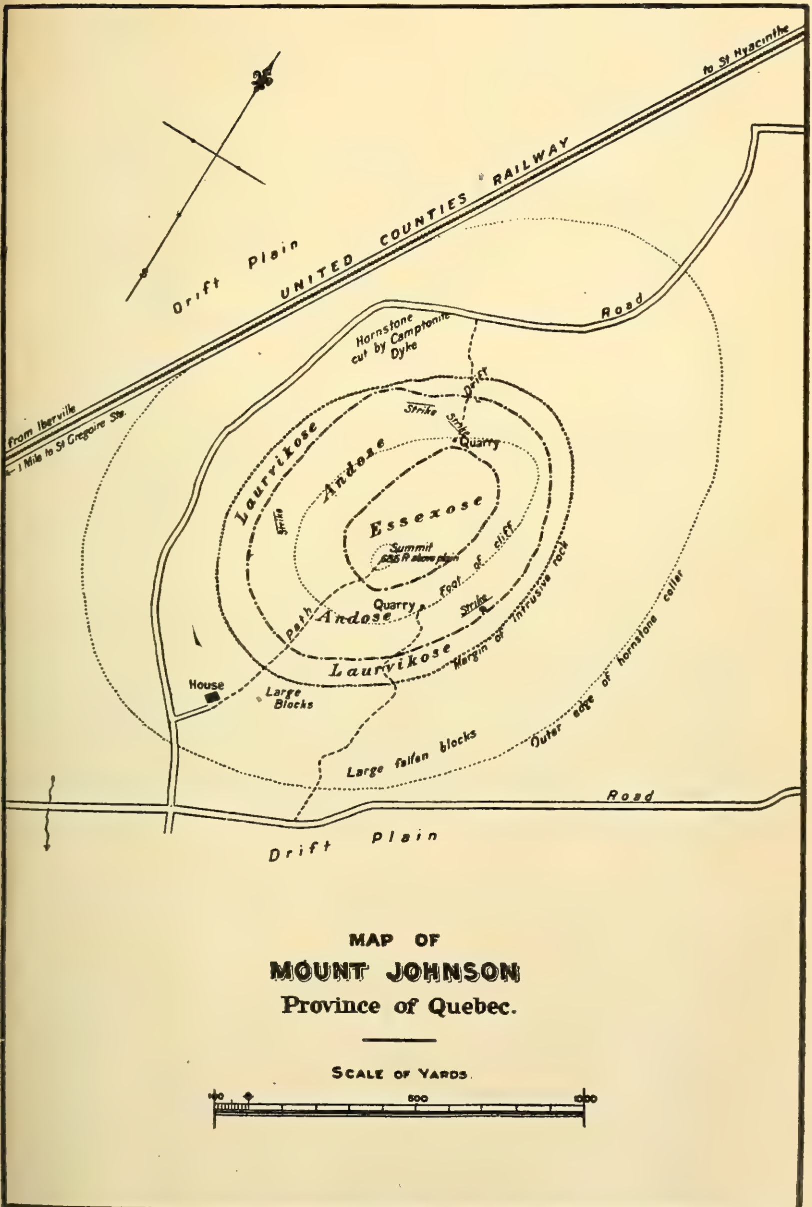

to St Hyacinthe
UNITED COUNTIES RAILWAY
Drift Plain
from Iberville
1 Mile to St Gregoire Sta.
Road
Hornstone cut by Camptonite Dyke
Drift
Strike
Strike
Quarry
Laurvikose
Andose
Strike
Essexose
Summit
Foot of cliff
Quarry
Path
Andose
Strike
Laurvikose
Margin of intrusive rock
House
Large Blocks
Outer edge of hornstone collar
Large fallen blocks
Road
Drift Plain
MAP OF
MOUNT JOHNSON
Province of Quebec.
SCALE OF YARDS.
500
1000

FIG. 2.

plug itself has at the base, immediately above the hornstone collar, a somewhat elliptical outline, and measures 3,500 feet by 2,500 feet, the longer axis having a direction N. 20° E. This gives the igneous intrusion an area of .423 of a square mile. The mean of a series of closely concordant aneroid readings, corrected by comparison with barometers at the observatory at McGill University at Montreal, shows that the highest point of the mountain is 685 feet above the main street in the village of St. Grègoire opposite the church, that is, above the surrounding plain, or 875 feet above sea level, the plain here having an elevation above sea-level of 190 feet. It has a somewhat dome-like outline, and forms a very striking feature in the landscape. The slope on the southern side is steep, in places precipitous, while to the north it is more gentle. The accompanying photograph (Fig. 3), taken from the railway station near St. Grègoire, which is about a mile and a quarter distant from the mountain in a direction approximately southwest, shows this profile, as well as the little notch near the summit, caused by a ravine which passes down the side.

At the foot of the mountain, more especially on its southern, southeastern, and southwestern sides, are numbers of large blocks which have fallen from the steep upper slopes and extended out from the foot; on the southern is a gentle sloping, terraced platform of drift which in part buries these great blocks, forming a "tail" probably due to the drift accumulating here on the lee side of the mountain during the ice movements in the glacial age. This drift, however, has been in part at least reassorted by wave-action during the period of depression which in this region followed the glacial age and during which the sea covered the plain to a depth of several hundred feet at least, as shown by the high level terraces with shell banks on the slopes of Mount Royal. On the plain about the mountain no rock exposures are seen. A mantle of drift covers it, and numerous erratic blocks and bowlders are scattered about. These are largely gneisses from the Laurentian highlands, but some of them are plutonic rocks from other hills of the Monteregian group. The plain about Mount Johnson is, however, stated by Ells, who has examined this district, to be underlain "presumably" by rocks of the Utica-Lorraine division of the Lower Silurian.

On ascending the mountain the first rock which is exposed above the drift mantle is a very fine-grained dark hornstone, uniform in character and lying in undisturbed horizontal beds. It can be seen at intervals all around

FIG. 3.—Mount Johnson, as seen from the southwest, showing limits of the several rock types composing the mountain.

the base of the mountain, forming a sort of collar, and is undoubtedly a shale such as that usually constituting the Utica formation, here however altered by its proximity to the intrusion. This shale wherever seen lies flat and abuts against the igneous rock of the intrusion, being cut sharply off by it, but not tilted or upturned. The upper limit of the shale is shown in the accompanying photograph of the mountain.

The mountain above this hornstone collar is made up exclusively of igneous material, which presents a most striking and beautiful instance of differentiation.

Immediately above the hornstone collar, and in contact with it, is a coarse-grained and highly feldspathic syenite, light buff in color, of the pulaskite type. This, as the mountain is scaled, passes rather abruptly into a dark-colored rock with large porphyritic white feldspars, which in its turn losses its porphyritic character and passes into a coarse-grained essexite which constitutes the mass of the hill, and which becomes at the summit finer in grain, richer in pyroxene and often holding a little olivine. No sharp lines can be drawn between these several rocks; one passes gradually into the other, the whole constituting one intrusive unit. The approximate limits of these several rock species are shown in the accompanying map (Fig. 2) and photograph (Fig. 3) of the mountain, it being impossible sharply to delimit the several species, seeing that they pass into one another. The mass therefore becomes progressively more basic as we pass from the margin of the intrusion to its center. The two chief rock types are the pulaskite and the essexite which will be separately considered. The essexite, being the more abundant rock and one presenting a greater complexity in mineralogical composition, may be first described.

Essexite.—The rock is dark in colour and rather course in grain, and although holocrystalline usually presents a more or less marked fluidal arrangement of the constituents. This is especially marked in the zone of transition between the essexite and pulaskite, owing to the presence there of the large feldspar phenocysts which, being arranged with their longer axes parallel to the direction of flow, serve to accentuate this structure. The finer-grained variety forming the summit of the mountain is more massive in character and does not exhibit the fluidal arrangement of constituents. Under the microscope the rock is seen to be composed of the following minerals: hornblende, pyroxene, biotite, olivine, plagioclase, nepheline, sodalite, apatite, magnetite, sphene, and in some cases a very small amount of orthoclase.

There is a marked tendency on the part of all the constituents to assume an idiomorphic development. The long lath-shaped plagioclases and large hornblende individuals have an approximately parallel arrangement, and between these lie the other iron-magnesia constituents with the smaller plagioclase individuals, the nepheline and the other components of the rock. These interstitial constituents do not differ greatly in size from the others, and show the same tendency to a parallel arrangement.

Hornblende.—Although almost every thin section of the rock contains not only hornblende, but pyroxene and biotite also, their relative proportion varies considerably. The hornblende is distinctly the most abundant, except in the finer-grained variety forming the summit of the mountain in which it is distinctly subordinate in amount to both pyroxene and mica. It is deep brown in color and is sometimes hypidiomorphic in its development, but often occurs with perfect crystalline form, showing the prismatic and the orthopinacoidal faces. Its extinction is larger than is usual in brown horneblendes, judging from the recorded instances, reaching 20°. It possesses a strong pleochroism as follows:

$\mathfrak{a}$ = pale yellowish-brown.
$\mathfrak{b}$ = deep-brown.
$\mathfrak{c}$ = very deep-brown.
Absorption = $\mathfrak{c} \gtrsim \mathfrak{b} > \mathfrak{a}$.

It is often twinned parallel to $\infty P \bar{\infty}$ or to a steep orthodome, and sometimes presents a faint zonal structure, marked by a slight difference in extinction of the several zones indicating a slight change in composition as growth proceeded, and occasionally a greenish tint is noticeable about the margin of the individual. It sometimes holds inclusions of magnetite and is often intergrown with the pyroxene. In the essexite from one place on the south side of the mountain, the hornblende was found free from inclusions, and practically free from the pyroxene which is usually so intimately associated with it. From this locality a quantity of the hornblende was obtained in a state of perfect purity through repeated separations by means of Klein's solution, all grains of foreign mineral still remaining being finally removed by picking them out by hand with the aid of a powerful lens. The pure material thus obtained was analysed by Professor Norton Evans, of the McGill University, every precaution to secure accuracy being observed and especial care being taken to effect a complete separation of the magnesia from the alumina by the repeated precipitation of the latter. The water was estimated by a direct determination. The results of the analysis are given below, together with those of several other hornblendes of similar composition which have been added for purposes of comparison :

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
SiO_2	38.633	39.75	40.15	40.14	41.35	39.16
TiO_4	5.035	5.40	5.21	4.26	4.97	.....
Al_2O_3	11.974	15.00	14 34	14.30	13.48	14.39
Fe_2O_3	3.903	7.86	7.80	7.07	5.14	12.42
FeO	11.523	2.89	4.53	6.27	10.33	5.85
MnO	0.729	.....	.....	0.21	.....	1.50
MgO	10.200	14.16	13.14	11.62	11.44	10.52
CaO	12.807	12.97	11.75	12.00	10.93	11.18
Na_2O	3.139	1.92	2.31	2.22	2.10	2.48
K_2O	1.489	1.61	1.14	1.35	0.62	2.01
H_2O	0.330	.....	.....	.....	0.48	0.39
	99.762	101.56	100.37	99.44	100.84	99.90

No. 1. Hornblende. From the essexite of Mount Johnson, province of Quebec, Canada.

No. 2. Hornblende. From Bohemian Mittelgebirge.

No. 3. Hornblende. From tuff of hornblende basalt, Härtlingen, Nassau.

No. 4. Hornblende. Basalt tuff, Hoheberg, near Giessen.

No. 5. Hornblende. From "hornblende diabase," Gräveneck, near Weilburg.

No. 6. Hornblend. Syntagmatite. Jan Mayen.

Analyses Nos. 2 to 6 are taken from Schneider's paper referred to below.

The hornblende thus belongs to the class of basaltic hornblendes, and not to the barkevikites as might be expected. It contains, however, proportionately more of the iron in a ferrous condition, together with somewhat less alumina and a somewhat larger proportion of alkalies than most hornblendes. The unusually high extinction for a hornblend of this class which it possesses is probably connected with the high content in ferrous iron, since Schneider[1] has shown that the extinction increases with the increase of iron in this state of oxidation.

Pyroxene.—This mineral occurs intimately associated and often intergrown with the hornblende, both minerals frequently holding many inclusions of magnetite and apatite. It is very pale-greenish in color, with no perceptible pleochroism, but with a marked dispersion of the bisectrices. It is usually hypidiomorphic, but is frequently idiomorphic, showing a distinct cleavage parallel to the pinacoids, but usually none parallel to the prismatic faces. It belongs to the variety of diopside-like augites which occur in rocks of this class. The extinction is high, reaching 45°.

Biotite.—This is deep-brown and almost identical in color with the hornblende and is strongly pleochroic, $\mathfrak{c}$ yellowish-brown, and $\mathfrak{a}$ deep-brown. It occurs intimately associated with the hornblende and augite, and also frequently as a border around the iron ore. While usually present in comparatively small amount, in the finer-grained essexite forming the summit of the mountain it is much more abundant than the hornblende. In this variety of the essexite both the mica and the hornblende often possess a poikilitic structure owing to the presence of numerous inclusions of plagioclase, which mineral also often penetrates the individuals of biotite and hornblende in theform of well-developed crystals.

Olivine.—This species is found in the finer-grained variety of the essexite at the summit of the mountain,

1 "Zur Kenntniss basaltischer Hornblenden *yst*, 1891, p. 579

and was also observed in the thin sections from the essexite at one point on the east side of the mountain not far from the summit. It is very pale-green in color and occurs as little grains inclosed in the biotite and pyroxene.

Plagioclase.—The plagioclase in the rock has well-developed, lath-like forms and is, almost without exception, excellently twinned according to the albite law. Twinning according to the carlsbad and pericline laws is also very common, occurring in the same individuals which show the albite twinning. The laths of plagioclase can in a few cases be seen to be distinctly twisted, evidently owing to pressure exerted upon them by other crystals during the consolidation of the rock, since the rock was submitted to no dymamic action subsequent to its crystallization.

As before mentioned, all the plagioclase individuals are not of the same dimensions. There are larger laths associated with the large hornblende crystals, and between these are smaller laths. The two sets are not, however, sufficiently well marked to cause the resulting structure to be classed as porphyritic. The plagioclase in the rock is not all of the same composition, but varies somewhat, even in the same hand specimen, ranging from an extremely acid labradorite to an oligoclase. It, however, is chiefly andesine. Its character was determined by a large number of extinction measurements carried out on the albite twins, as well as by Michel-Lévy's method, which can readily be applied owing to the frequency of carlsbad twinning in association with albite twinning. These determinations were extended and checked by a number of specific-gravity determinations and separations by means of Thoulet's solution. The larger plagioclase individuals were found, in the case of the rock on the north-east side of the mountain 320 feet above the plain, to be somewhat more basic than the smaller crystals, having the composition of a basic andesine, while the latter ranged in character from andesine to oligoclase. In this case no feldspar having a specific gravity of over 2.65 was found to be present in the rock. Again, in the rock of one of the quarries on the south side of the mountain, the larger feldspars tested by Michel-Lévy's method were found to have the composition of a very acid labradorite, $Ab_1 An_1$. The results of a separation of the constituents of the rock by Thoulet's solution showed that the feldspar was almost all andesine, although it varied from $Ab_1 An_1$ to an oligoclase. A crystal examined by Mr. Wright in Professor Rosenbusch's laboratory gave on P an extinction of 5°-6° and on M about 11°, showing the feldspar to be on the line between andesine and labradorite. A very small amount of orthoclase was also present, forming a subordinate accessory constituent. That there is a variation in composition even in the same individual of plagioclase is indicated in many cases by marked growth rings with different extinctions in the different rings. The smaller plagioclases, although twinned in the same manner as the larger, usually have the twinning developed in a less striking manner. A certain proportion of the smaller grains are also untwinned, but most of these must be identical in character with the twinned feldspar, since the separations show that while orthoclase is often present it occurs in only extremely small amount. Dr. Sterry Hunt gives[1] an analysis of the feldspar from the essexite of Mount Johnson (called by him diorite). This is as follows :

SiO_2	62.05
Al_2O_3	22.60
Fe_2O_3	.75
CaO	3.96
Na_2O	7.95
K_2O	1.80
Volatile	.80
	99.91

Sp. G. = 2.659.

1 *Geology of Canada*, p. 477.

This feldspar has the specific gravity and general composition of an acid andesine, although the high content of K_2O may possibly indicate the presence of some potash feldspar as an intergrowth.

Nepheline.—This is quite subordinate to the feldspar in amount. It possesses the usual low index of refraction, with extinction parallel to the cleavages, which latter can usually be seen. It is sometimes quite fresh, but at other times is found more or less completely altered to a mineral which occurs as little fibrous bundles, showing strong double refraction and parallel extinction. The fibres usually have a more or less distinctly parallel arrangement. The mineral remains practically unaltered when treated with concentrated hydrochloric acid for twenty minutes, although the nepheline in which it is imbedded is destroyed. It is either muscovite or kaolin. The nepheline is allotriomorphic and occurs chiefly in the corners between the larger crystals of feldspar and other minerals, and is penetrated by them. It is especially abundant in those portions of the rock which are rich in the dark-colored constituents. When occurring in this manner it appears, with the sodalite, to have been the last constituent of the rock to crystallize out. It is usually much more abundant than the sodalite. The nepheline also occurs in places as irregular-shaped lath-like inclusions in the feldspar.

Sodalite is usually, although not invariably, present. It strongly resembles the nepheline in appearance and shows the same alteration product. It is, however, quite isotropic. Like the nepheline, it occurs either in the spaces between the other minerals, cementing them together, or as inclusions in the feldspars.

Apatite.—The abundance of apatite is a distinct feature in this, as in similar rocks occurring elsewhere. It is always present and was the first constituent to crystallize out, being found in the form of perfect hexagonal prisms with double pyramidal terminations imbedded in the iron ore. It also occurs in the sphene as well as in the iron-magnesia constituents, in the nepheline, and also, although much less frequently, in the feldspar. Its large amount is shown by the high percentage of phosphoric acid in the analysis of the rock, 1.23 per cent. Another specimen of the rock in which the phosphoric acid was determined by Dr. B. J. Harrington gave 1.01 per cent. These figures represent 2.79 per cent. and 2.35 per cent. of apatite, respectively. It is usually somewhat turbid from the presence of minute dust-like inclusions.

Magnetite occurs chiefly inclosed in the iron-magnesia constituents, but is occasionally found in the feldspar. It is black, opaque, and highly magnetic, and is usually allotriomorphic, but occasionally presents an approximation to definite crystalline outline. As shown by the calculation of the analysis of the rock, this iron ore contains a considerable percentage of titanic acid.

Sphene is not found in more than one-half of the specimens examined. When present it is not very abundant and usually occurs as well-defined wedge-shaped crystals, often of considerable size.

In the accompanying table analyses are given of the normal essexite which forms the greater part of Mount Johnson, and of the finer-grained olivine-bearing variety of the same rock found at the summit of the mountain. For purposes of comparison there is presented in the same table the analysis of the essexite from Shefford mountain, which belongs to the same Monteregian province, together with analyses of the original essexite from Salem, Mass., and of allied rocks from two other localities. A partial analysis of the transitional rock between the essexite and the pulaskite of Mount Johnson is also given. For the analysis of the Mount Johnson essexite (No. 1) as well as for that of the associated pulaskite, which is given below, I am indebted to Professor Norton-Evans, while the analysis of the olivine-bearing variety of the essexite (No. 2) was made for me by Mr. M. F. Connor. The methods recommended by Hillebrand and employed in the very accurate, analytical work carried out in the laboratory of the United States Geological Survey were followed by both analysts, and every precaution was taken to insure accuracy.

	I	II	III	IV	V	VI
SiO_2	48.85	48.69	53.15	46.99	47.67	50.40
TiO_2	2.47	2.71	1.52	2.92	....	1.17
Al_2O_3	19.38	17.91	17.64	17.94	18.22	....
Fe_2O_3	4.29	3.09	3.10	2.56	3.65	5.58
FeO	4.94	6.41	4.65	7.56	3.85	
NiO + CoO ...	not det.	0.05	not det.	not det.	....	not det.
MnO..........	0.19	0.15	0.46	trace	0.28	0.77
MgO	2.00	3 06	2.94	3.22	6.35	...
CaO	7.98	7.30	5.66	7.85	8.03	6.77
BaO	....	0.08	0.13	none	....	....
Na_2O	5.44	5.95	5.00	6.35	4.93	6.24
K_2O.........	1.91	2.56	3.10	2.62	2.97	2.56
P_2O_5	1.23	1.11	0.65	0.94	....	0.09
Cl..........	not det.	not det.	0.07	....	....	....
H_2O.........	0.68	0.95	1.10	0.65	3.82	....
Total	99.36	100.02	99.84	99.60	100.15	

I. Normal essexite (andose), Mount Johnson, Quebec.

II. Olivine-bearing essexite (essexose), Mount Johnson, Quebec.

III. Essexite (akerose), Shefford mountain, Quebec, (*American Geologist*, 1901, p. 201), (with $CO_2$0.39 and $SO_3$0.28).

IV. Essexite (essexose), Salem Neck, Salem, Mass. (Washington, Jour. Geol., 1899, p. 57).

V. Theralite, Elbow Creek, Crazy Mountains, Montana.

VI. Rock forming transition from essexite to pulaskite, Mount Johnson, Quebec. (Partial analysis. The iron present is all calculated as FeO.)

The analyses (Nos. 1 and 2) of the two varieties of the essexite from Mount Johnson can be readily calculated out so as to show the quantitative mineralogical composition of the rocks.

The calculation of the *mode*[1]—or relative proportion of the minerals actually present gives the following result :

[1] *Quantitative Classification of Igneous Rocks* (*C.I.P.W.*) (University of Chicago Press, 1903), p. 147.

	Essexite (Analysis 1) Mount Johnson		Olivine-Essexite (Analysis 2) Mount Johnson	
Albite	36.75	66 45	29.14	54.79
Anorthite	20.23		13.11	
Orthoclase	9 47		12.54	
Nepheline	3.99	4.77	11.12	11.90
Kaolin	.78		.78	
Pyroxene		6 29		12.22
Hornblende		7.05		2.30
Biotite		2.04		4.08
Olivine		none		2.84
Magnetite	5.68	9.53	3.94	8.41
Ilmenite	3.85		4.47	
Apatite		2.68		2.59
Water (hygr.)		.58		.85
		99.39		99.98

In the case of No. 1 the percentage mineralogical composition given expresses exactly the chemical composition of the rock, except that it requires 0.06 per cent. of FeO in excess of that shown in the analysis. In No. 2 the agreement is complete.

The calculation further demonstrates that the plagioclase in the case of No. 1 is a trifle more basic, and in the case of No. 2 a little more acid, than $Ab_2\ An_1$, which as has been stated, is shown by the optical character and by the specific gravity of the feldspar to represent its average composition in these rocks. The amount of orthoclase recognized in thin sections also appears as mentioned in the description of the rock. The nepheline is in places somewhat altered to a mineral resembling kaolin. The small percentage of kaolin shown by the calculation has therefore been added to the nepheline in extending the table.

In order to fix the position of these rocks in the excellent system of classification recently elaborated by Messrs. Cross, Iddings, Pirsson, and Washington, and to determine the name which should be given to these rocks, if their precise character is to be designated, it is necessary to calculate their *norms.* These have been found to be as follows :—

	No. 1			No. 2		
Albite....		35.63	69.82		28.62	57.90
Anorthite.		23.07			14.23	
Orthoclase		11.12			15.05	
Nepheline.			5.40			11.83
Diopside..	34 CaO. SiO_2	— 3.94	7.56	53 CaO. SiO_2	— 6.15	12.03
	7 FeO. SiO_2	— .92		18 FeO. SiO_2	— 2.38	
	27 MgO. SiO_2	— 2.70		35 MgO. SiO_2	— 3.50	
Olivine...	6 FeO. $\frac{1}{2}$ SiO_2	— .61	2.22	21 FeO. $\frac{1}{2}$ SiO_2	— 2.14	5 08
	23 MgO. $\frac{1}{2}$ SiO_2	— 1.61		42 MgO. $\frac{1}{2}$ SiO_2	— 2.94	
Magnetite.			6 26			4.41
Ilmenite .			4 71			5.01
Apatite...			2.68			2.59
Water....			.68			.95
				BaO=.08, Excess FeO=.07		.15
			99.33			99.95

No. 1 thus takes the following position in the classification in question :

Class II, dosalane.
Order 5, germanare.
Rang 3, andase.
Subrang 4, andose (grad=polmitic.)

Its precise designation would be *nepheline-bearing grano-andose* or in some cases *nepheline-bearing tracho-andose.*

No. 2, however, belongs to the next order and is domalkalic. Its position is as follows :

Class II, dosalane.
Order 6, norgare.
Rang 2, essexase.
Subrang 4, essexose (grad=prepolic.

It would therefore be termed a *nepheline-bearing grano-essexose.* It is therefore seen that the essexite from the central portion of Mount Johnson (No. 2) is practically identical in character and composition with the essexite of the original locality of Salem, Mass. (Analysis IV), while the outer andose is poorer in nepheline and has a somewhat larger proportion of lime as compared with the alkalies.

The proportions of the several minerals present in thin sections of the specimens analyzed were then determined by the system of diametral measurements proposed by Rosiwal.[1] In each case over 500 average diameters were measured instead of 100, which latter number Rosiwal considers to be sufficient. The measurements were, however, confined to a small number of thin setions, namely two in the case of No. 1, and four in the case of No. 2, it being considered advisable to use only sections cut from the actual specimen from which the material for analysis was taken. The results obtained were as follows :

	No. 1	No. 2
Feldspar	63.77 per cent.	64.06 per cent.
Nepheline	6.12 "	6.16 "
Pyroxene	9.26 "	13.60 "
Hornblende	8.06 "	1.29 "
Biotite	2 11 "	4.07 "
Olivine	....	1.40 "
Iron Ore	8.56 "	8.10 "
Apatite	2.12 "	1.29 "
	100.00 "	99.97 "

In the case of No. 1 the results are substanially the same as the calculated *mode* except that there is about 3 per cent. more pyroxene and a correspondingly smaller proportion of feldspar. This relatively high proportion of pyroxene is unusual, the examination of thin sections of the rock for various parts of the mountain showing that, as has been stated above, and as is shown also by the calculation of the *mode* of this specimen, there is usually a preponderance of hornblende over pyroxene. In the case of No. 2 the chief difference between the values measured and the calculated *mode* lies in the relatively higher proportion of feldspar and lower proportion

[1] *Verhd. K. K. Geol. Reichsanst.* (Wien, 1898), p. 143.

of nepheline in the former. In this rock, however, it is very difficult to distinguish the nepheline from the feldspar in every case. These discrepancies indicate that in applying Rosiwal's method to comparatively coarse-grained rocks such as these, especially if there be any tendency to irregularity in composition, a considerable number of thin sections should be employed in order to obtain a true average of the rock as a whole.

For purposes of comparison the analysis of the essexite from Shefford Mountain (No. III) has been reduced to its normative form and the position of the rock in the Quantitative classification determined. It is found to be as follows:

Class II, dosalane.
Order 5, germanare.
Rang 3, monzonase.
Subrang 4, akerose (grad = polmitic).

It thus, in composition, occupies, in a manner, a middle place between the essexose and andose of Mount Johnson.

THE PULASKITE.—This soda-syenite which, as above mentioned, forms the outer zone of the mountain, girdling the essexite, is less abundant than the latter, and differs greatly from it in appearance. This difference is due chiefly to the fact that it is much lighter in color, being pale-yellow or buff instead of dark-gray, the lighter color being due to the very small proportion of iron-magnesia constituents present and the marked preponderance of the feldspars. The rock also has a more massive structure, the fluidal arrangement of the constituents often met with in the essexite being absent, and it weathers in a somewhat different manner. It possesses, moreover, a species of porphyritic structure, owing to the development of the feldspar in two forms; first, as stout prisms, up to 10^{mm} in diameter, which are light-gray in color and very abundant; and, secondly, in the form of smaller laths of a yellow or buff color which, in association with the iron-magnesia and other constituents, form a sort of ground-mass in the rock.

The constituent minerals of the rock are biotite, hornblende, (pyroxene), soda-orthoclase, nepheline, sodalile, apatite, magnetite, and sphene. The darker constituents are identical in character with those occurring in the essexite, and therefore do not require to be described again. Not only are they as a class much less abundant in this pulaskite, but the mica here preponderates, being the prevailing iron-magnesia constituent, while the hornblende is much less abundant and the pyroxene is entirely absent. It may be noted, however, that the hornblende sometimes possesses the greenish tint referred to as occasionally seen about the borders of the hornblende individuals in the essexite, indicating probably that, the pulaskite magma being richer in soda, the hornblende crystallizing out of it has a tendency to take up this element more abundantly.

The feldspar in the pulaskite, as has been mentioned, occurs in part as stout prisms and in part as smaller laths. The latter usually have a somewhat cloudy appearance under the microscope, probably owing to the incipient alteration. The larger feldspars are what is commonly described as soda-orthoclase. When examined under the microscope they are seen to be composed of very minute intergrowths of two, and in some cases perhaps even of three, different feldspars—causing them to present between crossed nicols a mottled appearance. These several feldspars have somewhat different indices of refraction, and frequently under a high power, where two are present, one of them can be seen to possess a very minute polysynthetic twinning, while the other is untwinned. The relative proportion of the several feldspars present differs in different grains. The individuals as a whole occasionally present the form of carlsbad twins, but usually have the appearance of simple crystals, and Professor Rosenbusch, to whom sections of the work were submitted, considers the feldspars composing them to be microcline, and in part microcline-microperthite, with probably some anorthoclase.

The specific gravity of these phenocrysts was determined in the case of two hand specimens of the pulaskite from different parts of the mountain. In the first of these three specimens of the feldspar were found to have specific gravities of 2.62, 2.609, and 2.603, respectively; while in the second, five specimens of the feldspar were selected and found to have specific gravities lying between orthoclase and albite, which bears out the results of their microscopic study.

The smaller lath-shaped feldspars, although more frequently composed of a single species, often show an intergrowth of two feldspars, as described in the case of the phenocrysts. Separations of the constituents of several species of the rock by means of Thoulet's solution show that these smaller feldspars have a somewhat lower specific gravity than the phenocsysts. Thus, while the specific gravity of the phenocrysts lies between 2.591, and 2.62, that of the smaller feldspars is between 2.591 and 2.56; that is to say, the smaller feldspars approach more nearly to pure orthoclase in composition. They consist chiefly of minute intergrowths of orthoclase with albite, or of either of these with microcline or anorthoclase. No lime-soda feldspar could be recognised in any specimen of the rock.

Nepheline and sodalite.—These minerals are quite subordinate in amount, although they are seen in nearly every thin section. Both minerals present the same characters and occur in the same way as the essexite, lying chiefly in the corners between the other constituents being penetrated by the latter, but also occurring as inclusions in the feldspar. They are, as a general rule much altered as to the same decomposition product seen in nepheline in the essexite and which is as has been mentioned, either kaolin or muscovite. Probably both are present.

Apatite is present in considerable amount and in the form of perfect crystals, occurring chiefly in the mica, hornblende, and sphene.

The *iron ore* and *sphene* present the same characters as in the case of the essexite, but the latter mineral is relatively more abundant than in that rock.

An analysis of this pulaskite is given in the accompanying table together with analysis of the pulaskite and the nordmarkite of Shefford mountain described by Dresser. Analysis of three allied rocks from other localities are added for purposes of comparison.

	VII	VIII	IX	X	XI	XII
SiO_2	57.44	59.96	65.43	56.45	59.01	60.03
TiO_2	1.97	0 66	0.16	0.29	0.81	.....
Al_2O_3	19.43	19.12	16.96	20.08	18.18	20.76
Fe_2O_3	1.69	1.85	1.55	1.31	1.63	4 01
FeO	2.70	1.73	1.53	4.39	3.65	0.75
MnO	0.25	0.49	0.40	0.09	0.03	trace
MgO	1.16	0 65	0.22	0.63	1.05	0.80
CaO	2 66	2.24	1.36	2.14	2.40	2.62
BaO	not det.	.12	none	.....	.08	.....
Na_2O	6 48	6 98	5.95	5.61	7.03	5.96
K_2O	4.28	4.91	5.36	7.13	5.34	5 48
P_2O_5	0.60	0.14	0.02	0.13	trace	0.07
SO_3	not det.	0 08	0 06	.....	.....	.....
CI	trace	0.14	0.04	0 43	0.12	.....
H_2O	1.03	1.10	0 82	1.51	0.50	0.59
	99.69	100.17	99.86	100.19	99.98	101.07

VII. Pulaskite (laurvikose), Mount Johnson, Quebec.

VIII. Pulaskite (laurvikose), Shefford mountain, Quebec. (*American Geologist*, 1901, p. 211).

IX. Nordmarkite (nordmarkose), Shefford mountain, Quebec. (*Ibid.*, 1901, p. 209).

X. Sodalite syenite, Square Butte, Montana (differentiation product of shonkinite).

XI. Umptekite, Red Hill, Moltonboro, New Hampshire.

XII. Pulaskite, Fourche mountain, Arkansas (original locality).

The *mode* of the Mount Johnson pulaskite (No. VII), calculated from the analysis given above, is as follows:

Albite - . . - -	48.73	
Anorthite - - - -	3.06	74.03
Orthoclase and microline -	22 24	
Nepheline - - - -		2.56
Kaolin - - - -		4.96
Hornblende - - - -		5.08
Biotite - . - -		6.29
Magnetite - - . -	1.86	2.77
Ilmenite - - - -	0.91	
Sphene - - - - -		2.35
Apatite - - - -		1.34
Water (hygroscopic) - -		0.30
		99.68

This proportion of the various minerals expresses exactly the chemical composition of the rock as presented by the analysis, except that a very small excess of silica, amounting to 0.06 per cent., is required.

The calculation shows clearly the fact, ascertained by the study of the thin sections of the rock, that a considerable percentage of sphene is present, a mineral which does not occur at all in the essexite.

The anorthite is probably in combination with the other feldspathic constituents in the form of anorthoclase. The calculation also brings out clearly a point already mentioned, namely, that in this rock the nepheline is much more highly altered than in the essexite, as shown by the amount of kaolin present. This kaolin, however, is not entirely derived from the alteration of the nepheline, but appears as a haze through all the smaller feldspars, and hence in the extension of the results should be assigned in part to the nepheline and in part to the feldspar. It is, of course, impossible to measure the amount of kaolin present by Rosiwal's method, occurring, as it does, distributed through the sections in the form of extremely minute individuals. If, however, the amount of nepheline given by the Rosiwal measurement be correct, namely 4.40 per cent.—and this, of course, includes both the unaltered mineral and that filled with decomposition products—then 1.84 per cent. of the kaolin has been derived from the alteration of the nepheline. There will thus remain 3.12 per cent. of the kaolin which has been derived from and measured up with the feldspar. If this amount be added to the feldspar found by calculation, it will increase the proportion present to 77.15 per cent., which is within 0.09 per cent. of the percentage of feldspar obtained by the Rosiwal measurement.

The *norm* of the pulaskite is found to be as follows :

Albite		50.30	85.61
Anorthite		9.73	
Orthoclase		25.58	
Nepheline			2.56
Olivine	$2MgO.SiO_2$	2.03	2.54
	$2FeO\text{-}SiO_2$	0.51	
Corundum			0.41
Magnetite			2.55
Ilmenite			3.80
Apatite			1.34
Water			1.03
			99.84

Its position is, therefore, as follows :

Class I, persalane.
Order 5, canadare.
Rang 2, pulaskase.
Subrang 4, laurvikose.

It should thus be termed a *grano-laurvikose*, or possibly, in view of its somewhat poryphyritic structure, a *granophyro-laurvikose.* The proportions of the several minerals present, or *mode*, as determined by Rosiwal's method were as follows :

Feldspar - - - -	77.24	per cent.
Nepheline - - - - -	4.40	"
Hornblende - - -	5.37	"
Biotite - - - -	7.08	"
Iron ore - - -	1.81	"
Sphene - - - -	3.29	"
Apatite - - - -	.81	"
	100.00	

For purposes of comparison the analysis of the pulaskite (No. VIII) and of the nordmarkite (No. IX) of Shefford mountain were calculated into their respective *norms* and the position of these rocks in the new system of classification determined. The pulaskite (No. VIII) is found to have the following position:

Class 1, persalane.
Order 5, canadare.
Rang 2, pulaskase.
Subrang 4, laurvikose.

The nordmarkite (No. IX), however, is peralkalic and must be classified as follows:

Class I, persalane.
Order 5, canadare.
Rang 1, nordmarkase.
Subrang 4, nordmarkose.

It, however, lies just on the line between nordmarkose and phlegrose, and might thus be best termed a nordmarkose-phlegrose.

It is thus seen that the rocks from Mount Johnson and from Shefford mountain which, following Rosenbusch's classification, have been called pulaskite, and which in this new scheme of classification are pulaskase, are almost identical in composition with one another and with the Norwegian laurvikite, and the nordmarkite of Shefford mountain is very close in composition to the nordmarkose of the original Scandinavian locality.

Diagrams showing the composition of these several rocks are presented in Fig. 4.

THE TRANSITION ROCK.—As has been metnioned, there intervenes in Mount Johnson between the pulaskite border and the central mass of essexite a transitional zone consisting of a rock which is dark in color and thus resembles the essexite, but which is characterized by the presence of large porphyritic feldspars sometimes as much as two inches in length, of peculiar form scattered through it and often arranged with their larger axes in the same direction, thus giving a fluidal appearance to the rock. This rock contains a large proportion of the same iron-magnesia minerals, more especially the hornblende, found in the essexite, and passes over gradually into this rock. Its passage into the pulaskite is rather more abrupt and is marked chiefly by the almost entire disappearance of the dark-coloured constituents above mentioned. There is, however, a continuous transition or passage from the pulaskite through this intermediate rock into the inner essexite of the mountain.

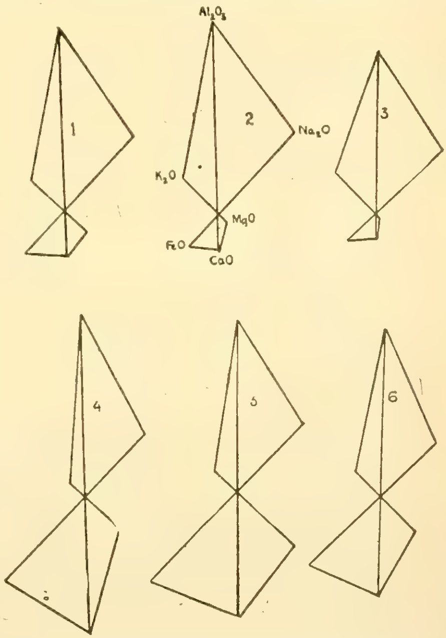


FIG. 4.—Diagrammatic representation of the chemical composition of the several rocks described.

No. 1. Laurvikose—Monnt Johnson.
No. 2. Laurvikose—Shefford mountain.
No. 3. Nordmarkose--Shefford mountain.
No. 4. Andose—Mount Johnson.
No. 5. Essexose—Mount Johnson.
No. 6. Andose—Shefford mountain.

This transitional rock is composed of the same minerals as the essexite with the exception of the feldspar, which consists in part of the soda-orthoclase characteristic of the pulaskite, and in part of the plagioclase (in this case oligoclase) which forms the feldspathic element of the essexite. It is thus in mineralogical composition intermediate between these two rocks, although, as above mentioned, being rich in the dark-coloured constituents, it more closely resembles the latter.

The large feldspars have frequently a peculiar crystalline form giving to the mineral, when broken across, a perfect hexagonal outline. The six faces represented in this form are apparently T, L, and M. The crystals hold many little inclusions of pyroxene, biotite, hornblende, magnetite, sphene, and nepheline, often regularly arranged so as to give a zonal structure to the feldspar individual. The specific gravity of twelve small fragments of the feldspar of these large crystals, collected from a locality on the southern side of the mountain and as free as possible from all inclusions, was determined. The specific gravity of nine of these lay between 2.59 and 2.607, while that of the other three was between 2.625 and 2.628. This shows the feldspar in the former case to be identical with that of the pulaskite, while in the latter three the specific gravity lies between that of albite and oligoclase. The somewhat greater specific gravity in this case may be due in part to inclusions of other minerals. A separation of the constituents of the rock shows, however, that, as above mentioned, a considerable amount of oligoclase is really present. The feldspar individuals, both great and small, usually show in thin sections the mottled character due to the intergrowth of different species, described in the pulaskite. A partial analysis of a specimen of this intermediate rock, from the south side of the mountain, is given in the accompanying table of analyses (No. VI), on page 220. As will be seen, in chemical composition as well as in mineralogical character, it occupies a position intermediate between the essexite and the pulaskite, occurring on either side of it, thus representing an intermediate zone in which the differentation was not quite completed. It is, however, much more nearly allied to the essexite, being alkalicalcic and dosodic, and although in the absence of a complete analysis or detailed measurements its position in the new classificatian cannot be determined with absolute certainty, there is very little doubt that it also, like the essexite adjacent to it, is an andose.

DYKES.—A feature in connection with Mount Johnson, and one possibly connected with its somewhat peculiar structure, is the almost entire absence of dykes. These were found only in two places, and in both cases the dykes were small in size. The first of these localities is on the northeastern margin of the intrusion, where the dyke occurs in association with and probably cutting the hornstone. It was found as large angular blocks in the heavy maple bush which here covers the slope of the mountain, but is undoubtedly in place in the immediate vicinity. The rock is very dark gray in color and very fine in grain, and belongs to the camptonites. It has a porphyritic structure, the very numerous phenocrysts consisting of hornblende and pyroxene. The hornblende phenocrysts are deep-brown in color and strongly pleochroic, the mineral being the same basaltic hornblende described in the essexite. The pyroxene of the phenocrysts is pale purplish in color and shows a marked dispersion of the bisectrices. Both minerals have very perfect crystalline forms. The plagioclase of the rock is very basic in character, as shown by its high extension. The rock resembles very closely certain occurrences found on Monnt Royal. The size of this dyke is not known, but it probably has not a width of more than a foot or two. The other dykes occur on the southeastern slope of the mountain by the side of the road leading down from the quarries here. At this locality there are four small dykes, the largest only a foot in width, cutting the essexite. These are all very fine in grain and much decomposed, but represent two varieties of rock. Two of the smallest are composed of a camptonite consisting of a groundmass of brownish hornblende and plagioclase, with lath-shaped plagioclase phenocrysts. The other two dykes consist of a rusty weathering rock, made up of feldspar laths and a mass of pseudomorphs of limonite

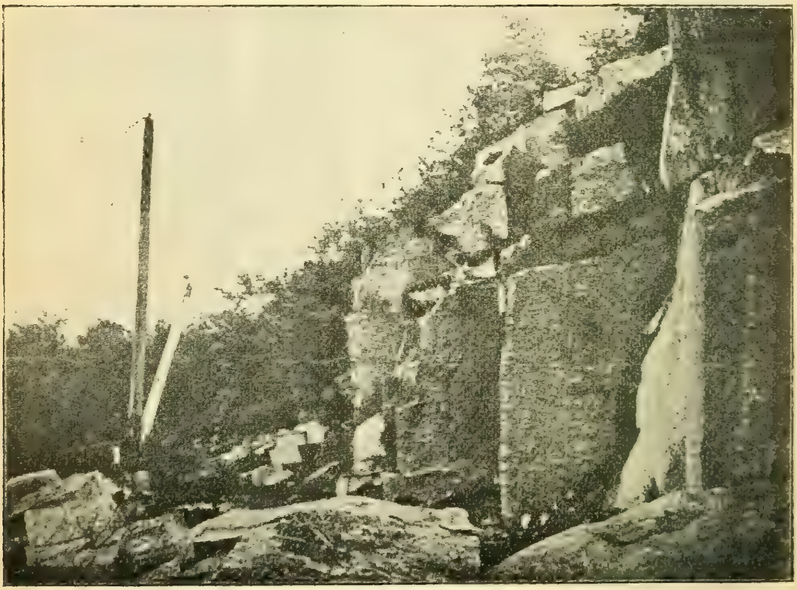


Fig. 5.—Quarry in andose, Mount Johnson, showing vertical flow structure on right.

after some prismatic mineral, probably either ægerin or arfvedsonite. Professor Rosenbusch considers it to be a highly altered tinguaite or sölvsbergite, probably the latter.

The several dykes, while small and unimportant in themselves, are of interest in that they present the petrographical types regularly associated with the alkaline rich intrusions of the class represented in Mount Johnson.

The Structure of Mount Johnson.—The structure of the mountain and the character of the rocks composing it also throw some light on the question as to where the differentiation took place. In course of conversation with the foreman of one of the quarries in the essexite on the flank of the mountain, the writer was informed by him that Mount Johnson consisted of three layers of horizontal rock; a fine-grained one on top, below which was the coarser-grained rock of the quarry, and beneath this a spotted variety. Each of these layers, he considered, went through the mountain horizontally and could be seen outcropping at their respective levels on every side. The three rocks referred to were, as will be recognized, the fine-grained essexose, the andose, and the transitional rock below the latter, respectively. The pulaskite zone he had not noticed, it being at the base of the mountain and in many places more or less covered with fallen blocks and talus. If this were the true interpretation of the structure, the mountain would have to be considered as the remnant of a laccolite which had been intruded between the horizontal Silurian strata and which had subsequently been almost entirely removed by peripheral denudation. This has been shown to be the true explanation of the origin of some of the occurrences, formerly supposed to be intrusive stocks, in the western portion of the United States, and it was at first considered as a possible explanation of the origin of Mount Johnson. A careful examination of the mountain, however, shows that such an explanation of its origin is untenable, and that it is a true neck, due to the filling up of a nearly circular perforation in the horizontal strata of the plane, by an upward moving magma.

The evidence of this is to be found in the direction of the banding or fluidal arrangement of the crystals in the essexite already referred to and shown in Fig. 5. This fluidal arrangement is seen in most large exposures of the essexite and with especial distinctness in the great faces, of this rock exposed in the quarries on the mountain side, and it is always vertical, showing that the movement of the rock was upward through the pipe, and not outward and horizontally over the pulaskite, as it would have been in the case of a laccolite. Furthermore, in several cases when the fluidal arrangement is very distinct and has a somewhat banded character, as shown in Fig. 6, due to the

Fig. 6.—Andose in quarry on Mount Johnson, showing vertical flow structure.

alteration of somewhat more feldspathic portions of the rock with others richer in iron-magnesia constituents, a strike can be made out on horizontal surfaces, and this strike curves around the mountain, following its marginal outline, as shown in the map, Fig. 2.

It is thus clear that Mount Johnson is a neck in its most typical form. A cross-section of the mountain is shown in Fig. 7. The opening occupied by the intrusion was in all probability formed by the perforation of the horizontal shales at this point by the explosive action of the steam and vapors preceding the eruption proper, as it presents exactly the features reproduced by Daubrée in his highly suggestive experiments on the penetrating action of exploding gases. It is, in fact, what he terms a *diatrème.*

Des perforations aussi remarkables, tant par leurs formes que par les communications qu'elles ont établies avec les profondeurs du sol, constituent, parmi les cassures terrestres, un type assez nettement charactérisé pour mériter d'être distingué par une dénomination précise et cosmopolite. Le nom de diatrème rapelle l'origine probable de ces trouées naturelles, véritables *tunnels verticaux,* qui se rattachent souvent, comme un incident particulier, aux cassures linéaires, diaclases et paraclases.[1]

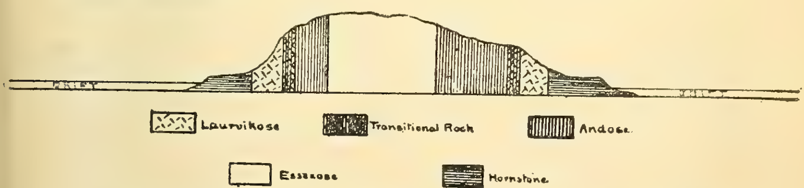


FIG. 7.—Diagrammatic cross-section of Mount Johnson, showing the relation of the several rock types.

The occurrence is one which presents a close resemblance to the remarkable volcanic necks recently described by Sir Archibald Geikie[2] in East Fife, and also to those described by Branco,[3] in Würtemberg. Mount Johnson, however, is a neck occurring in an area which has undergone much more extensive denudation since the time of the intrusion than in the cases above mentioned, and as a consequence of this the fragmental material

[1] "Recherches expérimentales sur le rôle possible des gaz à hautes températures doués de très fortes pressions, etc.," *Bull. de la Soc. Géol. de France,* 3e série, tome XIX (1891), p. 328.

[2] *The Volcanic Necks of East Fife.* Glasgow: Hedderwich & Sons.

[3] *Schwabens 125 Vulcan-Embryonen und deren tufferfüllte Ausbrurhsröhren das grösste Gebiet ehemaliger Maare auf der Erde.* Tübingen, 1894.

which fills some, although not all of the necks referred to above, has been entirely swept away.

In view of the fact, then, that Mount Johnson is a neck or pipe of comparatively small sectional area, in which the differentiation is very complete, but in which the magma did not remain at rest, but was long prior to final consolidation, moving upward, it seems improbable that the marked differentiation of the magma into the several varieties described in this paper took place while the magma was in the pipe itself. The evidence points rather to the differentiation of the mass having already taken place in the reservoir of molten rock beneath, which was tapped by the pipe. If this be the case, it would seem that the upper and more acid portion of the magma, represented by the lighter pulaskite, had collected in the upper portion of the reservoir, and that the essexite formed a lower, more basic, and heavier stratum or part. When the passage to the surface was opened up, the pulaskite would first rise in it and, after a more or less long-continued flow, being followed by the essexite, would be pressed toward the circumference of the pipe, the more basic rock occupying the central portion of the passage, and the most basic variety, originally lower, would be found in the central axis of the neck. The fact that, while the essexite forms the mass of the intrusion, there is a zone of pulaskite about it, would seem to indicate that there had not been at this center of volcanic activity any very protracted outpouring of the essexite, since, had this been the case, it would seem probable that the pipe would have in time been cleared of the earlier pulaskite magma.

The interesting question of the succession of the eruption of the several magmas in this petrographical province, as well as the causes of their differentiation, can be more profitably discussed when the other centers of eruption have been more thoroughly studied. It is interesting to note the cumulative evidence in favor of differentiation as an explanation of the origin of these and similar groups of rocks, arising not only from the repeated association of the various members of the group at many centres in a single area like that described in the present paper, but also at centers widely separated from one another in different parts of the world. The occurrences described by Ramsay[1] in the Kola peninsula may be especially noted in this connection as closely allied to those of the Monteregion hills, a soda-syenite (umptekite) occurring about the margin of an intrusion of the nepheline-syenite which constitutes the *massive,* while theralite is also found as a differentiation product of the same intrusion.

The author desires to acknowledge his indebtedness in connection with this investigation to Miss Rosalind Watson, of Victoria, B. C., who, when a student at this university began the study of Mount Johnson; also to Professor Rosenbusch, Professor Iddings, and Professor C. H. McLeod for valuable aid during the course of the work.

FRANK D. ADAMS.

McGILL UNIVERSITY,
Montreal.

1 *Des Nephelinsyenitgebiet auf der Halbinsel Kola.* Fennia 11, No. 2. Helsingfors, 1894.

Proceedings of the Natural History Society.

Montreal, October 26th, 1903.

The First Monthly Meeting of the society was held this evening. Present, Dr. E. W. MacBride, President, in the chair. Messrs. J. A. N. Beaudry, A Holden, H. McLaren, C. E. H. Phillips, Jos. Fortiér, R. W. McLachlan, C. J. Stuart, Rev. R. Campbell, J. S. Buchan, F. Topp, W. O. Roy, A. Griffin, T. Craig, H. H. Lyman and about twenty visitors.

Minutes of last meeting, April 27th, were read and confirmed.

The Curator reported the following Donations to the Museum:—Remains of whale ploughed up at Little Metis, donor, J. S. Buchan, Neptune's Drinking Cup, C. T. Hart, specimen Slate, Quarries, Newfoundland, E. W. Roberts, specimen Graphite, Calumet (Field day), A. Griffin, view, specimen of Meteorite (?) by J. M. Aird. It was moved by Rev. Dr. Campbell, and agreed, that the Secretary convey the thanks of the Society to the Donors. Rev. H. J. S. Boyle and C. J. Hart were admitted o membership. Miss Martha Craig was admitted to associate membership. Rev. Dr. Campbell then gave an interesting talk on the Fungi of the Island of Montreal, exhibiting many specimens, also a specimen of the foliage and fruit of the Coffee tree, from the mountain and cemetery, also specimens of fruit of Bladder Pod.

Mr. Stuart then read his paper "Further observations of the Aurora Borealis." After discussions and questions, the President in closing expressed the hope that Mr. Stuart would continue his investigations and again address the society, when Dr. Rutherford would be invited to be present.

MONTREAL, NOVEMBER 30TH, 1903.

The Second Monthly Meeting of the society, for the season, was held this evening, Dr. E. W. MacBride in the chair.

There were also present, J. Harper, Rev. Dr. Campbell, Jos. Fortiér, C. S. J. Phillips, C. E. H. Phillips, A. Holden, J. S. Buchan, A. E. Norris, C. T. Williams, A. Robertson, Thos. Craig, Prof. Bemrose, H McLaren, and about twenty visitors.

In the absence of the Secretary, Mr. H. McLaren consented to act in that capacity. The Minutes of last meeting were read and confirmed. On motion, the rules were suspended, and J. W. Currie was duly elected an ordinary member of the Society. Mr. S. Cleveland Morgan then read his paper on "The Mollusca of the Island of Montreal," followed by the Rev. Dr. Campbell, who exhibited and explained some new specimens (12) of Fungi, also 25 specimens of plants, many of which were quite new to the vicinity of Montreal. A discussion followed, many interesting questions being asked and answered by the respective lecturers.

A vote of thanks moved by A. E. Norris, seconded by John Harper, was unanimously carried, and tendered the lecturers. The meeting then adjourned.

MONTREAL, FEBRUARY 1ST, 1904.

The Third Monthly Meeting of the society was held this evening. The chair was occupied by Dr. E. W. MacBride. The following were present. Rev. Dr. Campbell, J. S. Buchan, John Topp, A. Robertson, A. E. Norris, A. Holden, H. McLaren, C. J. Stuart, Dr. Wesley Mills, Oswald Duckett, C. S. J. Phillips, C. E. H. Phillips, A. Griffin and about thirteen visitors.

In the absence of the secretary, Mr. A. E. Norris consented to act. The minutes of last meeting were read and confirmed. Rev. Dr. Campbell then read the obituary notice he had drafted, to be sent to the families of the late Samuel Finley and Sir William Van Horne. The curator reported the following donations:—70 specimens British Birds' Eggs, donor, Gilbert McGibbon. A vote of thanks was tendered to to the donor on motion of J. S. Buchan, seconded by Rev. Dr. Campbell. The librarian reported the following gifts to the Library:—Oysters and all about them, donor, L. Philpot, (2 vols.), Fish, and Fisheries, (prize essay, 1 vol.), Paley's Natural Theology, donor, Mrs Alfred Griffin. A vote of thanks was accorded the donors on motion of A. Robertson, seconded by J. S. Buchan. On motion the rules were suspended, and S. Cleveland Morgan was duly elected an ordinary member of the society.

Dr. E. W. MacBride then gave his paper, "The Canadian Oyster," followed by Charles J. Stuart, who gave a paper on A Remarkable Display of the Aurora Borealis on October 31st last. Both these papers evoked a spirited discussion, and were very much enjoyed.

A vote of thanks proposed by Dr. Wesley Mills, seconded by H. McLaren, was unanimously accorded the lecturers for their interesting and valuable communications.

The meeting then adjourned.

MONTREAL, FEBRUARY 29TH, 1904.

The Fourth Monthly Meeting of the society was held this evening at 8-30 p.m. The chair was occupied by Dr. E. W. MacBride. The following were also present: Rev. Dr. Campbell, J. Harper, A. E. Norris, J. S. Buchan, C. S. J. Phillips, A. Griffin, J. A. W. Beaudry, Jos. Fortiér, A. F. Winn, P. S. Ross, C. E. H. Phillips, H. McLaren.

Mr. McLaren kindly consented to act as secretary in the absence of Mr. Richards who was unable to attend. On motion, the rules were suspended, and Jas. Tasker was duly elected an ordinary member of the society. On motion, the minutes of last meeting were taken as read.

Mr. J. S. Buchan then read his paper on "The Pleistocene of Montreal and the Ottawa Valley as seen from the Windows of a Railway Carriage," followed by a paper from Mr. A. E. Norris, on "Insect Miners and their habits." Both of the papers were listened to with a great deal of interest, several members taking part in the discussion that followed. It was then moved by Rev. Dr. Campbell, seconded by J. Harper, that the thanks of the meeting be tendered to both of the above gentlemen for their interesting communications. Carried.

MONTREAL, APRIL 5TH, 1904.

The Fifth Monthly Meeting of the society was held this evening at 8-30. The chair was taken by George Sumner, and the following were also present. Rev. Dr. Campbell, Dr. F. D. Adams, J. S. Buchan, H. McLaren, J. Harper, C. E. H. Phillips, J. Topp, P. S. Ross, Dr. J. C. Cameron, Lachlan Gibb, Dr. J. Stafford, A. E. Norris, C. J. Stuart, A. Griffin, Jos. Fortiér, and a number of visitors.

In the absence of the secretary, Mr. H. McLaren consented to act. The minutes of last meeting were read and confirmed. The curator reported a donation to the Museum of a number of botanical specimens, collected in the vicinity of Montreal by Mrs. Marrotte. It was moved by Rev. R. Campbell, seconded by J. S. Buchan, that the thanks of the society be tendered to the donor. Carried.

The rules having been suspended, the following gentlemen were elected ordinary members of the society. J. H. Warren and Harry Bragg. Dr. Frank D. Adams then read his paper on "Mount Royal and the Monteregian Hills," followed by Rev. R. Campbell, who gave his paper on "Some characteristic Plants of British Columbia." Both of these papers were listened to with a great deal of attention, and elicited many questions, especially the former paper.

It was then moved by Mr. J. S. Buchan, seconded by Dr. J. C. Cameron, that the thanks of the society be tendered to the two gentlemen for their very interesting and instructive papers. Carried.

A communication was read from C. J. Stuart and A. Griffin, questioning the genuineness of the supposed meteorite loaned recently by J. M. Aird. The meeting then adjourned.

MONTREAL, APRIL 25TH, 1904.

The Sixth Monthly Meeting of the society was held this evening at 8-30. The minutes of last meeting were read and confirmed. The chair was occupied by the President, Prof. E. W. MacBride, and the following were also present: J. A. N. Beaudry, J. S. Buchan, R. W. McLachlan, Prof. Bemrose, Prof. D. P. Penhallow, Rev. R. Campbell, H. McLaren, C. S. J. Phillips, F. W. Richards, A. E. Norris, Jos. Fortiér, C. E. H. Phillips, A. Holden, J. Gardner, Miss O'Keeffe, Dr. Wesley Mills, Dr. J. Stafford, J. Walker, J. M. M. Duff, and a number of visitors, including several ladies.

The curator reported a donation of 130 plants from British Columbia, collected and presented to the Museum by the Rev. R. Campbell. On motion, a vote of thanks was tendered to the Rev. Dr. for his valuable donation. Carried. The report of Council was read and adopted on motion of C. S. J. Phillips, seconded by J. A. N. Beaudry. On motion, the following were requested to act on the Nomination Committee: Prof. E. W. MacBride, C. S. J. Phillips, F. W. Richards.

Prof. D. P. Penhallow then read his paper on "Some recent Developments in the Classification of the North American Coniferæ." This communication was very much appreciated by those present, and revealed a prodigous amount of research and study in its preparation. Dr. J. Stafford followed with his paper "The Fresh Water

Fishes brought to Montreal Markets," which was listened to with great attention.

On motion of C. S. J. Phillips, seconded by J. S. Buchan, a vote of thanks was tendered the above gentlemen for their valuable communications. The meeting then adjourned.

ANNUAL MEETING.

May 30th, 1904.

The Annual Meeting was held this evening at 8-30 o'clock, Prof. E. W. McBride presiding. There were also present Prof. F. D. Adams, J. Beattie, J. A. U. Beaudry, J. S. Buchan, K.C., C. Cassils, T. Craig, Oswald Duckett, Jos. Fortier, F. C. Morgan, A. E. Norris, C. E. H. Phillips, F. W. Richards, W. O. Roy, C. T. Williams, John Fair, G. A. Greene, A. Holden, J. Harper, A. C. Lyman, Miss Luke, Dr. Wesley Mills, John M. Coxen, H. McLaren, C. S. J. Phillips, A. Griffin, P. S. Ross, C. J. Stuart, and about 150 visitors.

Minutes of last Meeting were read and confirmed. Reports of Council, Treasurer, House Committee, Librarian, Museum, Lecture, Editing and Exchange Committees, were received and adopted after discussion on motion by Jos. Fortier, seconded by J. A. U. Beaudry.

The election of officers resulted as follows :—

Patron :

His Excellency the Governor General of Canada.

Hon. President :

Lord Strathcona and Mount Royal.

President :

Prof. D. P. Penhallow.

Vice-Presidents :

Frank D. Adams, Ph.D., F.R.S.C.	J. H. Joseph.
Rev. Robt. Campbell, M.A., D.D.	E. W. MacBride, M.A., Sc.D.
B. J. Harrington, Ph.D., F.R.S.C.	Dr. Wesley Mills.
Albert Holden.	Hon. J. K. Ward.

Hon. Recording Secretary

F. W. Richards.

Hon. Corresponding Secretary :
C. E. H. Phillips.

Hon. Treasurer :
Chas. S. J. Phillips.

Hon. Curator :
A. E. Norris.

Members of Council :

J. A. U. Beaudry, C.E., Chairman.	Edgar Judge.
J. S. Buchan, K.C., B.C.L.	H. McLaren, B.A.
Joseph Fortier.	Alex. Robertson, B.A.
John Harper.	C. T. Williams.

Prof. E. W. MacBride then delivered the President's annual address on "The Origin of the Human Race." A very interesting discussion of the paper followed, and Dr. MacBride, together with the retiring officers, was tendered a hearty vote of thanks by the members for their untiring efforts in promoting the welfare of the society during the year.

REPORT OF COUNCIL.

To the Officers and Members of the Natural History Society of Montreal :—

Ladies and Gentlemen :—

Your Council beg to submit the following report of their work for the year ending May 30th, 1904.

The regular business meetings have been well attended, and on the whole it has been a year of increased usefulness, although we are still suffering from the same causes that have crippled the work in former years.

The attendance at the Museum has increased beyond all expectations, while the hall has proved too small to accommodate all who came to the Somerville course of lectures, as well as to the Saturday afternoon talks to the young people.

The membership remains at about the same figure as at our last report, but we are sorry to say the rentals are somewhat less.

The pressure for increased room is more intense from year to year, and we could add considerably to our income if we could offer better accommodation to our tenants, while our librarian knows not which way to turn for accommodation.

The question of sale is still unsettled, the option granted to certain parties having still some time to run.

The field day excursion to Calumet was well attended, although the rain marred the pleasure of the day. Our reception at Calumet was most hospitable.

It is with much regret that we have to report the removal by death of four of our members:

Mr. Samuel Finley.	Mr. S. Silverman.
Major L. A. H. Latour.	Hon. Justice Wurtele.

The following papers were presented at the monthly meetings of the Society:

Oct. 26.—"The Toadstools of Montreal, Edible and Poisonous." Rev. Robt. Campbell, M.A., D.D.

"Further Observations of the Aurora Borealis." Chas. J. Stuart, Esq.

Nov. 30.—"The Mollusca of Montreal." S. Cleveland Morgan, B.A.

"Some additional notes on the Flora of Montreal, including the Toadstools." Rev. Robt. Campbell, M.A., D.D.

Feb. 1.—"The Canadian Oyster." Prof. E. W. MacBride, Principal of the Zoological Laboratory, McGill University.

"The Great Aurora Borealis of October 31st, as seen at Montreal." Chas. J. Stuart, Esq.

Feb. 29.—"The Pleistocene of Montreal and the Ottawa Valley, as seen from the Windows of a Railway Carriage." J. S. Buchan, B.C.L., K.C.

"Insect Miners and Their Habits." (Illustrated by colored lantern slides from Nature.) A. E. Norris, Esq.

Apr. 5.—"Mount Royal and the Monteregian Hills." Prof. Frank D. Adams, Ph.D., F.R.S.

"Some Characteristic Plants of British Columbia." Rev. Robt. Campbell, D.D.

Apr. 25.—"Some Recent Developments in the Classification of the North American Coniferæ." Prof. D. P. Penhallow.

"The Fresh Water Fishes brought to Montreal Markets." J. Stafford, M.A., Ph.D.

May 30.—"The Origin of the Human Race." Prof. E. W. MacBride, M.A., D.Sc., of Zoological Laboratory of McGill University.

SOMERVILLE COURSE.

Feb. 26.—"Bermuda and its Coral Reefs." Prof. C. L. Bristol.

Mar. 3.—"The Yukon Country." Prof. John McCoun, M.A., Naturalist to the Geological Survey.

10.—"Canada's Great Inland Sea (Hudson Bay) and the Surrounding Country." Robt. Bell, M.D., D.Sc., F.R.S., Acting Director of the Geological Survey.

17.—"The Grand Canoñ of Arizona." H. Bragg, Esq.

24.—"Japan, its Geography and People." Shaw T Nishimura, Esq.

31.—"The Sandwich Islands." Edgar Judge, Esq.

YOUNG PEOPLE'S HALF-HOUR TALKS.

Feb. 27.—"A Piece of Maple Sugar." J. S. Buchan, B.C.L., K.C.

Mar. 5.—"Dick's Dive in a Duck Pond." C. T. Williams, Esq.

12.—"The Story of an Apple." Carrie M. Derick, M.A.

19.—"How Plants Look after their Children." Eleanor Tatley, B.A.

26.—"The Purpose and Value of Pain." Wesley Mills, M.D.

Apr. 2.—"Wild Flowers and how to Treat Them." Rev. G. Colborne Heine, B.A.

9.—"On Collecting, Drying, and Mounting Plants." Rev. Robt. Campbell, D.D.

REPORT OF THE LECTURE COMMITTEE.

The chairman of the Lecture Committee being out of the city, I have been asked to report in his stead:

The Somerville course for the season was unusually interesting, and attracted large and intelligent audiences. Dealing mainly with descriptive geography, all the subjects treated of were within the grasp of ordinary hearers, who showed their unmistakable appreciation of them by their eager attention and hearty applause. This was specially the case with reference to the Japanese gentleman who gave such a realistic description of his country and its people. The thanks of the entire community, as well as of the members of the Natural History Society are due to the several lecturers, including the two members of the Geological Staff from Ottawa.

The Saturday afternoon talks to children abated nothing of the interest of former years. They continued to be attended by crowds of bright-eyed, eager young people, to the close of the series; and there is every ground to believe that from among those keenly attentive little folk future men and women of science will arise. The seed sown in their young minds cannot all perish.

In name of the Lecture Committee,

ROBERT CAMPBELL, Acting Chairman.

REPORT OF THE EDITING AND EXCHANGE COMMITTEE.

Your Editing and Exchange Committee beg leave to report that two numbers of the "Record of Science" were issued since the last annual meeting, one in July, 1903, vol. ix, No. 1, and one in January, 1904, vol. ix., No. 2. There was serious delay occasioned by our printer, with regard to both issues. The contents consisted mainly of papers communicated to the Society, and pertained to many of the fields of Natural History, while they were of special interest to those engaged in local research; they were of greater or less intrinsic value as aiding in the extension of a knowledge of Natural Science generally.

The exchange list continues to be large and valuable.

Respectfully submitted in name of the Editing and Exchange Committee.

ROBERT CAMPBELL, Chairman.

REPORT OF THE HOUSE COMMITTEE.

Montreal, 30th May, 1904.

To the President of the Natural History Society:

SIR:—Your Committee begs to report that the lease of the present tenants has been renewed for one year to May, 1905. The many repairs to the building which have been reported aud delayed for several years for want of funds have been carried over owing to the property being under offer for sale. The option is given to 1st November next. Should this sale be carried out, your Committee is ready to carry out a proposition that will (with the consent of the Society) place the Natural History Society in a position to make it independent in the future.

The thanks of the Society are due to the Superintendent and Mrs. Griffin for their many extra services during the past year.—Yours respectfully, A. HOLDEN,

For the Committee.

MUSEUM REPORT.

Session 1903-1904.

Mr. President, Ladies and Gentlemen,

On behalf of the Museum Committee the following report is submitted.

The Museum continues to attract great numbers of children and others. The fact of so many young people coming is an encouragement in itself, because they are generally more impressionable to the facts of Natural History than the older people, who naturally are burdened with other pursüits, and the cares of business.

We had great hopes of being able to report something concerning the proposed new Museum, but that must be left to a later date.

The donations to the Museum have been very interesting, and having been examined by the society, thanks to the donors were accorded in the minutes. The Botanical department has been considerably enriched by the generosity of Mrs. Marotte and Dr. Robert Campbell.

The Museum on the Saturday half-holiday is "Crush Day," when as many as three hundred to four hundred people visit it. Respectfully submitted,

A. E. NORRIS.
Honorary Curator.

LIBRARY REPORT.

During the past year many valuable bound volumes and Atlases have been received from Scientific Societies, as well as the usual Exchanges for the Record of Science. Nine volumes have also been presented by private individuals.

There is no relief yet to the congestion of the shelves, which are much overloaded, and in many cases "Two-deep," so that access to the volumes is difficult. More shelving is very urgently required, and it is to be hoped that the finances of the society may permit of this being done at an early date.

H. McLAREN,
Chairman, Library Committee.

June 6th, 1904.

NATURAL HISTORY SOCIETY OF MONTREAL

In account with CHAS. S. J. PHILLIPS, Hon. Treasurer.

CASH SUMMARY FOR YEAR ENDING MAY 31ST, 1904.

RECEIPTS.

To Rents	960.50	
" Members' subscriptions	475.00	
" Record of Science	18 61	
" Microscopical Society on affiliation	45.00	
		1499.11
" Bank overdraft		459.32
		$1,958.43

DISBURSEMENTS.

By Balance due Bank		352.16
" Superintendent's salary	650.00	
" " Commision	46.00	
" Mrs. Griffin	50.00	
" Sundry Expenses	167.02	
" Lighting account	169.23	
" Fuel "	250.16	
" Water "	34.92	
" Printing "	23.00	
" Lecture "	37.00	
" Museum "	12.00	
" Interest "	28.75	
" Record of Science	138.19	
		1,606.27
		$1,958.43

Audited and found correct, this 30th day of May, 1904.

(Signed) H. McLAREN,
ALEXANDER ROBERTSON.

ABSTRACT OF OBSERVATION OF AURORA BOREALIS SEEN FROM MONTREAL, 1903. By C. J. STUART.[1]

During the Autumn of 1903 I witnessed 5 displays of Aurora as follows :—

19th-20th Sept.—W. to E. drift indicated. Surface wind S.W. Cross winds above.

13th Oct.—Drift suggested not distinct. Wind W., and puffs from N.W. Cross winds above.

30th Oct.—1st Nov.—W. to E. drift pronounced. Surface wind W. and W.S.W. Cross winds.

Morning, 4th November.—W. to E. drift suggested (short observation). Surface wind S. of W. No clouds.

18th Nov.—Drift not observed, but not incompatible with conditions as seen. Surface wind W. Clouds from N.W.

The McGill monthly weather reports mention two Auroras for September, three for October, and evidently only one night in November —probably the early morning display of November 4th was missed—but it was undoubtedly Aurora, as indicated by the filling and fading of light. Dawn the same morning was high peaked, suggesting zodiacal light with which I am not familiar, however. As dates are not given in the weather reports, and as my observations do not pretend to be complete, it would appear that there were at least seven or eight displays during the year.

During the nights of September 19th and 20th, and again on October 13th and 14th, displays of Northern lights were noted from here.

On both occasions I had what I considered evidence of a West to East drift of the field or medium in which the luminous phenomona took place.

The display of September 19th was rather feeble and sluggish. I did not notice anything unusual until 8.35 p.m. and until 3 a.m.—when fog drifted in from the South—the overhead clouds were so thin and indistinct that no positive assurance could be obtained of high cross winds, but from the appearance and behavior of cloud banks on the horizon I inferred that there was both a high cirro mist and a W. to E. wind, the surface wind being South to North nearly.

On the 13th October, however, there was unequivocal evidence of several cross winds, the highest evidently from W. to E. This display, I understand, was observed as far South as Washington, D.C. In the early evening it was brilliant although sluggish in movement. The moon was in its last quarter, so the early morning appearance was chiefly interesting for the behavior of the clouds and winds. I watched

1 Read before the Natural History Society of Montreal, February 1st, 1904.

at intervals and saw Aurora from 6.20 p.m. up to 5.05 a.m. (dawn) morning of the 20th. At 4.40 a.m. 20th I had the good fortune to observe, under very favourable circumstances, the formation of a field of cirrus clouds almost overhead. It showed the wind action I expected—high W. to E., under N. to S., with a probable stratum almost calm in between—but what is of exceptional interest, the coincident behaviour of the Aurora showed a decrease while the clouds grew, and an increase while the clouds again melted away. At the same time the high cirrus mist which makes the stars look dim, and which was evident as a large halo round the moon, diminished in density and decreased in size. These changes in the cloud formation, the halo, and the Aurora were coincident and apparently in reverse proportion.

A somewhat similar cloud phenomenon was seen between 8 and 9 a.m. Of course the Aurora was invisible, but certain heavy low-lying, cumulus clouds were distinctly exhibiting electrical influences, so I presume if the Aurora had been still visible we would have seen changes in it also. I consider the observation of these clouds important, so the running notes I kept will be transcribed and forwarded to the Society for anyone who may be interested. It may be remarked that the period between these two displays is twenty five days, roughly one revolution of the sun. On the 20th of September there was no sun spot visible, although a group observed two weeks later must have been forming on the reverse surface. On October 14th the old group of sun spots that had been exciting so much attention could be seen on the Western limb of the sun's disc, while a single new spot was just appearing on the Eastern side. The meredian field, however, was clear. In this respect, however, I may mention that the connection of sun spots and terrestial Aurora Borealis is not direct, but probably through the "protuberances" which accompany the outburst of spots, or at least the earlier stages of their development, the solar protuberances in high latitudes are said to synchronize with terrestrial magnetic disturbance, or magnetic storms (Lockyer), and the latter, according to weather conditions and other modifying circumstances, finds a consequent expression either in Aurora or thunderstorms, or simply the unsettled state of the magnetic needle, indicating disturbed earth currents.

A great magnetic storm with displays of Aurora took place on the two nights, October 30th and 31st and November 1st. It was supposed to have originated in the sun, or at least to have had some connection with two large groups of sun spots then attracting attention. Telegraphic communication was generally interrupted, but in some instances lines were worked without battery power, as was the case between Montreal and Fort William Friday night. James Kent, Esq., of the C.P.R. Telegraph Company, gives me the information that trouble was first experienced about midnight on the Winnipeg circuits, rapidly extended

Eastward and South, lasted for over twelve hours, and retreated from South and East to West. The greatest disturbances centered North of Lake Superior.

As to the Aurora visible from Montreal, it was probably the most resplendent and extensive seen in the last fifty years.

The repetition of details, remarks, compass bearings, and other items, as I have them in my notes, would make somewhat monotonous reading, so I will confine my abstract to the principal points noticed, which seem to have a bearing on the peculiarities we have previously discussed. First, I had evidence to confirm the view that the body of the Aurora has a steady W. to E. "drift." During the early morning of October 31st I particularly observed patches of light exhibit a steady drift across the stars; also fields of red colored light and beams appeared in the W. and disappeared in the E., uniformly taking 15 minutes to pass from W. to E. The same drift was seen the following night in a less marked degree, the drift being a little slower and the opportunities to see it less frequent.

During the evening of the 31st the weather and clouds were changeable. These cloud changes came from the W., although the then cloud motion was from the N.W. by N. The suggestion is that the cloud changes were influenced by the electric conditions above passing W. to E. The Aurora light was not mixed up with the cloud at this time, but occurred in the intervals of clear weather.

Again on November 4th, at 20 minutes past five in the morning, I noticed a nebulous band lying from Orion's belt across to the Morning Star. It showed the filling and fading light of the Aurora, and one patch suggested the W. to E. "drift," but the exhibit was not long enough or distant enough to make sure.

On November 18th there was a bright display in rather peculiar weather, clearing up after rain and sleet. At the end of my notes that night I find this remark :—"Although bright and strong, the changes of light are quite rapid, and no distinct forms are retained ; for this reason I cannot say that there is any proper drift from W. to E." A slow drift, however, was not incompatible with the appearances as observed.

Cloud motions at variance with the surface winds were noted on October 31st and November 1st and 18th. There were no clouds to mark motion by on the morning of November 4th.

Of the great display of October 31st, between four and five o'clock in the morning the colors were magnificent. All the colors of the spectrum were to be seen. The reds and orange-lilac and violet shades predominated, but scarlet, a little green, purples, and even light browns were noticed. The reds hung together in rather large masses, as did the violets, lilacs, and whites. The reds all drifted W. to E., but the whites and blues sometimes succeeded to a climax of red, or crept back in little spurts and rushes from the Eastern edge to meet reds advancing from the W.

Both the white and colored climaxes, or pulses of light, rose out of the West. The colors began with rose red, about 3.40 a.m., and continued until dawn. Flat, even tints were the rule, rays or beams of exceptional length were one shade throughout, and would change tint as different colors rippled together; but after 5 o'clock, when things got a little mixed, a few lilac tinted beams exhibited orange and red butts, but they were probably two sets of short rays in the same line.

The light at the early morning climax was more diffused, but as bright, if not brighter, than moonlight. I could read pencil notes—and read small lettering on a tombstone at about 10 ft. distance. The following night (Hallowe'en), at 4 o'clock, I could hardly read the same lettering 6 in. from my nose.

During the first night very active and long beams (some of them with a visual angle of quite 30 degrees) and broken arches were the pronounced feature, while after midnight of the second night the nervous, fuming, fluttering light was most prevalent, and but few short and ill-defined beams were seen.

During the first night the set of the arches centred W. of N.; while the second night arches centred well E. of N. The difference was very noticeable. The W. to E. drift, however, was not apparently influenced by this change.

On Friday night I remarked a peculiar thing. From Fletcher's Field I seemed to be looking up at the legs of the arches resting on the misty horizon; while later, from the top of the mountain, I got the distinct impression of looking down on the lower ends of beams resting in the horizon mist. Whether it was some illusion of the night, the ground mist or light, I do not know, but the effect was to place the legs of the arches more in the middle foreground than past the horizon. This impression was not repeated the second night.

The arches that formed were not of uniform span, and several times volute forms and serried arches with broken echelon steps appeared, but changes of form and changes of phase to rippling beams would only be a matter of a moment or two. As to other forms, the corona was in evidence more or less all night, and twice for a brief moment the serpentine form which figures so largely in illustrations of Aurora was seen. It was evidently an accidental appearance, resulting from the disposition of long and short beams in several parallel arched fragments.

The brilliance and beauty of the display between four and five o'clock in the morning of the 31st was surpassingly grand. Much the finest display within my experience.

Book Notices.

The Department of the Interior has recently published in book form a " Dictionary of Altitudes in Canada," by Jas. White, Esq., F.R.G.S. The data are substantially the same as in this author's well known "Altitudes in Canada," but in the present issue places in each Province are arranged alphabetically, and the work makes a most convenient volume for reference. In the several columns are given the name of the station, its location, the elevation, and the source of the information. There is to be a relief map of the Dominion that will give a synoptic view of the broad features of the country, and will issue from the Press presently as provision is made for it.

The book will fill a distinct want on many bookshelves, and there should be a considerable demand for it, from the general public as well as professional and scientific men, to whom altitudes are a matter of frequent concern.

Mr. White is to be congratulated on the style, finish, and accuracy of his work.

C. J. S.

..., 1903.

... H. McLEOD, *Superintendent.*

DAY	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY.....	.00	....	.00	1..........SUNDAY
	....	....	....	2
	....	....	....	3
	....	....	....	4
	.33	2.1	.54	5
	....	....	....	6
	....	....	....	7
SUNDAY.....	....	0.0	.00	8..........SUNDAY
	....	....	....	9
	....	....	....	10
	....	....	....	11
	.05	....	.05	12
	.00	....	.00	13
	.06	0.2	.08	14
SUNDAY.....	....	0.2	.02	15..........SUNDAY
	.01	0.4	.05	16
	.37	0.1	.38	17
	....	0.0	.00	18
	....	0.3	.03	19
	....	0.3	.03	20
	....	0.0	.00	21
SUNDAY.....	....	0.1	.00	22..........SUNDAY
	.11	0.8	.19	23
	....	0.3	.05	24
	......	0.2	.02	25
	....	0.1	.01	26
	....	0.1	.01	27
	....	0.2	.02	28
SUNDAY.....	....	0.0	.00	29..........SUNDAY
	....	0.0	.00	30
Means......	0.93	5.4	1.46	.......Sums.........
29 Years me... for and incluc... this month..	2.28	13.33	3.64	29 Years means for and including this month.

...nd

Direction.... ...m

Miles ....00.

Duration in h...

Mean velocity ...he ...on

Greatest mile... ...2.3

Greatest velo... ...he

Resultant mi...

Highest barometer reading was 30.76 on the 21st; lowest barometer was 29.42 on the 24th, giving a range of 1.34 inches.

Minimum relative humidity observed, was 61 on the 6th.

Rain fell on 8 days.

Snow fell on 19 days.

Rain and snow on 5 days.

Lunar halos observed on 2 nights

Aurora was observed on 1 night.

Snow on ground in patches.

H Wind direction taken from City Hall records for first 25 days.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1903.

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 relative humidity.	WIND. General direction	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY....... 1	47.4	54.4	40.1	14.3	30.06	30.09	30.01	.08	80	S.W.	24.1	98	.00	....	.00	1..........SUNDAY
2	47.8	53.0	41.3	11.7	30.06	30.10	30.02	.08	78	S.W.	16.6	75	....	....	....	2
3	50.2	56.6	43.5	13.1	30.00	30.05	29.95	.10	80	S.W.	24.7	92	....	....	....	3
4	50.2	55.2	45.5	9.7	29.84	29.95	29.62	.33	88	S.W.	21.6	50	....	....	....	4
5	39.9	55.0	31.8	23.2	29.62	29.79	29.48	.31	84	N.E.	21.6	....	.33	2.1	.54	5
6	30.4	34.8	26.2	8.6	30.01	30.17	29.79	.38	66	N.W.	16.8	05	....	....	....	6
7	51.9	37.2	25.0	12.2	30.12	30.17	30.08	.09	80	N.W.	16.4	24	....	....	....	7
SUNDAY........ 8	38.6	42.0	32.7	9.3	30.13	30.17	30.08	.09	85	S.W.	18.2	....	....	0.0	.00	8..........SUNDAY
9	48.3	55.0	40.5	14.5	30.02	30.15	29.91	.24	83	S.W.	23.8	67	....	....	....	9
10	45.4	56.1	39.0	17.1	29.82	29.94	29.70	.24	75	S.W.	24.0	15	....	....	....	10
11	43.1	48.7	38.1	10.6	29.90	30.00	29.66	.34	90	S.W.	13.9	56	....	....	....	11
12	43.4	47.7	39.7	8.0	29.80	29.88	29.63	.25	73	S.W.	22.4	82	.05	....	.05	12
13	42.6	49.8	37.5	12.3	29.85	30.02	29.76	.26	68	S.W.	20.3	39	.00	....	.00	13
14	36.7	44.0	32.2	11.8	29.98	30.05	29.90	.15	76	S.W.	18.3	30	.06	0.2	.08	14
SUNDAY........15	31.2	34.8	28.0	6.8	30.11	30.20	29.96	.24	81	S.W.	16.2	12	....	0.2	.02	15..........SUNDAY
16	24.0	32.1	20.0	12.1	30.12	30.25	29.85	.40	83	N.E.	17.8	....	.01	0.4	.05	16
17	33.1	41.0	24.0	17.0	29.75	29.90	29.63	.27	84	N.W.	22.3	....	.37	0.1	.38	17
18	27.4	33.0	23.2	9.8	29.99	30.07	29.90	.17	83	N.W.	19.0	52	....	0.0	.00	18
19	24.2	27.6	19.1	8.5	30.25	30.40	30.07	.33	87	S.W.	13.1	77	....	0.3	.03	19
20	20.4	23.1	14.5	8.6	30.63	30.75	30.40	.35	87	W.	13.3	62	....	0.3	.03	20
21	20.7	28.0	12.0	16.0	30.64	30.76	30.44	.32	85	S.W.	11.2	58	....	0.0	.00	21
SUNDAY........22	29.5	34.3	20.8	13.5	30.22	30.44	30.10	.34	86	S.W.	9.1	09	....	0.1	.00	22..........SUNDAY
23	33.0	35.8	29.0	6.8	29.77	30.10	29.46	.64	93	N.W.	13.5	....	.11	0.8	.19	23
24	27.6	36.1	19.0	17.1	29.57	29.78	29.42	.36	89	S.W.	28.8	....	....	0.3	.05	24
25	17.5	21.1	14.0	7.1	29.92	29.99	29.78	.21	84	S.W.	27.5	65	......	0.2	.02	25
26	11.0	17.4	4.3	13.1	30.07	30.10	29.99	.11	89	S.W.	19.9	60	....	0.1	.01	26
27	15.6	19.0	12.6	6.4	30.07	30.11	30.03	.08	87	S.W.	12.6	33	....	0.1	.01	27
28	16.2	18.1	11.9	6.2	29.88	30.03	29.78	.25	87	N.W.	5.9	30	....	0.2	.02	28
SUNDAY........29	17.4	19.7	14.3	5.4	29.79	29.81	29.77	.04	89	N.W.	4.6	....	....	0.0	.00	29..........SUNDAY
30	17.9	22.0	13.7	8.3	29.94	30.11	29.81	.30	86	N.W.	7.1	...	....	0.0	.00	30
Means..........	32.09	37.75	26.45	11.30	29.999	30.11	29.86	.25	82.9	S.62° W	17.6	37	0.93	5.4	1.46	.......Sums.........
29 Years means for and including this month......	32.65	38.87	26.78	12.09	30.013	......	......	.27	80.5	.....	§ 14.1	¶ 29	2.28	13.33	3.64	29 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	416	908	111	55	465	7536	1995	1186	
Duration in hrs..	46	52	12	3	34	365	145	63	
Mean velocity....	9.0	17.5	9.3	18.3	13.7	20.7	13.8	18.8	

Greatest mileage in one hour was 45 on the 10th.
Greatest velocity in gusts was 60 on the 10th and 24th.
Resultant mileage, 8,350

Resultant direction, S. 62° W.
Total mileage, 12,672.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 17 years only.

The greatest heat was 56.6 above zero on the 3rd. The greatest cold was 4.3 above zero on the 26th, giving a range of temperature of 52.3 degrees.

Warmest day was the 4th. Coldest day was the 26th.

Highest barometer reading was 30.76 on the 21st; lowest barometer was 29.42 on the 24th, giving a range of 1.34 inches.

Minimum relative humidity observed, was 61 on the 6th.

Rain fell on 8 days.

Snow fell on 19 days.

Rain and snow on 5 days.

Lunar halos observed on 2 nights

Aurora was observed on 1 night.

Snow on ground in patches.

‖ Wind direction taken from City Hall records for first 25 days.

‹, 1903.

‹. H. McLEOD, *Superintendent.*

DAY	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	....	0.5	.05	1
	....	....	....	2
	....	....	....	3
	....	....	....	4
	....	1.6	.16	5
SUNDAY....	....	0.1	.01	6..........SUNDAY
	....	2.5	.25	7
	....	0.2	.02	8
	....	2.6	.26	9
	....	12.6	1.26	10
	....	0.6	.09	11
	....	0.7	.07	12
SUNDAY....	.04	0.0	.04	13..........SUNDAY
	....	....	....	14
	......	0.2	.02	15
	....	0.8	.05	16
	....	0.0	.00	17
	....	....	....	18
	....	....	....	19
SUNDAY....	.50	1.3	.63	20..........SUNDAY
	.02	0.3	.05	21
	....	0.2	.02	22
	....	2.7	.14	23
	.05	5.9	.64	24
	....	0.1	.01	25
	....	....	....	26
SUNDAY....	....	1.6	.19	27..........SUNDAY
	....	0.9	.09	28
	....	1.3	.13	29
	....	1.0	.09	30
	....	1.0	.05	31
Means......	.61	38.7	4.32	.......Sums.........
29 Years m‹ for and inclu‹ this month..	1.35	24.0	3.69	29 Years means for and including this month.

Direction...

Miles ......

Duration in ‹

Mean velocit‹

Greatest mile‹

Greatest velo‹

Resultant mi‹

Highest barometer reading was 30.60 on the 19th; lowest barometer was 29.11 on the 21st, giving a range of 1.49 inches.

Minimum relative humidity observed, was 53 on the 13th and 28th.

Rain fell on 4 days.

Snow fell on 24 days.

Rain and snow on 4 days.

Lunar halos observed on 1 night.

No. of inches of snow on ground, 15.5.

ABSTRACT FOR THE MONTH OF DECEMBER, 1903.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	20.1	28.2	16.2	12.0	30.22	30.35	30.13	.22	87	S.W.	10.2	18	....	0.5	.05	1
2	17.7	22.6	14.2	8.4	30.36	30.41	30.28	.13	91	N.E.	11.8	34	....	....	....	2
3	20.9	25.7	15.9	9.8	30.24	30.28	30.18	.10	92	N.E.	18.5	50	....	....	....	3
4	25.0	27.0	22.1	4.9	30.11	30.18	30.07	.11	87	N.E.	9.5	....	....	....	....	4
5	27.7	32.2	25.5	6.7	29.98	30.07	29.92	.15	94	S.W.	13.5	....	....	1.6	.16	5
SUNDAY........ 6	25.3	28.8	23.0	5.8	29.94	30.00	29.87	.13	91	W.	15.3	04	....	0.1	.01	6..........SUNDAY
7	22.6	29.0	17.3	11.7	29.87	29.92	29.81	.11	93	N.E.	9.0	....	....	2.5	.25	7
8	16.2	20.9	10.0	10.9	30.05	30.16	29.87	.29	87	W.	9.0	33	....	0.2	.02	8
9	13.5	19.9	8.5	11.4	29.99	30.18	29.54	.64	88	N.E.	19.8	....	....	2.6	.26	9
10	20.4	24.0	16.2	7.8	29.35	29.60	29.20	.40	93	W.	26.1	....	....	12.6	1.26	10
11	18.2	26.8	8.2	18.6	29.82	29.93	29.60	.33	87	S.W.	21.8	40	....	0.6	.09	11
12	23.4	30.9	16.2	14.7	30.09	30.26	29.85	.41	95	S.W.	17.2	13	....	0.7	.07	12
SUNDAY....... 13	24.7	36.9	10.9	26.0	29.75	29.99	29.50	.49	70	S.W.	28.4	40	.04	0.0	.04	13...........SUNDAY
14	4.8	13.9	—1.7	15.6	30.20	30.32	29.99	.33	68	N.W.	23.5	68	....	....	....	14
15	3.2	14.2	—6.7	20.9	30.09	30.32	29.94	.38	77	N.W.	22.7	16	......	0.2	.02	15
16	8.2	16.6	—0.8	17.4	29.84	29.99	29.77	.22	83	N.W.	20.7	....	....	0.8	.05	16
17	3.9	9.0	—3.6	12.6	29.99	30.14	29.89	.25	82	N.W.	23.4	....	....	0.0	.00	17
18	3.4	9.2	—0.7	9.9	30.43	30.55	30.14	.41	67	N.W.	20.4	89	....	....	....	18
19	5.6	14.0	—2.2	16.2	30.43	30.60	30.12	.48	74	S.E.	15.5	....	....	....	....	19
SUNDAY........20	22.9	35.9	5.3	30.6	29.59	30.12	29.12	1.00	96	S.E.	13.0	....	.50	1.3	.63	20...........SUNDAY
21	26.5	35.8	22.0	13.8	29.46	29.62	29.11	.51	87	S.W.	25.5	47	.02	0.3	.05	21
22	18.5	35.0	4.0	31.0	29.69	30.06	29.34	.72	78	N.W.	31.2	67	....	0.2	.02	22
23	21.8	32.0	5.8	26.2	29.95	30.07	29.88	.19	91	S.W.	24.8	....	....	2.7	.14	23
24	27.9	34.3	23.9	10.4	29.80	30.01	29.45	.56	94	S.W.	14.8	....	.05	5.9	.64	24
25	22.6	35.0	11.0	24.0	29.56	29.64	29.41	.23	80	N.W.	18.7	17	....	0.1	.01	25
26	—4.5	11.0	—13.6	24.6	29.78	29.94	29.63	.31	80	N.W.	19.7	21	....	....	....	26
SUNDAY........27	—7.6	—0.6	—16.3	15.7	29.70	29.94	29.52	.42	71	N.E.	11.8	....	....	1.6	.19	27...........SUNDAY
28	—8.4	2.7	—14.6	17.3	30.03	30.28	29.54	.74	65	W.	26.4	47	....	0.9	.09	28
29	—4.9	3.4	—14.9	18.3	30.17	30.28	30.02	.26	78	N.E.	14.2	....	....	1.3	.13	29
30	4.6	7.7	—0.5	8.2	30.00	30.04	29.96	.08	79	N.W.	17.5	01	....	1.0	.09	30
31	10.0	17.2	0.5	16.7	29.86	29.98	29.78	.20	83	S.W.	18.5	....	....	1.0	.05	31
Means......	14.03	21.9	6.5	15.4	29.946	30.10	29.75	.35	83.5	N. 85° W	18.5	20	.61	38.7	4.32	.......Sums.........
29 Years means for and including this month......	18.93	26.0	11.8	14.1	30.028	......	......	.30	83.3	......	§ 16.1	¶ 26	1.35	24.0	3.69	29 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	758	1679	497	344	1262	1141	6712	1336	
Duration in hrs..	62	106	44	26	84	46	312	64	
Mean velocity....	12.2	15.8	11.3	13.2	15.0	24.8	21.1	20.9	

Greatest mileage in one hour was 47 on the 13th.
Greatest velocity in gusts was 72 on the 13th.
Resultant mileage, 6,561

Resultant direction, N. 85° W.
Total mileage, 13,729.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 17 years only.

The greatest heat was 36.9 above zero on the 13th. The greatest cold was 16.3 below zero on the 27th, giving a range of temperature of 53.2 degrees.

Warmest day was the 24th. Coldest day was the 28th.

Highest barometer reading was 30.60 on the 19th; lowest barometer was 29.11 on the 21st, giving a range of 1.49 inches.

Minimum relative humidity observed, was 53 on the 13th and 28th.

Rain fell on 4 days.

Snow fell on 24 days.

Rain and snow on 4 days.

Lunar halos observed on 1 night.

No. of inches of snow on ground, 15.5.

903.

Observation 45° 30′ 17″. Longitude $4^h\ 54^m\ 18^s{\cdot}67^s$ W.

C. H. McLEOD, *Superintendent.*

Month.	ECIPITATION. Number of days on which snow fell.	Inches of rain and melted snow.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.	Month.
January	20	4.08	2	24	January
February	12	5.28	1	15	February
March	7	3.49	1	19	March
April	3	2.22	1	8	April
May	..	0.11	..	9	May
June	..	4.76	..	17	June
July	..	2.87	..	17	July
August	..	3.17	..	13	August
September	..	1.27	..	11	September
October	4	3.71	3	18	October
November	19	1.46	5	22	November
December	24	4.32	4	24	December
Sums for 1903	89	36.74	17	197	Sums for 1903
Means for 1903	..	3.06	..	..	Means for 1903
Means for 29 years e Dec. 31, 1903	..	40.96	..	..	Means for 29 years ending Dec. 31, 1903

* Barometer re from self-recording instruments, beginning 1 h. 0 m. Eastern Standard time. ¶ " y relative, saturation being 100; the humidity means are derived from observ al, 54 feet above the ground and 807 feet above sea level. *h* For 340½ days only

The greatest h herefore, 108.0°. Greatest thermometer range in one day was 41.7° on May 1; lea as Jan. 19th, when the mean temperature was 10.2° below zero. The minimum test velocity in gusts was at the rate of 72 miles per hour on Feb. 28, April 30, Ma age 38268. Lunar halos were observed on 5 nights. Auroras were observed on 6 n

Fog on 9 days; ll of the autumn was on Oct. 26th. The first trace of snow was on Oct. 18th.

Note.—The ye

Meteorological Abstract for the Year 1903.

Observations made at McGill College Observatory, Montreal, Canada.—Height above sea level 187 ft. Latitude N. 45° 30′ 17″. Longitude $4^h\ 54^m\ 18^s{\cdot}67^s$ W.

C. H. McLEOD, *Superintendent.*

Month.	Thermometer. † Mean.	Thermometer. ¶ Deviation from 29 years, means.	Thermometer. Max.	Thermometer. Min.	Thermometer. Mean daily range.	* Barometer. † Mean.	Barometer. Max.	Barometer. Min.	Barometer. Mean daily range.	‡ Mean relative humidity.	Wind. Resultant direction.	Wind. Mean velocity in miles per hour.	Per cent. possible sunshine.	Precipitation. Inches of rain.	Precipitation. Number of days on which rain (or sleet) fell.	Precipitation. Inches of snow.	Precipitation. Number of days on which snow fell.	Precipitation. Inches of rain and melted snow.	Precipitation. No. of days on which rain *and* snow fell.	Precipitation. No. of days on which rain *or* snow fell.	Month.
January	14.61	+ 2.17	38.6	−20.0	16.2	29.898	30.59	29.11	.35	81.3	N. 77° W.	10.3	27.3	0.64	6	33.5	20	4.08	2	24	January
February	18.86	+ 3.13	46.5	−11.8	13.7	29.962	30.41	28.97	.39	81.2	S. 37° W.	18 4	32.7	2.16	4	26.2	12	5.28	1	15	February
March	34 15	+ 9.15	62.0	− 0.6	13.6	30.188	30.71	29 38	.28	80.7	S. 64° W.	16.7	34.0	3.19	13	3.1	7	3.49	1	19	March
April	44.06	+ 3.22	82.2	12.8	18.2	29.895	30 48	29.34	.21	63.8	N. 51° W.	15.8	43.0	1.61	6	4.3	3	2.22	1	8	April
May	57.79	+ 3.02	84.8	27.9	24.2	30.097	30.52	29.58	.20	59.7	S. 46° W.	14.4	63.5	0.11	9	....	..	0.11	..	9	May
June	62.90	− 1.83	84.2	46.5	16 8	29.931	30.38	29.58	.12	70.5	S. 1° E.	11.8	38.0	4.76	17	....	..	4.76	..	17	June
July	67.72	− 1.08	88.0	54.0	14.9	29.847	30 16	29.46	.14	73 1	N. 84° W.	12.6	56.0	2.87	17	...	..	2.87	..	17	July
August	62.00	− 4.55	80.2	43.3	14.9	29.969	30.43	29.45	.11	74.3	N. 87° W.	10.3	47.1	3.17	13	....	..	3.17	..	13	August
September	59 99	+ 1.36	83.0	39.6	16.3	30.062	30.43	29.48	.20	72.3	S. 32° E.	13.1	64.0	1.27	11	....	..	1.27	..	11	September
October	48.58	+ 2.59	66.8	25.2	14.7	29.995	30.41	29.42	.23	74.6	S. 8° W.	16.4	38.4	3.56	17	1.5	4	3.71	3	18	October
November	32.09	− 0.56	56.6	4.3	11.3	29.999	30.76	29.42	.25	82.9	S. 62° W.	17.6	36.6	0.93	8	5.4	19	1.46	5	22	November
December	14.03	− 4.90	36.9	−16.3	15.4	29.946	30.60	29.11	.35	83.5	N. 85° W.	18.5	19.8	0.61	4	38.7	24	4.32	4	24	December
Sums for 1903	516.78	....	....	....	....	...	....	....	....	....	....	....	....	24.88	125	112.7	89	36.74	17	197	Sums for 1903
Means for 1903	43.07	+ 0.98	....	....	15.9	29.982	....	....	.24	74.8	S. 62° W.	14.7	41.7	....	....	....	..	3.06	..	..	Means for 1903
Means for 29 years ending Dec. 31, 1903	42.09	....	...	....	...	29.979	....	....	....	75.5	....	a14.8	§45.3	28.93	....	120.3	..	40.96	..	..	Means for 29 years ending Dec. 31, 1903

* Barometer readings reduced to 32° Fah. and to sea level. † The monthly thermometer and barometer means are derived from bi-hourly readings taken from self-recording instruments, beginning 1 h. 0 m. Eastern Standard time. ¶ "+" indicates that the temperature has been *higher*: "—" that it has been *lower* than the average for 29 years inclusive of 1903. ‡ Humidity relative, saturation being 100; the humidity means are derived from observations made at 8 *h*, 15 *h* and 20 *h*. § For 22 years only. *a* For 17 years only. The anemometer and wind vane are on the summit of Mount Royal, 54 feet above the ground and 807 feet above sea level. *h* For 340½ days only.

The greatest heat was 88.0° (Fah.) above zero on July 9th; the greatest cold was 20.0 below zero on Jan. 19th. The extreme range of temperature was, therefore, 108.0°. Greatest thermometer range in one day was 41.7° on May 1; least range was 3.9° on March 5th. The warmest day was July 10th, when the mean temperature was 79.7° above zero. The coldest day was Jan. 19th, when the mean temperature was 10.2° below zero. The minimum relative humidity observed was 20 on June 4th. The greatest mileage of wind recorded in one hour was 55 on Feb. 28th, and the greatest velocity in gusts was at the rate of 72 miles per hour on Feb. 28, April 30, May 1 and Dec. 13. The total mileage of wind was 119,935 *h*. The resultant direction of the wind for the year was S. 62° W., and the resultant mileage 38268. Lunar halos were observed on 5 nights. Auroras were observed on 6 nights.

Fog on 9 days; thunderstorms on 12 days; total number of thunderstorms 14. First sleighing of winter in city was on Dec. 6th. The first appreciable snowfall of the autumn was on Oct. 26th. The first trace of snow was on Oct. 18th.

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

1904.

, H. McLEOD, *Superintendent.*

DAY	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	....	0.2	.05	1
	....	0.3	.03	2
SUNDAY....	....	0.0	.00	3...........SUNDAY
	....	....	....	4
	....	....	....	5
	....	0.5	.03	6
	....	0.1	.01	7
	....	0.5	.03	8
	....	2.4	.19	9
SUNDAY....	....	0.8	.09	10...........SUNDAY
	....	0.0	.00	11
	....	....	....	12
	....	5.9	.57	13
	....	9.3	.93	14
	......	....	....	15
	....	3.2	.27	16
SUNDAY....	....	0.7	.06	17...........SUNDAY
	....	....	....	18
	....	....	....	19
	....	0.4	.05	20
	....	....	....	21
	....	3.7	.47	22
	....	0.0	.00	23
SUNDAY....	....	1.0	.03	24...........SUNDAY
	....	....	....	25
	....	4.6	.46	26
	....	1.5	.15	27
	....	....	....	28
	....	....	....	29
	....	0.2	.01	30
SUNDAY....	....	3.0	.22	31...........SUNDAY
Means.....	....	38.3	3.65	.......Sums.........
30 Years m for and incl this month	....	30.3	3.71	30 Years means for and including this month.

Direction..

Miles .....

Duration in

Mean veloc

Greatest mi

Greatest ve

Resultant m

Highest barometer reading was 30.96 on the 19th ; lowest barometer was 29.21 on the 14th, giving a range of 1.75 inches.

Minimum relative humidity observed, was 30 on the 4th.

Snow fell on 21 days.

No. of inches of snow on ground at end of month, 28.5.

ABSTRACT FOR THE MONTH OF JANUARY, 1904.

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

DAY	THERMOMETER. † Mean.	THERMOMETER. Max.	THERMOMETER. Min.	THERMOMETER. Range.	* BAROMETER. † Mean.	* BAROMETER. Max.	* BAROMETER. Min.	* BAROMETER. Range.	‡ Mean relative humidity.	WIND. General direction.	WIND. Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	6.3	22.0	—11.0	33.0	29.93	30.23	29.70	.53	82	N.W.	20.1	....	....	0.2	.05	1
2	—11.7	—6.3	—15.0	8.7	30.21	30.28	30.10	.18	56	N.E.	9.0	....	....	0.3	.03	2
SUNDAY........ 3	—9.5	—7.2	—11.8	4.6	30.11	30.17	30.05	.12	64	W.	20.2	63	....	0.0	.00	3............SUNDAY
4	—14.6	—8.4	—20.7	12.3	30.41	30.54	30.11	.43	39	S.W.	32.0	63	....	....	....	4
5	—5.7	1.1	—14.7	15.8	30.51	30.59	30.38	.21	67	S.W.	24.1	44	....	....	....	5
6	9.6	17.9	—1.0	18.9	30.12	30.38	29.97	.41	88	S.W.	17.5	....	....	0.5	.03	6
7	18.9	23.0	12.2	10.8	29.94	29.97	29.89	.08	94	S.W.	8.0	....	....	0.1	.01	7
8	22.7	28.6	12.2	16.4	29.69	29.89	29.60	.29	92	S.E	16.9	....	....	0.5	.03	8
9	23.3	28.0	19.0	9.0	29.61	29.65	29.56	.09	89	N.E.	16.5	....	....	2.4	.19	9
SUNDAY....... 10	21.7	27.0	16.0	11.0	29.75	29.89	29.63	.26	86	N.W.	20.6	01	....	0.8	.09	10............SUNDAY
11	14.6	17.4	6.1	11.3	30.07	30.16	29.89	.27	91	W.	6.0	09	....	0.0	.00	11
12	10.7	21.0	3.6	17.4	30.21	30.26	30.16	.10	89	S.E.	9.3	17	....	....	....	12
13	27.2	30.4	15.8	14.6	29.95	30.16	29.61	.55	96	S.E.	16.8	....	....	5.9	.57	13
14	27.6	30.0	20.4	9.6	29.30	29.61	29.21	.40	93	W.	23.4	....	....	9.3	.93	14
15	7.2	23.8	2.3	21.5	29.89	30.12	29.51	.61	81	W.	29.7	51	......	....	....	15
16	7.5	15.5	—1.2	16.7	29.82	30.13	29.51	.62	88	N.W.	8.3	....	....	3.2	.27	16
SUNDAY........17	8.8	12.7	—1.0	13.7	30.01	30.35	29.52	.83	68	N.W.	20.0	22	....	0.7	.06	17............SUNDAY
18	—7.9	2.0	—13.9	15.9	30.65	30.86	30.35	.51	53	N.W.	11.7	64	....	....	....	18
19	—10.8	—5.0	—16.8	11.8	30.84	30.96	30.55	.41	62	N..E	8.8	03	....	....	....	19
20	6.7	14.8	—11.4	26.2	30.22	30.55	30.15	.40	90	N.W.	9.6	....	....	0.4	.05	20
21	5.5	14.4	—0.8	15.2	30.28	30.35	30.16	.19	72	N.E.	15.0	....	....	....	....	21
22	8.2	18.9	—2.0	20.9	29.90	30.29	29.56	.73	85	N.E.	17.9	....	....	3.7	.47	22
23	28.0	34.5	10.2	24.3	29.78	29.91	29.55	.36	87	S.W.	17.6	02	....	0.0	.00	23
SUNDAY........24	19.2	29.0	5.6	23.4	29.88	29.96	29.84	.12	76	S.W.	26.1	54	....	1.0	.03	24............SUNDAY
25	3.3	9.8	—1.0	10.8	30.26	30.41	29.96	.45	74	W.	25.5	88	....	....	....	25
26	—0.3	7.0	—6.5	13.5	30.27	30.47	29.92	.55	73	N.E.	15.8	....	....	4.6	.46	26
27	3.4	7.8	—2.2	10.0	30.11	30.43	29.82	.61	82	W.	24.5	51	....	1.5	.15	27
28	0.6	7.0	—7.7	14.7	30.48	30.55	30.43	.12	68	S.W.	13.4	28	....	....	....	28
29	0.4	7.0	—6.2	13.2	30.32	30.45	30.18	.27	72	N.E.	5.6	....	....	....	....	29
30	6.6	15.0	—2.3	17.3	30.09	30.18	29.98	.20	82	S.W.	9.6	....	....	0.2	.01	30
SUNDAY........31	25.7	28.9	6.4	22.5	29.80	29.98	29.59	.39	91	N.W.	16.5	....	....	3.0	.22	31............SUNDAY
Means......	8.17	15.08	—0.56	15.64	30.077	30.25	29.89	.36	78.4	West	16.66	17.8	....	38.3	3.65	.......Sums.........
30 Years means for and including this month......	12.29	20.58	4.34	16.24	30.047	......	......	.34	82.3	......	§ 16.27	¶ 33.7	....	30.3	3.71	30 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	495	2030	303	859	614	2722	3677	1692	
Duration in hrs..	39	146	30	63	50	131	180	105	
Mean velocity....	12.7	13.9	10.1	13.7	12.3	20.8	20.4	16.1	

Greatest mileage in one hour was 41 on the 15th.
Greatest velocity in gusts was 60 on the 15th.
Resultant mileage, 4,452.

Resultant direction, West.
Total mileage, 12,392.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

The greatest heat was 34.5 above zero on the 23rd. The greatest cold was 20.7 below zero on the 4th, giving a range of temperature of 55.2 degrees.

Warmest day was the 23rd. Coldest day was the 4th.

Highest barometer reading was 30.96 on the 19th; lowest barometer was 29.21 on the 14th, giving a range of 1.75 inches.

Minimum relative humidity observed, was 30 on the 4th.

Snow fell on 21 days.

No. of inches of snow on ground at end of month, 28.5.

ABSTRAC

Meteorological Observations, McG

DAY	THERMOMETER.			AY.	
	† Mean.	Max.	Min.	Rar	
1	12.8	29.0	—9.2	38	
2	—12.5	0.7	—18.7	19	
3	—4.0	2.6	—11.7	14	
4	3.2	6.0	—2.8	8	
5	—1.4	6.0	—6.4	12	
6	—1.0	7.0	—8.7	15	
SUNDAY........ 7	8.7	10.2	4.2	6	....SUNDAY
8	—1.9	13.3	—9.4	22	
9	—10.1	—4.0	—18.7	14	
10	—3.1	2.5	—12.1	14	
11	2.6	5.5	—3.3	8	
12	6.4	10.0	1.4	8	
13	8.5	14.4	2.1	12	
SUNDAY....... 14	12.7	24.0	0.3	23	....SUNDAY
15	15.7	25.7	5.7	20	
16	—0.5	9.0	—2.9	11	
17	—1.5	1.7	—6.7	8	
18	2.5	7.0	—5.7	12	
19	10.8	17.3	3.5	13	
20	13.2	17.9	7.4	1c	
SUNDAY........21	20.3	34.6	4.3	3c	....SUNDAY
22	32.5	38.0	24.0	14	
23	20.6	28.0	12.9	1[illegible]	
24	10.9	19 6	2.4	1[illegible]	
25	9.6	15.8	2.7	1[illegible]	
26	5.8	10.2	0.5	[illegible]	
27	5.5	14.3	—7.4	21	
SUNDAY........28	26.8	31.8	8.6	2[illegible]	....SUNDAY
29	16.5	32.0	10.0	2[illegible]	
Means............	7.23	14.83	—1.16	15	ıms ....
30 Years means for and including this month......	15.45	23.51	7.46	15	Years means ıd including ›nth.

ANALYSIS OF WIN

30.61 on the
29.31 on the

Direction........	N.	N.E.	E.	S.E.	S
Miles	693	1539	315	570	19
Duration in hrs..	52	85	36	50	1
Mean velocity....	13.3	18.1	8.8	11.4	12

ırved, was 33

on 20 days.

ıd at end of

Greatest mileage in one hour was 56 on the 16th.
Greatest velocity in gusts was 72 on the 16th.
Resultant mileage, 6,718.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1904.

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

DAY	THERMOMETER.				* BAROMETER.				‡Mean relative humid-ity.	WIND.		Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour.					
1	12.8	29.0	—9.2	38.2	29.60	29.88	29.46	.42	83	N.W.	18.1	....	....	.8	.08	1
2	—12.5	0.7	—18.7	19.4	30.00	30.16	29.76	.40	50	N.E.	16.9	....	....	.3	.03	2
3	—4.0	2.6	—11.7	14.3	30.00	30.13	29.73	.40	63	S.W.	20.4	61	....	.6	.06	3
4	3.2	6.0	—2.8	8.8	30.07	30.16	29.96	.20	65	S.W.	23.0	52	....	.3	.03	4
5	—1.4	6.0	—6.4	12.4	30.16	30.24	29.96	.28	61	N.W.	16.8	78	...	.0	.00	5
6	—1.0	7.0	—8.7	15.7	29.91	30.18	29.78	.40	76	N.E.	16.3	....	....	2.9	.29	6
SUNDAY........ 7	8.7	10.2	4.2	6.0	29.55	29.79	29.31	.48	91	N.E.	16.1	....	....	2.9	.65	7............SUNDAY
8	—1.9	13.3	—9.4	22.7	30.06	30.40	29.48	.92	66	N.W.	28.0	76	....	1.5	.09	8
9	—10.1	—4.0	—18.7	14.7	30.47	30.51	30.40	.11	51	N.W.	23.5	76	....	....	....	9
10	—3.1	2.5	—12.1	14.6	30.52	30.58	30.48	.10	56	W.	31.2	70	....	....	....	10
11	2.6	5.5	—3.3	8.8	30.49	30.52	30.46	.06	71	S.W.	10.6	....	....	....	....	11
12	6.4	10.0	1.4	8.6	30.45	30.49	30.43	.06	79	S.E.	4.6	....	....	.0	.00	12
13	8.5	14.4	2.1	12.3	30.48	30.55	30.39	.16	80	N.E.	6.5	32	....	.....	....	13
SUNDAY....... 14	12.7	24.0	0.3	23.7	30.06	30.39	29.73	.66	89	S.E.	15.0	....	....	3.0	.20	14...........SUNDAY
15	15.7	25.7	5.7	20.0	29.71	29.73	29.67	.06	80	S.W.	28.0	19	......	1.8	.11	15
16	—0.5	9.0	—2.9	11.9	29.81	29.97	29.73	.24	77	W.	39.1	14	....	.3	.03	16
17	—1.5	1.7	—6.7	8.4	30.19	30.37	29.97	.40	63	W.	33.6	83	....	.0	.00	17
18	2.5	7.0	—5.7	12.7	30.48	30.55	30.37	.18	70	S.W.	9.5	74	....	....	....	18
19	10.8	17.3	3.5	13.8	30.32	30.42	30.25	.17	83	N.W.	8.3	11	....	.3	.03	19
20	13.2	17.9	7.4	10.5	30.53	30.61	30.38	.23	80	N.W.	21.5	87	....	....	....	20
SUNDAY........21	20.3	34.6	4.3	30.3	30.31	30.61	29.85	.76	90	S.W.	17.5	33	.04	.0	.04	21...........SUNDAY
22	32.5	38.0	24.0	14.0	29.55	29.85	29.41	.44	84	S.W.	30.8	....	.22	.0	.22	22
23	20.6	28.0	12.9	15.1	29.69	29.76	29.57	.19	89	S.W.	18.8	....	....	3.1	.21	23
24	10.9	19.6	2.4	17.2	29.72	29.80	29.66	.14	78	N.W.	17.4	....	....	.9	.07	24
25	9.6	15.8	2.7	13.1	29.88	30.23	29.64	.59	78	S.W.	24.9	15	....	.8	.08	25
26	5.8	10.2	0.5	9.7	30.36	30.41	30.23	.18	82	S.W.	11.0	87	....	....	....	26
27	5.5	14.3	—7.4	21.7	30.48	30.54	30.38	.16	83	N.E.	10.7	81	....	....	....	27
SUNDAY........28	26.8	31.8	8.6	23.2	30.05	30.38	29.92	.46	90	S.W.	19.7	....	.09	2.0	.29	28...........SUNDAY
29	16.5	32.0	10.0	22.0	30.39	30.51	30.15	.36	79	N.E.	20.3	21	....	....	....	29
Means............	7.23	14.83	—1.16	15.99	30.114	30.27	29.95	.32	75.4	S 83° W.	19.26	24.8	.35	21.5	2.51	.......Sums.........
30 Years means for and including this month......	15.45	23.51	7.46	15.79	30.012	......	......	.31	80.6	......	§ 18.29	¶ 40.5	.80	23.5	3.14	30 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	693	1539	315	570	198	4176	4571	1342	
Duration in hrs..	52	85	36	50	16	200	188	68	1
Mean velocity....	13.3	18.1	8.8	11.4	12.4	20.9	24.3	19.7	

Greatest mileage in one hour was 56 on the 16th.
Greatest velocity in gusts was 72 on the 16th.
Resultant mileage, 6,718.

Resultant direction, S. 83° W.
Total mileage, 13,404.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 17 years only.

The greatest heat was 38.0 above zero on the 22nd. The greatest cold was 18.7 below zero on the 2nd and 9th, giving a range of temperature of 56.7°.

Warmest day was the 22nd. Coldest day was the 2nd.

Highest barometer reading was 30.61 on the 20th and 21st; lowest barometer was 29.31 on the 7th, giving a range of 1.30 inches.

Minimum relative humidity observed, was 33 on the 2nd.

Rain fell on 3 days. Snow fell on 20 days. Rain and snow on 3 days.

No. of inches of snow on ground at end of month, 31.5.

H, 1904.

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

	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	....	....	9.0	.86	1
	10	....	.4	.04	2
	....	.09	.1	.10	3
	87	....	....	....	4
	16	....	....	....	5
SUND	18	....	.0	.00	6..........SUNDAY
	....	1.16	2.0	1.36	7
	....	.09	.2	.11	8
	41	....	.0	.00	9
	77	....	.0	.00	10
	33	....	....	....	11
	57	....	.1	.01	12
SUND	28	....	.2	.03	13..........SUNDAY
	71	......	....	....	14
	....	....	.4	.04	15
	68	....	....	....	16
	77	....	....	....	17
	....	....	2.2	.27	18
	42	....	1.3	.13	19
SUND	25	....	....	....	20..........SUNDAY
	79	....	....	....	21
	....	.36	....	.36	22
	83	.01	....	.01	23
	83	....	....	....	24
	14	.09	....	.09	25
	....	.60	0.0	.60	26
SUND	62	....	....	....	27..........SUNDAY
	55	....	....	....	28
	87	....	....	....	29
	....	....	....	....	30
	57	....	....	....	31
Mean	38.8	2.40	15.9	4.01	.......Sums.........
30 Y for an this m	¶ 45.1	1.42	22.9	3.88	30 Years means for and including this month.

level and	Highest barometer reading was 30.94 on the 5th; lowest barometer was 29.14 on the 3rd, giving a range of 1.80 inches.
Direc on from	
Miles eing 100. urs.	Minimum relative humidity observed, was 54 on the 10th.
Durat	Rain fell on 7 days. Snow fell on 14 days. Rain and snow on 4 days.
Mean o on the zero on	No. of inches of snow on ground at end of month, 9 inches.
Great f 49.6° Great y was the Resul	The average temperature for the four months ending March 31st, was 13°.5, which is the coldest since the winter of 1884-85, and 10°.5 below normal.

ABSTRACT FOR THE MONTH OF MARCH, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	24.1	30.9	14.3	16.6	30.13	30.27	30.03	.24	93	S.W.	23.0	....	....	9.0	.86	1
2	32.3	38.8	25.0	13.8	30.10	30.17	29.91	.26	87	S.W.	16.8	10	....	.4	.04	2
3	29.5	39.1	5.0	34.1	29.50	29.91	29.14	.77	94	S.W.	32.3	....	.09	.1	.10	3
4	4.1	13.0	—2.9	15.9	30.38	30.73	29.77	.96	81	S.W.	22.0	87	....	....	....	4
5	8.4	18.9	—5.4	24.3	30.81	30.94	30.66	.28	86	N.E.	9.2	16	....	....	....	5
SUNDAY........ 6	26.3	32.4	12.8	19.6	30.51	30.66	30.35	.31	83	W.	15.5	18	....	.0	.00	6..........SUNDAY
7	35.3	38.5	30.0	8.5	29.94	30.35	29.53	.82	94	S.E.	16.2	....	1.16	2.0	1.36	7
8	35.5	39.1	32.9	6.2	29.52	29.56	29.48	.08	91	W.	26.8	....	.09	.2	.11	8
9	18.8	34.3	6.1	28.2	29.75	30.05	29.51	.54	77	S.W.	29.8	41	....	.0	.00	9
10	6.8	21.8	—0.4	12.2	30.15	30.24	30.05	.19	73	S.W.	19.5	77	....	.0	.00	10
11	11.2	15.6	5.4	10.2	29.96	30.08	29.85	.23	85	N.E.	10.4	33	....	....	....	11
12	11.0	15.0	3.5	11.5	29.83	29.90	29.77	.13	88	W.	20.2	57	....	.1	.01	12
SUNDAY....... 13	17.7	24.3	10.5	13.8	29.90	30.02	29.77	.25	83	N.W.	17.9	28	....	.2	.03	13..........SUNDAY
14	23.1	29.4	13.7	15.7	30.00	30.05	29.94	.11	87	N.W.	9.0	71	......	....	....	14
15	24.7	29.9	12.6	17.3	29.86	29.94	29.81	.13	85	N.E.	13.3	....	....	.4	.04	15
16	19.5	28.7	12.8	15.9	30.11	30.33	29.86	.47	85	N.W.	20.2	68	....	....	....	16
17	18.5	24.9	12.8	12.1	30.36	30.46	30.21	.25	69	N.W.	12.5	77	....	....	....	17
18	19.6	24.5	13.0	11.5	29.89	30.21	29.71	.50	93	N.W.	10.2	....	....	2.2	.27	18
19	30.5	36.2	23.0	13.2	29.78	29.86	29.35	.31	79	S.W.	18.3	42	....	1.3	.13	19
SUNDAY........20	33.1	36.2	24.1	12.1	29.83	30.28	29.51	.77	71	N.W.	28.3	25	....	....	....	20..........SUNDAY
21	22.2	30.0	16.0	14.0	30.46	30.54	30.28	.26	90	N.E.	10.7	79	....	....	....	21
22	32.8	36.7	21.1	15.6	29.97	30.41	29.74	.67	87	S.E.	19.5	....	.36	....	.36	22
23	36.8	39.8	33.7	6.1	30.04	30.28	29.74	.54	74	S.W.	26.2	83	.01	....	.01	23
24	34.4	40.5	28.1	12.4	30.47	30.59	30.28	.31	69	S.W.	15.4	83	....	....	....	24
25	39.8	42.9	34.6	8.3	29.99	30.36	29.70	.66	84	S.W.	22.6	14	.09	....	.09	25
26	37.2	44.2	25.3	18.9	29.64	29.99	29.44	.55	81	N.W.	24.7	....	.60	0.0	.60	26
SUNDAY........27	17.6	32.6	12.0	20.6	30.12	30.18	29.99	.19	80	N.E.	10.7	62	....	....	....	27..........SUNDAY
28	22.2	28.2	14.5	13.7	30.17	30.21	30.14	.07	84	S.W.	6.3	55	....	....	....	28
29	25.8	31.5	19.0	12.5	30.23	30.27	30.17	.10	82	S.W.	14.2	87	....	....	....	29
30	34.5	42.1	26.7	15.4	30.26	30.30	30.22	.08	73	S.	10.7	....	....	....	....	30
31	34.8	40.1	30.7	9.4	30.29	30.34	30.25	.09	82	N.E.	11.0	57	....	....	....	31
Means............	24.78	31.3	16.5	14.8	30.062	30.24	29.88	.36	82.9	S 69° W.	17.5	38.8	2.40	15.9	4.01	.......Sums.........
30 Years means for and including this month......	24.99	32.1	17.6	14.5	29.981	......	......	.28	77.5	......	§ 17.6	¶ 45.1	1.42	22.9	3.88	30 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	571	846	435	453	1619	4228	2696	2188	
Duration in hrs..	59	67	44	26	97	196	142	112	1
Mean velocity....	9.7	12.6	9.9	17.4	16.7	21.6	19.0	19.5	

Greatest mileage in one hour was 50 on the 3rd.
Greatest velocity in gusts was 72 on the 3rd.
Resultant mileage, 6,281.

Resultant direction, S. 69° W.
Total mileage, 13,036.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 17 years only.

The greatest heat was 44.2 above zero on the 26th. The greatest cold was 5.4 below zero on the 5th, giving a range of temperature of 49.6°.

Warmest day was the 25th. Coldest day was the 4th.

Highest barometer reading was 30.94 on the 5th; lowest barometer was 29.14 on the 3rd, giving a range of 1.80 inches.

Minimum relative humidity observed, was 54 on the 10th.

Rain fell on 7 days. Snow fell on 14 days. Rain and snow on 4 days.

No. of inches of snow on ground at end of month, 9 inches.

The average temperature for the four months ending March 31st, was 13°.5, which is the coldest since the winter of 1884-85, and 10°.5 below normal.

1904.

C. H. McLEOD, *Superintendent.*

DA[Y]	Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	.	.88	....	.88	1
		.00	....	.00	2
SUNDAY..		....	.6	.04	3..........SUNDAY
		....	....	....	4
		....	....	....	5
		....	....	....	6
		.06	....	.06	7
		....	....	....	8
		.55	....	.55	9
SUNDAY..	.	.03	....	.03	10..........SUNDAY
		....	....	....	11
		.18	....	.18	12
		....	.6	.06	13
		....	.0	.00	14
		....	....	....	15
		....	....	....	16
SUNDAY..		....	....	....	17..........SUNDAY
		....	....	....	18
		....	1.0	.06	19
		....	4.3	.51	20
		....	....	....	21
		....	....	....	22
		....	....	....	23
SUNDAY..	.	.09	....	.09	24..........SUNDAY
	.	.31	....	.31	25
	.	.02	....	.02	26
		....	....	....	27
	.	.60	....	.60	28
	.	.35	....	.35	29
	.	.07	....	.07	30
Means...	7	3.14	6.5	3.81	.......Sums.........
30 Year[s means] for and in[cluding] this mon[th]	4	1.78	5.1	2.31	30 Years means for and including this month.

[...] and

Direction [...] from

Miles ... 100.

Duration

Mean vel[...]

Greatest [...]n the

Greatest [...]ro on

Greatest [...]2.3°.

Resultan[...]

Warmest day was the 24th. Coldest day was the 13th.

Highest barometer reading was 30.50 on the 22nd; lowest barometer was 29.43 on the 10th, giving a range of 1.07 inches.

Minimum relative humidity observed, was 35 on the 23rd.

Rain fell on 12 days. Snow fell on 5 days. Rain or snow on 17 days.

No snow on ground at end of month.

ABSTRACT FOR THE MONTH OF APRIL, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	36.0	40.0	30.2	9.8	29.86	30.23	29.57	.66	85	S.E.	22.3	....	.88	....	.88	1
2	37.2	40.1	33.9	6.2	29.58	29.68	29.50	.18	88	S.W.	27.0	07	.00	....	.00	2
SUNDAY........ 3	28.6	32.8	23.6	9.2	30.07	30.29	29.68	.61	87	N.	19.3	82	....	.6	.04	3...........SUNDAY
4	34.4	42.0	25.9	16.1	30.21	30.33	30.12	.21	61	S.W.	29.6	88	...	....	....	4
5	39.3	46.0	31.1	14.9	30.16	30.20	30.12	.08	64	W.	30.0	84	....	....	....	5
6	40.8	50.9	32.2	18.7	30.08	30.14	30.00	.14	65	S.W.	12.5	55	....	....	....	6
7	37.2	41.2	32.2	9.0	29.98	30.08	29.94	.14	86	N.W.	9.6	09	.06	....	.06	7
8	40.1	49.7	32.2	17.5	30.15	30.23	30.07	.16	83	N.E.	11.0	83	....	....	....	8
9	39.6	45.2	35.9	9.3	29.79	30.07	29.50	.57	92	N.E.	12.2	43	.55	....	.55	9
SUNDAY....... 10	43.3	51.4	36.5	14.9	29.50	29.59	29.43	.16	72	S.W.	23.0	....	.03	....	.03	10...........SUNDAY
11	41.2	47.2	37.2	10.0	29.66	29.77	29.59	.18	69	S.W.	20.5	18	....	....	....	11
12	37.9	45.5	31.4	14.1	29.62	29.77	29.50	.27	85	S.W.	16.5	12	.18	....	.18	12
13	26.7	37.0	22.0	15.0	29.85	29.92	29.61	.31	87	W.	20.4	03	....	.6	.06	13
14	30.8	36.8	24.0	12.8	29.89	29.96	29.86	.10	81	W.	14.7	76	....	.0	.00	14
15	28.2	31.2	25.3	5.9	30.04	30.11	29.96	.15	87	N.W.	8.0	08	....	....	....	15
16	30.4	35.4	24.0	11.4	29.91	29.99	29.88	.11	69	N.W.	17.0	74	....	....	....	16
SUNDAY........17	36.5	45.4	27.0	18.4	29.98	30.02	29.92	.10	58	S.W.	26.6	85	....	....	....	17...........SUNDAY
18	41.2	51.2	32.0	19.2	29.91	29.97	29.85	.12	55	W.	14.5	15	....	....	....	18
19	35.6	45.5	25.5	20.0	29.77	29.85	29.70	.15	77	S.W.	16.3	10	....	1.0	.06	19
20	29.6	35.9	19.5	16.4	29.84	30.03	29.73	.30	96	N.E.	20.2	87	....	4.3	.51	20
21	38.1	46.4	29.5	16.9	30.21	30.32	30.03	.29	59	N.W.	10.3	83	....	....	....	21
22	41.9	50.6	34.0	16.6	30.45	30.50	30.32	.18	69	S.W.	4.3	34	....	....	....	22
23	47.0	61.0	32.2	28.8	30.33	30.44	30.18	.26	50	S.	....	15	....	....	....	23
SUNDAY........24	52.1	61.8	41.8	20.0	29.99	30.18	29.70	.48	79	S.	....	....	.09	....	.09	24...........SUNDAY
25	45.3	56.6	42.3	14.3	29.65	29.73	29.59	.14	84	S.W.	22.9	....	.31	....	.31	25
26	44.8	50.3	39.2	11.1	29.94	30.09	29.73	.36	75	N.E.	10.3	....	.02	....	.02	26
27	50.4	60.0	39.6	20.4	30.16	30.25	30.09	.16	53	N.E.	17.8	52	....	....	....	27
28	47.2	54.7	41.4	13.3	30.17	30.24	30.03	.21	85	N.E.	18.7	....	.60	....	.60	28
29	47.7	53.4	44.0	9.4	29.85	30.03	29.74	.29	80	N.E.	13.4	....	.35	....	.35	29
30	49.4	53.7	45.0	8.7	29.73	29.81	29.70	.11	98	N.W.	8.6	....	.07	....	.07	30
Means......	39.27	46.6	32.3	14.3	29.943	30.06	29.82	.24	76.0	West.	17.05	33.7	3.14	6.5	3.81	.......Sums.........
30 Years means for and including this month......	40.79	49.18	33.01	16.17	29.960	......	......	.20	67.0	......	§ 16.29	¶ 49.4	1.78	5.1	2.31	30 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	967	1893	511	375	300	3333	3237	843	
Duration in hrs..	78	122	45	24	21	148	166	65	3
Mean velocity....	12.4	15.5	11.4	15.6	14.3	22.5	19.5	13.0	

Greatest mileage in one hour was 45 on the 5th.
Greatest velocity in gusts was 72 on the 5th.
Resultant mileage, 4,075.

Resultant direction, West.
Total mileage, 11,459. ‖

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 17 years only.

‖ For 28 days only.

The greatest heat was 61.8 above zero on the 24th. The greatest cold was 19.5 above zero on the 20th, giving a range of temperature of 42.3°.

Warmest day was the 24th. Coldest day was the 13th.

Highest barometer reading was 30.50 on the 22nd; lowest barometer was 29.43 on the 10th, giving a range of 1.07 inches.

Minimum relative humidity observed, was 35 on the 23rd.

Rain fell on 12 days. Snow fell on 5 days. Rain or snow on 17 days.

No snow on ground at end of month.

04.

H. McLEOD, *Superintendent.*

DAY	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY....	....	....	....	1...........SUNDAY
	...	....	....	2
	....	....	....	3
	....	....	....	4
	....	....	....	5
	....	....	....	6
	....	....	....	7
SUNDAY....	....	....	....	8...........SUNDAY
	....	...	....	9
	....	....	....	10
	... .	...	....	11
	....	....	....	12
	....	....	....	13
	....	....	....	14
SUNDAY....	.38	....	.38	15...........SUNDAY
	.49	....	.49	16
	.11	....	.11	17
	.04	....	.04	18
	1.05	....	1.05	19
	.15	....	.15	20
	....	....	....	21
SUNDAY....	....	....	....	22...........SUNDAY
	.20	....	.20	23
	...	....	....	24
	2.08	....	2.08	25
	.22	....	.22	26
	.08	....	.08	27
	....	....	....	28
SUNDAY....	.00	....	.00	29 .. ..SUNDAY
	....	....	....	30
	....	....	....	31
Means.....	4.80	....	4.80	.......Sums.........
30 Years m for and incl this month.	2.90	....	2.91	30 Years means for and including this month.

Warmest day was the 9th. Coldest day was the 20th.

Highest barometer reading was 30.30 on the 3rd; lowest barometer was 29.42 on the 27th, giving a range of .88 inches.

Minimum relative humidity observed, was 30 on the 6th.

Rain fell on 11 days.

Thunder on the 15th and 25th.

Direction..

Miles .....

Duration in

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ABSTRACT FOR THE MONTH OF MAY, 1904.

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

DAY	THERMOMETER.				* BAROMETER.				‡Mean relative humidity.	WIND.		Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	† Mean.	Max.	Min	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour.					
SUNDAY........ 1	51.2	60.3	41.7	18.6	30.01	30.14	29.84	.30	50	N.E.	14.5	82	....	....	....	1..........SUNDAY
2	57.8	66.6	46.1	20.5	30.24	30.27	30.14	.13	43	N.E.	10.8	88	...	....	....	2
3	65.9	75.3	53.0	22.3	30.26	30.30	30.22	.08	46	S.W.	17.3	82	....	....	....	3
4	66.1	75.3	57.0	18.3	30.16	30.26	30.02	.24	52	S.W.	26.8	87	....	....	....	4
5	59.8	68.4	53.0	15.4	30.05	30.14	30.00	.14	55	S.W.	19.7	52	....	....	....	5
6	55.5	65.2	42.2	23.0	30.18	30.26	30.11	.15	40	N.E	9.8	94	....	....	....	6
7	63.7	78.9	48.9	30.0	29.96	30.11	29.81	.30	52	S.W.	9.5	67	....	....	....	7
SUNDAY........ 8	66.3	75.0	57.5	17.5	29.84	29.92	29.75	.17	63	S.W.	12.8	43	....	....	....	8..........SUNDAY
9	66.6	78.5	56.0	22.5	29.63	29.75	29.63	.12	61	S.E.	17.4	70	....	...	....	9
10	59.3	69.0	51.2	17.8	29.87	29.95	29.70	.25	52	S.W.	22.3	80	....	....	....	10
11	57.1	66.0	45.8	20.2	30.04	30.13	29.95	.18	60	S.W.	17.4	90	....	...	....	11
12	52.1	61.0	39.8	21.2	30.13	30.19	30.08	.11	58	S.W.	12.3	81	....	....	....	12
13	61.6	72.5	48.5	24.0	30.06	30.13	29.94	.19	54	N.E.	6.5	80	....	....	....	13
14	66.1	76.2	56.6	19.6	29.87	29.95	29.79	.16	53	S.E.	21.0	76	....	....	....	14
SUNDAY........15	58.4	65.8	48.8	17.0	29.77	29.83	29.72	.11	83	S.E.	13.5	69	.38	....	.38	15..........SUNDAY
16	50.9	57.7	46.8	10.9	29.72	29.77	29.70	.07	93	W.	16.8	....	.49	....	.49	16
17	53.7	63.5	44.1	19.4	29.89	29.99	29.77	.22	73	S.W.	16.8	....	.11	....	.11	17
18	61.9	73.6	48.0	25.6	29.97	30.01	29.90	.11	74	N.E.	12.5	73	.04	....	.04	18
19	49.9	64.8	46.8	18.0	29.82	29.92	29.73	.19	100	N.E.	15.6	....	1.05	....	1.05	19
20	49.9	53.4	45.5	7.9	29.67	29.74	29.64	.10	96	N.E.	5.6	....	.15	....	.15	20
21	61.5	73.9	46.9	27.0	29.78	29.81	29.74	.07	79	W.	18.5	91	....	....	....	21
SUNDAY........22	66.4	77.2	56.6	20.6	29.80	29.83	29.76	.07	62	S.W.	20.8	54	....	....	....	22..........SUNDAY
23	63.3	74.9	57.5	17.4	29.76	29.84	29.71	.13	86	S.W.	16.0	....	.20	....	.20	23
24	65.6	71.5	58.7	12.8	29.91	30.04	29.74	.30	55	S.W.	17.9	77	....	....	....	24
25	57.8	65.5	52.6	12.9	29.99	30.07	29.87	.20	90	N.E.	10.9	03	2.08	....	2.08	25
26	59.8	69.0	52.6	16.4	29.77	29.89	29.56	.33	98	S.W.	7.4	....	.22	....	.22	26
27	59.4	65.0	52.2	12.8	29.62	29.85	29.42	.43	78	S.W.	22.7	28	.08	....	.08	27
28	57.4	67.3	45.6	21.7	29.92	30.00	29.85	.15	62	S.W.	19.4	95	....	....	....	28
SUNDAY........29	64.6	75.0	53.0	22.0	29.93	30.03	29.80	.23	58	S.W.	21.0	93	.00	....	.00	29..........SUNDAY
30	64.1	71.7	54.3	17.4	29.80	29.97	29.75	.22	67	S.W.	19.9	19	....	....	....	30
31	55.7	62.8	46.7	16.1	30.17	30.25	29.97	.28	69	F.E.	10.8	69	....	....	....	31
Means...........	59.72	69.0	50.1	18.9	29.925	30.01	29.83	.18	66.5	......	15.62	56	4.80	....	4.80	.......Sums.........
30 Years means for and including this month......	54.93	64.3	46.0	18.4	29.935	......	......	.17	66.2	......	§ 14.35	¶ 51.5	2.90	....	2.91	30 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	274	1596	290	1046	491	4480	2796	650	
Duration in hrs..	24	133	29	80	41	240	155	40	2
Mean velocity....	11.4	12.0	10.0	13.1	12.0	18.7	18.0	16.3	

Greatest mileage in one hour was 40 on the 10th.
Greatest velocity in gusts was 60 on the 10th.
Resultant mileage, 4,902.

Resultant direction, S.59°W.
Total mileage, 11,623.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 17 years only.

The greatest heat was 78.9 above zero on the 7th. The greatest cold was 39.8 above zero on the 12th, giving a range of temperature of 39.1°.

Warmest day was the 9th. Coldest day was the 20th.

Highest barometer reading was 30.30 on the 3rd; lowest barometer was 29.42 on the 27th, giving a range of .88 inches.

Minimum relative humidity observed, was 30 on the 6th.

Rain fell on 11 days.

Thunder on the 15th and 25th.

904.

. H. McLEOD, *Superintendent.*

DAY	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	.57	....	.57	1
	.03	....	.03	2
	.41	....	.41	3
	.00	....	.00	4
SUNDAY.....	.28	....	.28	5 ....SUNDAY
	.04	....	.04	6
	.62	....	.62	7
	....	....	....	8
	....	....	....	9
	....	....	....	10
	....	....	....	11
SUNDAY....	....	....	....	12 ....SUNDAY
	....	....	....	13
	....	....	....	14
	.18	....	.18	15
	....	....	....	16
	....	....	....	17
	....	....	....	18
SUNDAY....	....	....	....	19 ....SUNDAY
	....	....	....	20
	.00	....	.00	21
	.30	....	.30	22
	....	....	....	23
	....	....	....	24
	.10	....	.10	25
SUNDAY....	....	....	....	26 ....SUNDAY
	....	....	....	27
	...	....	....	28
	.28	....	.28	29
	.00	....	.00	30
Means......	2.81	....	2.81	.......Sums ....
30 Years m for and inclu this month.	3.62	....	3.62	30 Years means for and including this month.

Direction..

Miles .....

Duration in

Mean veloci

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Warmest day was the 26th. Coldest day was the 5th.

Highest barometer reading was 30.30 on the 10th; lowest barometer was 29.48 on the 21st, giving a range of .82 inches.

Minimum relative humidity observed, was 62 on the 11th.

Rain fell on 13 days.

Thunder on 4 days.

ABSTRACT FOR THE MONTH OF JUNE, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	54.9	57.8	51.5	6.3	30.21	30.25	30.17	.08	97	N.E	11.0	....	.57	....	.57	1
2	63.4	66.5	50.4	16.1	30.09	30.17	29.98	.19	90	N.E.	6.7	17	.03	....	.03	2
3	60.8	64.3	57.0	7.3	29.97	30.05	29.94	.11	97	N.E.	9.0	04	.41	....	.41	3
4	59.5	66.0	51.1	14.9	30.15	30.21	30.05	.16	74	N.E.	12.6	52	.00	....	.00	4
SUNDAY........ 5	54.4	58.8	51.5	7.3	29.88	30.07	29.83	.24	95	N.E.	12.8	....	.28	....	.28	5..........SUNDAY
6	55.4	60.3	51.0	9.3	29.81	29.84	29.80	.04	97	N.E.	9.7	....	.04	...	.04	6
7	63.7	74.8	53.1	21.7	29.82	29.89	29.80	.09	90	S.W.	7.1	47	.62	....	.62	7
8	63.1	73.2	53.6	19.6	29.97	30.02	29.89	.13	82	N.E.	10.7	44	....	....	....	8
9	64.1	73.0	53.8	19.2	30.19	30.28	30.02	.26	85	N.E.	7.4	46	....	....	....	9
10	64.7	74.7	58.0	16.7	30.22	30.30	30.08	.22	81	S.W.	10 4	80	....	....	....	10
11	66.5	74.1	58.6	15.5	30.09	30.15	30.05	.10	70	N.E.	11.3	94	....	....	....	11
SUNDAY....... 12	60.2	67.4	51.0	16.4	30.17	30.20	30.10	.10	75	N.E.	6.0	93	....	....	....	12..........SUNDAY
13	59.9	70.8	46 6	24.2	30.20	30.25	30.13	.12	74	N.E.	5.2	94	....	....	....	13
14	65.0	74.3	54.0	20.3	30.06	30.13	29.94	.19	85	E.	8.2	88	....	....	....	14
15	65.9	74.6	59.4	15.2	29.91	29.95	29.85	.10	88	N.W.	10.5	28	.18	....	.18	15
16	62.7	69.7	56.7	13.0	30.02	30.10	29.88	.22	81	N.W.	6.9	95	....	....	....	16
17	64.3	73.5	51.0	22.5	30.06	30.14	29.95	.19	78	W.	5.9	87	....	....	....	17
18	66.0	75.5	58.8	16.7	29.93	30.03	29.90	.13	75	N.W.	13.4	83	....	....	....	18
SUNDAY........19	63.0	72.5	50.5	22.0	30.06	30.12	30.00	.12	77	N.W.	6.3	91	....	....	....	19..........SUNDAY
20	71.7	82.0	61.5	20.5	29.85	30.00	29.68	.32	79	W.	8.3	93	....	....	....	20
21	73.0	81.9	66.1	15.8	29.56	29.68	29.48	.20	89	W.	8.6	61	.00	....	.00	21
22	63.9	69.4	56.6	12.8	29.74	29.98	29.50	.48	88	N.	11.5	56	.30	....	.30	22
23	65.2	74.4	53.1	21.3	30.16	30.22	29.98	.24	84	W.	9.6	96	....	....	....	23
24	70.5	81.0	55.5	25.5	30.09	30.19	29.98	.21	83	W.	12.6	85	....	....	....	24
25	74.8	83.0	67.5	15.5	29.88	29.98	29.81	.17	93	W.	12.8	59	.10	....	.10	25
SUNDAY........26	76.4	83.8	66.8	17 0	29.80	29.90	29.77	.13	86	W.	20.3	88	....	....	....	26..........SUNDAY
27	65.5	72.6	60.5	12.1	30.06	30.12	29.90	.22	81	N.W.	10.9	89	....	....	....	27
28	67.7	75.9	57.3	18.6	30.07	30.16	29.95	.21	85	W.	8.7	96	...	....	....	28
29	62.3	66.1	58.1	8.0	29.83	29.95	29.77	.18	98	W.	8.0	41	.28	....	.28	29
30	69.6	79.7	61.0	18.7	29.73	29.78	29.69	.09	92	W.	9.7	....	.00	....	.00	30
Means..........	64.60	72.39	56.05	16.33	29.985	30.07	29.90	.17	85.0	N. 51° W.	9.7	60.4	2.81	....	2.81	.......Sums........
30 Years means for and including this month......	64.73	73.43	56.19	17.24	29.905	......	......	.16	70.9	......	§ 12.73	¶ 54.0	3.62	....	3.62	30 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	961	1221	689	39	176	232	3253	440	
Duration in hrs..	85	140	90	6	19	29	286	57	8
Mean velocity....	11.3	8.7	7 7	6.5	9.3	8.0	11.4	7.7	

Greatest mileage in one hour was 25 on the 11th.
Greatest velocity in gusts was 36 on the 11th.
Resultant mileage, 2,534.

Resultant direction, N.51°W.
Total mileage, 7,011.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 17 years only.

The greatest heat was 83.8° above zero on the 26th. The greatest cold was 46.6 above zero on the 13th, giving a range of temperature of 37.2°.

Warmest day was the 26th. Coldest day was the 5th.

Highest barometer reading was 30.30 on the 10th; lowest barometer was 29.48 on the 21st, giving a range of .82 inches.

Minimum relative humidity observed, was 62 on the 11th.

Rain fell on 13 days.

Thunder on 4 days.

)04.

M. H. McLEOD, *Superintendent.*

DAY	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	.02	....	.02	1
	.59	....	.59	2
SUNDAY........	....	....	....	3..........SUNDAY
	.00	....	.00	4
	.08	....	.08	5
	.01	....	.01	6
	....	....	....	7
	....	....	....	8
	...	....	....	9
SUNDAY.......	.13	....	.13	10..........SUNDAY
	.00	....	.00	11
	.50	....	.50	12
	...	....	....	13
	....	....	....	14
	.02	....	.02	15
	....	....	....	16
SUNDAY........	....	....	....	17..........SUNDAY
	....	....	....	18
	.00	....	.00	19
	.00	....	.00	20
	....	....	....	21
	....	....	....	22
	.08	....	.08	23
SUNDAY.......	....	....	....	24..........SUNDAY
	....	....	....	25
	.09	....	.09	26
	....	....	....	27
	.36	....	.36	28
	.57	....	.57	29
	.00	....	.00	30
SUNDAY.......	.50	....	.50	31..........SUNDAY
Means......	2.95	....	2.95	.......Sums.........
30 Years mear for and includin this month....	4.16	....	4.16	30 Years means for and including this month.

d	Warmest day was the 19th. Coldest day was the 2nd.
Direction......n	Highest barometer reading was 30.18 on the 4th; lowest barometer was 29.44 on the 12th, giving a range of .74 inches.
Miles ....).	
Duration in hrs	Minimum relative humidity observed, was 43 on the 8th.
Mean velocity..	
e	Rain fell on 17 days.
Greatest mileagn	Thunder on 5 days.
Greatest veloci	
Resultant mile	

ABSTRACT FOR THE MONTH OF JULY, 1904.

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

DAY	THERMOMETER.				* BAROMETER.				‡Mean relative humidity.	WIND.		Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	† Mean.	Max.	Min	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour.					
1	69.4	77.8	61.9	15.9	29.74	29.80	29.70	.10	89	S.E.	11.2	72	.02	....	.02	1
2	58.7	63.9	55.2	8.7	29.86	30.00	29.79	.21	92	N.W.	11.0	....	.59	....	.59	2
SUNDAY........ 3	60.3	70.5	49.5	21.0	30.14	30.17	30.00	.17	81	N.W.	12.3	94	....	....	....	3..........SUNDAY
4	66.1	75.0	54.0	21.0	29.98	30.18	29.78	.40	84	W.	13.1	36	.00	...	.00	4
5	70.8	76.8	65.4	11.4	29.86	29.95	29.79	.16	73	W.	17.7	46	.08	....	.08	5
6	73.9	68.7	61.0	7.7	30.04	30.07	29.95	.12	71	N.W.	10.3	40	.01	....	.01	6
7	68.9	78.1	58.1	20.0	30.07	30.11	30.05	.06	71	W.	12.5	98	....	....	....	7
8	63.9	83.3	61.0	22.3	30.07	30.12	30.05	.07	60	W.	3.3	97	....	....	....	8
9	74.1	83.9	62.0	21.9	30.00	30.07	29.92	.15	62	E.	6.6	78	...	....	....	9
SUNDAY....... 10	67.7	73.0	64.7	8.3	29.86	29.91	29.83	.08	95	W.	9.2	11	.13	....	.13	10..........SUNDAY
11	70.6	79.4	63.7	15.7	29.76	29.82	29.70	.12	87	N.W.	12.5	61	.00	....	.00	11
12	69.8	82.2	61.7	20.5	29.56	29.69	29.44	.25	92	N.W.	9.0	45	.50	....	.50	12
13	62.5	67.2	59.0	8.2	29.78	29.95	29.56	.39	71	N.W.	10.6	44	....	....	....	13
14	66.7	76.0	55.0	21.0	30.01	30.07	29.95	.12	72	W.	5.5	97	....	....	....	14
15	68.7	75.8	60.9	14.9	29.91	30.01	29.80	.21	84	W.	11.0	11	.02	....	.02	15
16	71.9	78.8	65.0	13.8	29.85	29.90	29.80	.10	77	N.W.	12.2	78	....	....	....	16
SUNDAY........17	70.0	77.0	63.2	13.8	29.92	29.97	29.88	.09	70	N.W.	4.9	68	....	....	....	17..........SUNDAY
18	76.2	85.9	67.9	18.0	29.85	29.88	29.82	.06	80	W.	7.0	77	....	....	....	18
19	78.3	90.1	69.1	21.0	29.78	29.86	29.69	.17	65	W.	16.8	73	.00	....	.00	19
20	70.9	78.7	62.7	16.0	29.78	29.82	29.69	.13	61	N.W.	13.4	82	.00	....	.00	20
21	69.8	68.6	56.4	12.2	29.87	29.90	29.82	.08	66	N.W.	5.7	63	....	....	....	21
22	64.8	72.2	56.8	15.4	29.98	30.03	29.90	.13	55	N.W.	3.8	95	....	....	....	22
23	63.0	68.5	59.1	9.4	30.07	30.10	30.02	.08	82	N.E.	4.4	02	.08	....	.08	23
SUNDAY........24	67.9	76.0	60.1	15.9	30.09	30.14	30.06	.08	77	N.E.	5.1	32	....	....	....	24..........SUNDAY
25	72.4	79.8	64.5	15.3	30.09	30.12	30.07	.05	76	N.E.	3.5	47	....	....	....	25
26	68.1	71.2	63.5	7.7	30.08	30.11	30.04	.07	87	N.W.	4.7	14	.09	....	.09	26
27	71.9	82.3	63.0	19.3	30.02	30.06	29.98	.08	83	W.	7.2	71	....	....	....	27
28	70.1	78.0	63.3	14.7	29.97	30.01	29.87	.14	85	W.	7.3	22	.36	....	.36	28
29	63.0	69.0	57.6	11.4	29.93	30.08	29.84	.24	90	N.W.	15.2	40	.57	....	.57	29
30	66.5	74.0	55.9	18.1	30.05	30.10	29.92	.18	73	W.	9.5	65	.00	....	.00	30
SUNDAY........31	70.0	80.4	63.6	16.8	29.81	29.92	29.74	.18	94	W.	15.5	16	.50	....	.50	31..........SUNDAY
Means......	68.38	76.2	60.8	15.4	29.929	30.00	29.88	.12	77.5	......	8.94	54	2.95	....	2.95	.......Sums.........
30 Years means for and including this month......	68.80	77.2	60.8	16.4	29.898	......	......	.14	72.0	......	§ 12.69	¶ 58.7	4.16	....	4.16	30 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	170	280	449	27	18	....	4233	1472	
Duration in hrs..	24	52	71	3	2	....	432	149	11
Mean velocity....	7.1	5.4	6.3	9.0	9.0	....	9.8	9.9	

Greatest mileage in one hour was 25 on the 31st.
Greatest velocity in gusts was 48 on the 31st.
Resultant mileage, 4,860.

Resultant direction, N.73°W.
Total mileage, 6,613.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

The greatest heat was 90.1° above zero on the 19th. The greatest cold was 49.5 above zero on the 3rd, giving a range of temperature of 40.6°.

Warmest day was the 19th. Coldest day was the 2nd.

Highest barometer reading was 30.18 on the 4th; lowest barometer was 29.44 on the 12th, giving a range of .74 inches.

Minimum relative humidity observed, was 43 on the 8th.

Rain fell on 17 days.

Thunder on 5 days.

1904.

M H. McLEOD, *Superintendent.*

DAY	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	.04	....	.04	1
	....	....	....	2
	....	....	....	3
	....	....	....	4
	.12	....	.12	5
	.00	....	.00	6
SUNDAY........	....	....	....	7..........SUNDAY
	.06	....	.06	8
	....	....	....	9
	...	....	....	10
	.13	....	.13	11
	.01	....	.01	12
	.13	....	.13	13
SUNDAY.......	1,00	....	1.00	14..........SUNDAY
	....	....	....	15
	.35	....	.35	16
	.52	....	.52	17
	....	....	....	18
	....	....	....	19
	2.21	....	2.21	20
SUNDAY.......	....	....	....	21..........SUNDAY
	.61	....	.61	22
	....	....	....	23
	....	....	....	24
	.08	....	.08	25
	....	....	....	26
	....	....	....	27
SUNDAY.......	....	....	....	28..........SUNDAY
	....	....	....	29
	.. .	....	....	30
	....	....	....	31
Means........	5.26	....	5.26	.......Sums ....
30 Years mea for and includin this month....	3.64	....	3.64	30 Years means for and including this month.

d	Warmest day was the 1st. Coldest day was the 31st.
Direction......	Highest barometer reading was 30.38 on the 9th; lowest barometer was 29.54 on the 25th, giving a range of .84 inches.
Miles	
Duration in hr	Minimum relative humidity observed, was 44 on the 3rd.
Mean velocity.	
Greatest milea	Rain fell on 13 days.
Greatest veloc	Thunder on 6 days.
Resultant mile	

ABSTRACT FOR THE MONTH OF AUGUST, 1904.

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 relative humidity.	ɪɪ WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	72.5	80.5	67.1	13.4	29.85	29.89	29.80	.09	79	S W,	10.4	65	.04	....	.04	1
2	67.6	73.2	61.7	11.5	29.95	29.99	29.89	.10	69	N.E.	2.8	60	....	....	....	2
3	67.9	77.0	58.5	18.5	30.05	30.08	29.97	.11	60	N.E.	4.5	92	....	....	....	3
4	69.6	78.8	57.7	21.1	30.06	30.12	30.00	.12	69	S.W.	4.9	89	....	....	....	4
5	71.1	80.4	61.3	19.1	29.85	30.00	29.74	.26	80	S.W.	11.7	44	.12	....	.12	5
6	71.3	81.8	63.0	18.8	29.68	29.77	29.60	.17	77	S.W.	14.8	72	..00	....	.00	6
SUNDAY........ 7	63.6	74.0	51.1	22.9	29.85	29.93	29.69	.24	79	N.W.	11.8	..	....	....	....	7............SUNDAY
8	62.5	69.8	57.0	12.8	30.01	30.21	29.91	.30	71	N.W.	10.8	69	.06	....	.06	8
9	63.3	73.4	50.0	23.4	30.34	30.38	30.21	.17	66	W.	8.3	85	....	....	....	9
10	64.3	71.8	54.6	17.2	30.18	30.33	29.99	.34	86	S.W.	12.9	02	...	....	....	10
11	65.0	72.3	60.1	12.2	29.96	30.10	29.91	.19	92	N.W.	13.6	28	.13	....	.13	11
12	65.2	74.7	56.0	18.7	30.21	30.28	30.10	.18	82	S.W.	5.1	79	.01	....	.01	12
13	63.0	65.9	59.0	6.9	30.00	30.17	29.81	.36	93	S.W.	12.8	..	.13	....	.13	13
SUNDAY....... 14	68.0	74.6	61.8	12.8	29.74	29.81	29.68	.13	85	S W.	13.0	50	1,00	....	1.00	14...........SUNDAY
15	64.7	70.0	59.3	10.7	29.81	29.90	29.71	.19	75	N.W.	8.2	93	....	....	....	15
16	60.2	63.3	56.3	7.0	29.84	29.90	29.77	.13	97	N.E.	6.6	..	.35	....	.35	16
17	65.7	72.6	58.6	14.0	29.78	29.81	29.73	.08	91	W.	12.7	59	.52	....	.52	17
18	60.8	67.0	55.5	11.5	29.94	30.07	29.78	.29	73	N.W.	17.3	73	....	....	....	18
19	61.8	71.2	51.0	20.2	30.14	30.21	30.07	.14	72	W.	8.2	87	....	....	....	19
20	57.9	59.0	54.7	4.3	29.84	30.11	29.60	.51	99	S.W.	14.7	..	2.21	....	2.21	20
SUNDAY........21	60.6	67.6	54.5	13.1	29.98	30.04	29.73	.31	86	S.W.	6.6	50	....	....	....	21............SUNDAY
22	66.5	79.3	59.2	20.1	29.92	30.06	29.75	.31	85	S.W-	18.2	42	.61	....	.61	22
23	58.5	64.5	51.6	12.9	30.25	30.33	30.06	.27	66	N.W.	8.6	93	....	....	....	23
24	64.3	74.3	51.0	23.3	30.11	30.22	30.00	.22	71	S.W.	15.0	92	....	....	....	24
25	69.6	78.0	59.3	18 7	29.74	30.00	29.54	.46	83	S.W.	13.9	40	.08	....	.08	25
26	61.0	70.9	52.3	18.6	29.91	30.08	29.54	.54	68	N.W.	22.0	87	....	....	....	26
27	63.5	71.7	55.0	16.7	30.09	30.14	30.03	.11	76	S.W.	19.3	92	....	....	....	27
SUNDAY........28	67.1	76.2	58.7	17.5	29.95	30.03	29.83	.20	74	S.W.	21.2	84	....	....	....	28...........SUNDAY
29	62.4	66.8	56.3	10.5	29.99	30.15	29.82	.33	63	N.W.	13.9	88	....	....	....	29
30	59.7	67.3	51.8	15.5	30.15	30.19	30.12	.07	67	S.W.	13.2	77	.. .	....	....	30
31	56.9	63.5	50.0	13.5	30.24	30.29	30.13	.16	63	N.W.	7.5	96	....	....	....	31
Means......	64.39	72.0	56.6	15.4	29.981	30.08	29.85	23	77.5	S 74° W	11.69	60.6	5.26	....	5.26	.......Sums ....
30 Years means for and including this month......	66.47	74.7	58.6	16 1	29.943	......	......	.14	73 7	......	§ 11.90	¶ 57.6	3.64	....	3.64	30 Years means for and including this month.

ɪɪ ANALYSIS OF WIND RECORD.

Direction.......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	231	367	39	74	101	4778	1074	2034	
Duration in hrs..	36	60	8	11	14	359	101	142	13
Mean velocity....	6.4	6.1	4.9	6.7	7.2	13.3	10.6	14.3	

Greatest mileage in one hour was 32 on the 25th.
Greatest velocity in gusts was 60 on the 25th.
Resultant mileage, 5,767.

Resultant direction, S.74° W.
Total mileage, 8,698.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

Aurora on the 3rd. ɪɪ Direction for part of month taken from City Hall records.

The greatest heat was 81.8° above zero on the 6th. The greatest cold was 50.0 above zero on the 9th and 31st. giving a range of temperature of 31.8°.

Warmest day was the 1st. Coldest day was the 31st.

Highest barometer reading was 30.38 on the 9th; lowest barometer was 29.54 on the 25th, giving a range of .84 inches.

Minimum relative humidity observed, was 44 on the 3rd.

Rain fell on 13 days.

Thunder on 6 days.

⁝R, 1904.

H. McLEOD, *Superintendent.*

DAY	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	.08	....	.08	1
	.53	....	.53	2
	1.72	....	1.72	3
SUNDAY..	....	....	....	4..........SUNDAY
	.08	....	.08	5
	....	....	....	6
	.01	....	.01	7
	.02	....	.02	8
	....	....	....	9
	....	....	....	10
SUNDAY..	....	....	....	11..........SUNDAY
	.17	....	.17	12
	....	....	....	13
	.86	....	.86	14
	.05	....	.05	15
	....	....	....	16
	....	....	....	17
SUNDAY..	.41	....	.41	18..........SUNDAY
	....	....	....	19
	.15	....	.15	20
	....	.00	.00	21
	....	....	....	22
	....	....	....	23
	1.77	....	1.77	24
SUNDAY..	....	....	....	25..........SUNDAY
	.07	....	.07	26
	....	....	....	27
	....	....	....	28
	.68	....	.68	29
	.06	....	.06	30
Means.....	6.66	....	6.66	.......Sums ....
30 Years r for and incl this month	3.33	....	3.33	30 Years means for and including this month.

nd	
Direction..	m
Miles	0.
Duration in	
Mean veloci	he
Greatest mi	on of
Greatest ve	
Resultant r	

Warmest day was the 11th. Coldest day was the 21st.

Highest barometer reading was 30.57 on the 22nd; lowest barometer was 29.34 on the 30th, giving a range of 1.23 inches.

Minimum relative humidity observed, was 47 on the 6th.

Rain fell on 15 days.

Trace of snow on the 21st.

Thunder on 5 days.

Earth quake on the 14th.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1904.

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

DAY	THERMOMETER. † Mean.	THERMOMETER. Max.	THERMOMETER. Min.	THERMOMETER. Range.	* BAROMETER. † Mean.	* BAROMETER. Max.	* BAROMETER. Min.	* BAROMETER. Range.	‡ Mean relative humidity.	WIND. General direction.	WIND. Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	58.5	68.5	50.3	18.2	30.14	30.25	30.04	.21	86	S.E.	8.8	43	.08	....	.08	1
2	58.6	66.0	54.5	11.5	30.09	30.15	30.03	.12	95	N.E.	12.5	..	.53	....	.53	2
3	55.6	57.2	53.3	3.9	29.94	30.03	29.83	.20	100	N.E.	11.6	..	1.72	....	1.72	3
SUNDAY........ 4	61.1	65.7	54.1	11.6	29.89	29.97	29.81	.16	83	S.W.	18.7	79	....	....	....	4..........SUNDAY
5	56.1	62.8	47.3	15.5	30.04	30.23	29.95	.28	79	S.W.	14.3	35	.08	....	.08	5
6	52.8	59.8	44.0	15.8	30.28	30.35	30.23	.12	60	N.W.	8.9	96	....	....	....	6
7	56.9	64.8	47.0	17.8	30.13	30.24	30.00	.24	82	S.W.	12.1	57	.01	....	.01	7
8	55.2	58.8	47.7	11.1	30.09	30.20	29.98	.22	70	N.E.	11.0	56	.02	....	.02	8
9	52.1	60.8	41.1	19.7	30.17	30.20	30.11	.09	82	S.E.	10.2	47	....	....	....	9
10	60.3	69.8	51.1	18.7	30.08	30.12	30.02	.10	89	S	8.8	28	....	....	....	10
SUNDAY....... 11	65.0	72.9	57.0	15.9	29.96	30.06	29.86	.20	83	S	15.2	79	....	....	....	11..........SUNDAY
12	59.4	66.8	50.2	16.6	29.99	30.24	29.84	.40	84	N.W.	14.0	14	.17	....	.17	12
13	53.0	58.7	45.0	13.7	30.32	30.39	30.24	.15	73	N.E.	6.6	93	....	....	....	13
14	58.9	68.9	49.8	19.1	29.97	30.24	29.75	.49	93	S.E.	16.0	04	.86	....	.86	14
15	53.7	60.0	48.0	12.0	29.92	30.16	29.78	.38	80	N.W.	18.3	64	.05	....	.05	15
16	55.7	63.0	44.5	18.5	30.01	30.15	29.83	.32	80	S.W.	15.0	65	....	....	....	16
17	58.5	64.0	53.0	11.0	29.91	29.96	29.84	.12	76	S.W.	14.1	68	...	....	....	17
SUNDAY........18	62.9	74.1	53.5	20.6	29.84	29.99	29.78	.21	91	S W.	16.0	27	.41	....	.41	18..........SUNDAY
19	51.0	60.0	44.7	15.3	30.19	30.27	29.99	.28	72	N.E.	9.4	91	....	....	....	19
20	49.6	55.3	42.7	12.6	29.99	30.14	29.86	.28	94	N.W.	15.1	..	.15	....	.15	20
21	40.1	45.5	36.6	8.9	30.29	30.42	30.13	.29	70	N.W.	16.7	29	....	.00	.00	21
22	41.5	47.6	34.8	12.8	30.52	30.57	30.42	.15	67	N.W.	11.7	84	....	....	....	22
23	47.0	55.0	34.2	20.8	30.40	30.54	30.19	.35	77	S.W.	13.7	48	....	....	....	23
24	52.0	61.2	48.8	12.4	29.86	30.19	29.59	.60	100	S.W.	14.6	..	1.77	....	1.77	24
SUNDAY........25	52.1	58.5	49.9	8.6	29.88	29.93	29.71	.22	91	N.E.	8.9	..	....	....	....	25..........SUNDAY
26	53.5	58.9	49.8	9.1	29.82	29.91	29.73	.18	99	S.W.	10.0	91	.07	....	.07	26
27	46.3	52.2	39.8	12.4	30.06	30.13	29.88	.25	76	N.E.	8.6	90	....	....	....	27
28	49.2	56.7	40.2	16.5	30.17	30.24	30.13	.11	75	S.W.	5.8	..	....	....	....	28
29	53.7	63.2	45.7	17.5	29.80	30.14	29.53	.61	100	S.W.	17.3	..	.68	....	.68	29
30	56.2	63.9	49.3	14.6	29.43	29.56	29.34	.22	88	S.W.	26.7	24	.06	....	.06	30
Means...........	54.22	61.3	46.9	14.4	30.039	30.17	29.91	.25	83.3	S 66° W	13.0	43.8	6.66	....	6.66	.......Sums.........
30 Years means for and including this month......	58.49	66.5	50.8	15.6	30.017	......	......	.19	76.5	......	§ 12.6	¶ 53.7	3.33	....	3.33	30 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	353	1756	149	462	1465	2635	1098	1460	
Duration in hrs..	36	155	15	49	124	166	81	93	1
Mean velocity....	9.8	11.3	10.0	9.4	11.8	15.8	13.6	15.7	

Greatest mileage in one hour was 32 on the 30th.
Greatest velocity in gusts was 48 on the 30th.
Resultant mileage, 2,408.

Resultant direction, S.66° W.
Total mileage, 9,378.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

The greatest heat was 74.1° above zero on the 18th. The greatest cold was 34.2 above zero on the 23rd, giving a range of temperature of 39.9°.

Warmest day was the 11th. Coldest day was the 21st.

Highest barometer reading was 30.57 on the 22nd; lowest barometer was 29.34 on the 30th, giving a range of 1.23 inches.

Minimum relative humidity observed, was 47 on the 6th.

Rain fell on 15 days.

Trace of snow on the 21st.

Thunder on 5 days.

Earth quake on the 14th.

℞, 1904.

H. McLEOD, *Superintendent.*

DA[Y]	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY
	.00	...	.00	1
SUNDAY..	....	....	....	2..........SUNDAY
	.01	...	.01	3
	....	....	....	4
	.23	....	.23	5
	....	....	....	6
	....	....	....	7
	.02	....	.02	8
SUNDAY..	.00	....	.00	9 ....SUNDAY
	.18	....	.18	10
	.00	....	.00	11
	....	....	....	12
	....	....	....	13
	.04	....	.04	14
	....	....	....	15
SUNDAY..	...	....	....	16..........SUNDAY
	.01	....	.01	17
	.05	....	.05	18
	....	....	....	19
	...	....	....	20
	2.29	....	2.29	21
	....	....	....	22
SUNDAY..	....	....	....	23 ....SUNDAY
	....	....	....	24
	.24	....	.24	25
	.13	....	.13	26
	....	.00	.00	27
	....	....	....	28
	.01	....	.01	29
SUNDAY..	....	....	....	30..........SUNDAY
	....	....	....	31
Means....	3.21	.00	3.21	.......Sums.........
30 Years for and inc[luding] this month	3.03	1.00	3.13	30 Years means for and including this month.

[...]nd	
Direction..	[...]m
Miles	[...]0.
Duration i[...]	
Mean veloc[...]	[...]m
Greatest m[...]	[...]ne
Greatest v[...]	[...]on
Resultant	[...]of

Warmest day was the 20th. Coldest day was the 31st.

Highest barometer reading was 30.57 on the 7th; lowest barometer was 29.21 on the 1st, giving a range of 1.36 inches.

Minimum relative humidity observed, was 63 on the 7th.

Rain fell on 14 days.

Snow fell on 1 day.

Aurora on the 6th.

ABSTRACT FOR THE MONTH OF OCTOBER, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY
1	46.2	50.5	44.5	6.0	29.28	29 33	29.21	.12	82	S.W.	27.4	..	.00	...	.00	1
SUNDAY........ 2	44.6	47.8	39 2	8.6	29.40	29 55	29.31	.24	77	S.W.	19.9	41	....	....	....	2..........SUNDAY
3	44.8	50.9	40.0	10.9	29.82	30.07	29.55	.52	82	S.W.	17.0	34	.01	...	.01	3
4	45.1	52.0	37.4	14.6	30.17	30.23	30.07	.13	83	S	9.2	68	....	....	....	4
5	48.9	53.0	44.6	8.4	29.92	30.20	29.73	.47	99	S.E.	6.2	..	.23	....	.23	5
6	41.4	46.0	36.0	10.0	30.20	30.38	29.82	.56	77	S.W.	18.9	85	....	....	....	6
7	36.7	43.0	28.1	14.9	30.47	30.57	30.38	.19	72	S.E.	5.3	69	....	....	....	7
8	43.6	50.0	35.2	14.8	30.24	30.39	30.17	.22	82	S.E.	5.7	..	.02	....	.02	8
SUNDAY....... 9	47.1	52.0	44.0	8.0	30.21	30.26	30.12	.14	91	N.W.	9.9	7	.00	....	.00	9..........SUNDAY
10	57.5	68.0	44.6	23.4	29.69	30.12	29.46	.66	95	S.E.	20.7	..	.13	...	.18	10
11	48.5	53.2	39.2	14.0	29.92	30.23	29.52	.71	84	N.E.	16.5	19	.00	....	.00	11
12	37.3	44.0	30.8	13.2	30.40	30.45	30.23	.22	77	N.E.	18.0	..	....	....	....	12
13	38.8	44.0	34.7	9.3	30.37	30.46	30.26	.20	89	N.E.	7.1	..	....	....	....	13
14	41.6	48.6	34.2	14.4	30.22	30.28	30.17	.11	83	N.W.	17.9	11	.04	....	.04	14
15	39.9	48.0	31.6	16.4	30.30	30.37	30.24	.13	77	N.W.	12.7	91	....	....	....	15
SUNDAY........16	46.9	56.0	34.5	21.5	30.21	30.28	30.15	.13	75	S.E.	14.5	91	....	....	....	16..........SUNDAY
17	52.0	62.0	43.0	19.0	30.08	30.16	29.98	.18	79	S W.	21.5	53	.01	....	.01	17
18	50.7	56.0	40.6	15.4	29.96	30.07	29.87	.20	96	N.E.	11.0	72	.05	....	.05	18
19	48.1	58.7	40.1	18.6	30.06	30.14	29.98	.16	97	N.W.	6.3	24	....	....	....	19
20	58.3	67.0	50.2	16.8	29.85	29.98	29.74	.24	94	E.	19.1	40	...	....	....	20
21	54.0	63.0	47.0	16.0	29.55	29.74	29.33	.41	99	S.E.	13.1	..	2.29	....	2.29	21
22	47.9	54.2	43.0	11.2	29.59	29.65	29.55	.10	90	S.W.	19.0	27	....	....	....	22
SUNDAY........23	42.3	48.0	36.6	11.4	29.84	30.02	29 65	.37	89	S.W.	18.6	65	....	....	....	23..........SUNDAY
24	36.8	42.0	33.0	9.0	30.19	30.25	30.02	.23	87	W.	11.1	87	....	....	....	24
25	42.5	48.0	35.5	12.5	30.08	30.22	30.02	.20	99	S.W.	18 2	..	.24	....	.24	25
26	39.0	43.0	35 0	8.0	29.96	30 08	29.87	.21	100	S.W.	12.6	..	.13	....	.13	26
27	32.7	38 0	28.7	9.3	30.08	30.21	29.88	.33	96	N.W.	15.6	38	....	.00	.00	27
28	33.3	40.2	24.4	15.8	30.25	30.31	30.20	.11	89	S.W.	12.8	36	....	....	....	28
29	39.7	49.8	35.0	14.8	30.10	30.20	29.99	.21	97	S.W.	18.5	98	.01	....	.01	29
SUNDAY........30	30.2	34.8	26.0	8.8	30.36	30.41	30.20	.21	88	N.W.	14.5	..	....	....	....	30..........SUNDAY
31	29.0	36.0	23.0	13.0	30.32	30.42	30.12	.30	97	W.	9.9	33	....	....	....	31
Means........	43.39	49.9	36.8	13.1	30.034	30.16	29.90	.26	87.8	S 43° W	14.64	35.1	3.21	.00	3.21	......Sums........
30 Years means for and including this month......	45.91	52.9	39.0	13 9	30.014	......	......	.22	77 3	......	§ 13.50	¶ 41.1	3.03	1.00	3.13	30 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	209	926	833	1512	973	3633	1323	1533	
Duration in hrs..	27	68	66	99	66	200	116	107	5
Mean velocity....	7 7	13.6	12.6	15.2	14.0	18.2	11.4	14.3	

Greatest mileage in one hour was 36 on the 10th.
Greatest velocity in gusts was 48 on the 10th.
Resultant mileage, 8,560.

Resultant direction, S.43°W.
Total mileage, 10,892.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

ʙ Direction for part of month taken from City Hall records.

The greatest heat was 68.0° above zero on the 10th. The greatest cold was 23.0 above zero on the 31st, giving a range of temperature of 45.00.

Warmest day was the 20th. Coldest day was the 31st.

Highest barometer reading was 30.57 on the 7th; lowest barometer was 29.21 on the 1st, giving a range of 1.36 inches.

Minimum relative humidity observed, was 63 on the 7th.

Rain fell on 14 days.

Snow fell on 1 day.

Aurora on the 6th.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY
1	35.6	40.7	30.8	9.9	30.23	30.42	30.07	.35	87	N.E.	11.0	..	....	...	....	1
2	33.8	42.8	26.2	16.6	30.35	30.46	30.17	.29	91	N.E.	9.6	76	....	....	....	2
3	42.9	51.8	35.4	16.4	30.01	30.17	29.94	.23	96	N.W.	14.4	35	.05	....	.05	3
4	36.6	47.5	32.5	15.0	30.01	30.07	29.94	.13	81	E.	10.3	14	....	....	....	4
5	27.7	33.0	24.0	9.0	29.85	29.97	29.80	.17	99	E.	15.0	36	....	....	....	5
SUNDAY 6	27.9	34.2	24.0	10.2	29.78	29.82	29.74	.08	99	N.W.	12.9	..	....	.00	.00	6 ....SUNDAY
7	30.9	38.7	26.3	12.4	29.71	29.74	29.66	.08	97	S.W.	21.6	19	....	....	....	7
8	23.9	36.0	23.0	13.0	29.87	29.94	29.74	.20	98	N.W.	11.6	86	....	....	....	3
9	24.4	32.0	20.6	11.4	30.06	30.17	29.94	.23	94	N.E.	9.3	28	....	....	....	9
10	25.0	30.0	19.7	10.3	30.22	30.29	30.17	.12	87	N.W.	9.3	65	....	....	....	10
11	23.2	26.0	18.9	7.1	30.08	30.16	29.96	.22	83	N.W.	8.6	.	....	....	....	11
12	37.6	48.0	21.0	27.0	29.61	29.96	29.44	.52	80	S.W.	22.0	49	...	....	....	12
SUNDAY....... 13	39.0	44.0	37.0	7.0	29.42	29.51	29.26	.25	80	S.W.	15.2	.	.00	....	.00	13 ....SUNDAY
14	35.9	41.0	31.2	9.8	29.58	29.91	29.24	.67	60	N.W.	28.9	38	....	....	....	14
15	36.4	41.0	29.5	11.5	30.03	30.03	29.91	.12	83	S.W.	17.4	.	.03	....	.03	15
16	32.0	38.0	19.5	18.5	30.26	30.57	30.03	.54	62	N.W.	13.9	49	. .	.00	.00	16
17	17.8	24.0	10.3	13.7	30.65	30.72	30.56	.16	74	N.E.	9.3	39	....	....	....	17
18	21.2	30.0	12.7	17.3	30.39	30.56	30.26	.30	85	N.E.	12.4	36	....	....	....	18
19	25.5	32.0	20.0	12.0	30.18	30.26	30.04	.22	93	E.	3.1	..	....	....	....	19
SUNDAY........20	29.7	33.8	25.7	8.1	29.79	30.04	29.59	.45	98	N.E	4.5	..	.14	....	.14	20..... .....SUNDAY
21	34.2	38.0	29.0	9.0	29.89	30.09	29.58	.51	91	S.W.	12.9	13	.11	....	.11	21
22	33.1	36.0	27.0	9.0	29.93	30.09	29.79	.30	86	S.W.	2.6	..	.06	...	.06	22
23	35.0	37.5	32.9	4.6	29.88	29.96	29.79	.17	80	S.W.	10.6	.	...	....	....	23
24	33.1	35.8	31.0	4.8	29.69	29.81	29.64	.17	78	N.E.	16.4	..	....	.00	.00	24
25	31.0	33.2	29.5	3.7	29.70	29.82	29.64	.18	97	N.W.	16.6	..	....	.10	.01	25
26	23.1	29.0	20.0	9.0	29.96	30.02	29.82	.20	77	W.	18.1	..	....	.00	.00	26
SUNDAY........27	20.0	30.0	9.4	20.6	29.96	30.02	29.93	.09	93	N.E.	7.2	..	. ..	3.25	.09	27 ....SUNDAY
28	11.8	15.6	8.0	7.6	30.17	30.26	30.02	.24	83	S.W.	9.5	..	....	.00	.00	28
29	21.8	34.0	6.9	27.1	29.84	30.23	29.57	.66	91	S	7.1	..	....	5.75	5.7	29
30	34.0	37.6	31.0	6.6	29.68	29.75	29.58	.17	99	S.W.	15.4	..	....	1.50	.16	30
Means......	29.64	35.7	23.8	11.9	29.959	30.10	29.83	27	86.7	N 30° W	12.57	21.6	.39	10.6	1.22	.......Sums ....
30 Years means for and including this month......	32.55	38.8	26.7	12.1	30.012	......	......	27	80.7	......	§ 15.6	¶ 28.7	2.22	13.2	3.56	30 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	1260	1997	833	5	250	2949	1073	681	
Duration in hrs..	95	175	80	1	37	185	82	51	14
Mean velocity....	13.3	11.4	10.4	5.0	6.8	16.3	13.1	13.3	

Greatest mileage in one hour was 46 on the 13th.
Greatest velocity in gusts was 60 on the 13th.
Resultant mileage, 1,612.

Resultant direction, N.30°W.
Total mileage, 9,048.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

H Velocity for part of month and direction taken from City Hall records.

The greatest heat was 51.8° above zero on the 3rd. The greatest cold was 6.9 above zero on the 29th, giving a range of temperature of 44.9°

Warmest day was the 3rd. Coldest day was the 28th.

Highest barometer reading was 30.72 on the 17th; lowest barometer was 29.24 on the 14th, giving a range of 1.48 inches.

Minimum relative humidity observed, was 48 on the 16th.

Rain fell on 6 days.

Snow fell on 9 days.

First sleighing in the City Nov. 27th.

ABSTRACT FOR THE MONTH OF DECEMBER, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	22.5	28.0	20.3	7.7	29.81	29.92	29.76	.16	88	S.W.	14.0	21	....	.3	.03	1
2	14.1	21.5	9.8	11.7	30.29	30.49	29.92	.57	88	S.W.	13.6	81	....	....	....	2
3	11.9	15.6	7.9	7.7	30.46	30.52	30.34	.18	68	W.	6.5	18	....	...	....	3
SUNDAY........ 4	11.4	16.6	5.9	10.7	30.28	30.34	30.23	.11	80	S.W.	10.9	09	....	.2	.02	4 ....SUNDAY
5	21.7	25.7	13.0	12.7	30.05	30.24	29.85	.39	90	S.W.	6.1	..	....	2.6	.26	5
6	13.7	26.0	9.0	17.0	30.04	30.16	29.85	.31	74	S.W.	10.0	63	....	....	....	6
7	20.9	29.4	11.0	18.4	29.55	29.90	29.38	.52	90	S.W.	11.5	..	....	3.0	.30	7
8	7.8	11.8	5.2	6.6	29.56	29.71	29.47	.24	80	N.E.	8.2	37	....	....	....	8
9	4.2	7.5	—3.8	11.3	29.91	30.10	29.71	.39	72	N.W.	16.0	18	....	.0	.00	9
10	—2.3	3.2	—7.2	10.4	30.10	30.12	30.07	.05	63	W.	12.0	..	....	....	....	10
SUNDAY....... 11	—1.6	1.6	—6.5	8.1	30.17	30.22	30.10	.12	63	N.W.	14.6	80	....	....	....	11 ....SUNDAY
12	2.9	6.0	—3.6	6.6	30.13	30.21	30.05	.16	72	N.E.	13.8	.	...	.0	.00	12
13	4.7	8.5	—1.0	9.5	30.12	30.23	30.05	.18	66	N.E.	13.8	73	....	....	....	13
14	9.0	11.0	5.6	5.4	30.37	30.45	30.23	.22	75	N.W.	11.2	43	....	....	....	14
15	6.2	8.6	1.0	7.6	30.38	30.45	30.22	.23	79	N.E.	4.2		....	.0	.00	15
16	6.1	11.8	—1.6	13.4	30.18	30.24	30.13	.11	86	W.	9.0	03	....	....	....	16
17	7.7	12.6	0.6	12.0	30.14	30.20	30.04	.16	83	S.W.	8.4	04	....	....	....	17
SUNDAY........18	10.2	17.4	2.1	15.3	29.99	30.06	29.96	.10	74	N.E.	11.0	80	...	.0	.00	18..... .....SUNDAY
19	22.2	27.7	7.6	20.1	29.75	29.99	29.60	.39	90	S.	16.2	..	....	1.8	.18	19
20	11.8	30.0	6.2	23.8	29.75	29.86	29.60	.26	81	W.	15.5	56	....	.1	.01	20
21	0.4	6.0	—5.5	11.5	30.09	30.28	29.79	.49	70	W.	15.7	71	....	....	....	21
22	8.9	12.3	—5.3	17.6	30.19	30.24	30.14	.10	86	N.W.	12.2	72	....	3.5	.35	22
23	8.4	10.0	6.4	3.6	29.90	30.15	29.75	.40	87	N.E.	13.4	67	....	5.3	.53	23
24	—1.7	6.0	—8.2	14.2	30.36	30.58	29.92	.66	71	N.E.	12.2	35	....	....	....	24
SUNDAY........25	—7.4	—1.4	—14.0	12.6	30.57	30.62	30.51	.11	58	E.	9.9	..	....	....	....	25 ....SUNDAY
26	1.6	10.4	—5.0	15.4	30.45	30.56	30.30	.26	71	N.E.	9.1	..	....	...	....	26
27	18.1	24.5	7.0	17.5	29.88	30.30	29.41	.89	94	N.E.	12.1	..	.00	6.2	.62	27
28	22.3	28.2	16.2	12.0	29.18	29.41	29.08	.33	94	E.	9.0	..	.41	5.0	.76	28
29	7.5	16.0	2.0	14.0	29.64	29.91	29.22	.69	84	N.W.	16.5	64	....	.3	.02	29
30	5.8	7.7	1.8	5.9	29.98	30.11	29.89	.22	84	N.E.	4.2	..	....	.9	.09	30
31	33.4	36.4	3.9	32.5	29.65	29.89	29.52	.37	94	S.W.	15.5	..	.07	1.1	.19	31
Means..........	9.44	15.4	2.7	12.7	30.032	30.17	29.87	.30	79.2	N 80° W	11.65	28.8	.48	30.3	3.36	.......Sums.........
30 Years means for and including this month......	18.61	25.6	11.5	14.1	30.023	......	......	.30	83.2	......	§ 15.84	¶ 26.5	1.32	24.3	3.68	30 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	236	2258	530	52	488	1927	2559	621	
Duration in hrs..	33	183	68	7	48	145	206	48	6
Mean velocity....	7.2	12.3	7.8	7.4	10.2	13.3	12.4	12.9	

Greatest mileage in one hour was 30 on the 20th.
Greatest velocity in gusts was 40 on the 20th.
Resultant mileage, 2,230.

Resultant direction, N.80°W.
Total mileage, 8,671.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100.

Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

The greatest heat was 36.4° above zero on the 31st. The greatest cold was 14.0° below zero on the 25th, giving a range of temperature of 50.4 degrees.

Warmest day was the 31st. Coldest day was the 25th.

Highest barometer reading was 30.62 on the 25th; lowest barometer was 29.08 on the 28th, giving a range of 1.54 inches.

Minimum relative humidity observed, was 45 on the 25th.

Rain fell on 3 days.

Snow fell on 17 days.

Rain and Snow on 3 days.

Aurora on 1 night.

Meteorological Abstract for the Year 1904.

Observations made at McGill College Observatory, Montreal, Canada. — Height above sea level 187 ft. Latitude N. 45° 30′ 17″. Longitude 4^h 54^m $18^s{\cdot}67^s$ W.

C. H. McLEOD, *Superintendent.*

Month.	Thermometer.					* Barometer.				‡ Mean relative humidity.	Wind.		Per cent. possible sunshine.	Precipitation.							Month.
	† Mean.	¶ Deviation from 30 years, means.	Max.	Min.	Mean daily range.	† Mean.	Max.	Min.	Mean daily range.		Resultant direction.	Mean velocity in miles per hour		Inches of rain.	Number of days on which rain (or sleet) fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and melted snow.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.	
January	8.17	— 4 12	34.5	—20.7	15.6	30.077	30.96	29.21	.36	78.4	West	16.66	17.8	....	..	38.3	21	3.65	..	21	January
February	7.23	— 8.22	38 0	—18 7	16.0	30.114	30.61	29 31	.32	75.4	S. 83° W.	19 26	24.8	0 35	3	21.5	20	2 51	3	20	February
March	21 78	— .21	44.2	— 5.4	14 8	30.062	30.94	29.14	.36	82.9	S. 69° W.	17.50	38.8	2.40	7	15.9	14	4 01	4	17	March
April	39.27	— 1.52	61.8	19.5	14.3	29.943	30 50	29.43	.24	76.0	West	17.05	33.7	3.14	12	6.5	5	3.81	0	17	April
May	59.72	+ 4.79	78 9	39.8	18.9	29.925	30.30	29.42	.18	66.5	S. 59° W.	15.62	56.0	4.80	11	.....	..	4.80	..	11	May
June	64.60	— .13	83 8	46.6	16.3	29.985	30.30	29.48	.17	85.0	N. 51° W.	9.70	60.4	2.81	13	....	..	2.81	..	13	June
July	68.38	— .42	90.1	49 5	15.4	29.929	30.18	29.44	.12	77.5	N. 73° W.	8.94	54.0	2.95	17	...	..	2.95	..	17	July
August	61 39	— 2.08	81 8	50.0	15.4	29.981	30.38	29.54	.23	77.5	S. 74° W.	11.69	60.6	5.26	13	....	..	5.26	..	13	August
September	54.22	— 4.27	74.1	34.2	14.4	30.039	30.57	29.34	.25	83.3	S. 66° W.	13.00	43.8	6.66	15	0.0	1	6.66	0	16	September
October	43 39	— 2.52	68 0	23 0	13.1	30 034	30.57	29 21	.26	87.8	S. 43° W.	14.64	35.1	3.21	14	0.0	1	3.21	0	15	October
November	29.64	— 2.91	51.8	6.9	11.9	29.959	30.72	29.24	.27	86.7	N. 30° W.	12.57	21.6	0.39	6	10.6	9	1.22	0	15	November
December	9 44	— 9.17	36.4	— 14.0	12.7	30.032	30.62	29 08	.30	79.2	N. 80° W.	11.65	28 8	0.48	3	30.3	17	3.36	3	17	December
Sums for 1904	....	....	....	....	....	...	....	....	....	....	....	....	....	32.45	114	123.1	88	44.25	10	192	Sums for 1904
Means for 1904	30.44	— 2.56	....	....	14.9	30.007	....	....	.26	79.7	S. 82° W.	14.0	39.6	....	....	....	..	....	..	..	Means for 1904
Means for 30 years ending Dec. 31, 1904	42.00	....	...	....	...	29.980	....	....	....	75.7	....	14.75	§45.1	29.05	....	120.4	..	41.08	..	..	Means for 30 years ending Dec. 31, 1904.

* Barometer readings reduced to 32° Fah. and to sea level. † The monthly thermometer and barometer means are derived from bi-hourly readings taken from self-recording instruments, beginning 1 h. 0 m. Eastern Standard time. ¶ "+" indicates that the temperature has been *higher*: "—" that it has been *lower* than the average for 30 years inclusive of 1904. ‡ Humidity relative, saturation being 100; the humidity means are derived from observations made at 8 *h*, 15 *h* and 20 *h*. § For 23 years only. *a* For 18 years only. The anemometer and wind vane are on the summit of Mount Royal, 54 feet above the ground and 807 feet above sea level.

The greatest heat was 90.1° (Fah.) above zero on July 19th; the greatest cold was 20.7 below zero on Jan. 4th. The extreme range of temperature was, therefore, 110.8°. Greatest thermometer range in one day was 38.2° on Feb. 1st; least range was 3 6° on Dec. 23rd. The warmest day was July 19th, when the mean temperature was 78.3° above zero. The coldest day was Jan. 4th, when the mean temperature was 14.6° below zero. The minimum relative humidity observed was 30 on Jan. 4th and May 6th. The greatest mileage of wind recorded in one hour was 56 on Feb. 16th, and the greatest velocity in gusts was at the rate of 72 miles per hour on Feb. 10, March 3rd and April 5th. The total mileage of wind was 122,261. The resultant direction of the wind for the year was S. 82° W., and the resultant mileage 46378. Lunar halo was observed on 1 night. Lunar coronas on 2 nights. Auroras on 3 nights.

Earthquakes on March 21st and Sept. 14th.

Fog on 2 days; thunderstorms on 21 days; total number of thunderstorms 24. First sleighing of winter in city was on Nov. 27th. The first appreciable snowfall of the autumn was on Nov. 25th. The first trace of snow was on Sept. 21st.

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

1905.

I. McLEOD, *Superintendent.*

	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
Su	....	....	....	1 .... SUNDAY
	.08	....	.08	2
	....	....	....	3
	....	....	....	4
	....	....	....	5
	....	6.7	.60	6
	....	6.2	.64	7
Su	....	2.2	.14	8 .... SUNDAY
	....	....	....	9
	....	2.3	.20	10
	....	....	....	11
	.00	8.5	.85	12
	....	....	....	13
	....	....	....	14
Su	....	.6	.05	15 .... SUNDAY
	...	4.1	.38	16
	....	1.3	.12	17
	.. .	.8	.07	18
	....	5.9	.63	19
	...	....	....	20
	....	.7	.07	21
Su	....	1.0	.10	22 .... SUNDAY
	....	....	....	23
	....	...	....	24
	....	....	....	25
	....	....	....	26
	....	3.3	.30	27
	....	2.0	.20	28
Su	....	.0	.00	29 .... SUNDAY
	....	....	....	30
	....	....	....	31
Me	.08	45.6	4.43	.... Sums ....
3 for this	.80	30.8	3.74	31 Years means for and including this month.

Warmest day was the 1st. Coldest day was the 5th.

Highest barometer reading was 30.79 on the 11th; lowest barometer was 29.15 on the 7th, giving a range of 1.64 inches.

Minimum relative humidity observed, was 48 on the 5th.

Rain fell on 2 days.

Snow fell on 15 days.

Rain and Snow on 1 day.

Slight aurora on the 14th inst.

Depth of snow on ground at end of month 30 inches.

ABSTRACT FOR THE MONTH OF JANUARY, 1905.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	35.9	37.0	34.8	2.2	29.71	29.79	29.53	.26	96	S W.	15.9	..	....	....	....	1..........SUNDAY
2	28.3	35.8	10.5	25.3	29.80	29.95	29.76	.19	97	N.E.	9.6	..	.08	...	.08	2
3	1.2	9.4	−3.5	12.9	30.03	30.09	29.95	.14	60	N.E.	11.2	..	....	....	....	3
4	−2.4	1.0	−7.7	8.7	30.03	30.18	29.96	.22	62	N.W.	12.8	61	....	....	....	4
5	−6.8	−4.0	−10.4	6.4	30.46	30.64	30.18	.46	51	N.W.	3.2	78	....	....	....	5
6	−3.3	5.5	−11.3	16.8	30.50	30.65	30.21	.44	69	N.E.	14.6	..	....	6.7	.60	6
7	21.6	32.5	4.8	27.7	29.51	30.21	29.15	1.06	92	N.E.	25.0	03	....	6.2	.64	7
SUNDAY....... 8	16.9	24.4	10.2	14.2	29.68	30.10	29.38	.72	87	S.W.	22.9	44	....	2.2	.14	8..........SUNDAY
9	18.0	28.0	8.0	20.0	30.33	30.44	30.10	.34	89	S.W.	15.8	.	....	....	....	9
10	18.5	24.0	12.4	11.6	30.28	30.51	30.15	.36	79	S.W.	26.4	75	....	2.3	.20	10
11	3.1	12.4	−3.6	16.0	30.69	30.79	30.51	.28	75	N.W.	14.4	42	....	....	....	11
12	9.7	18.3	2.0	16.3	29.99	30.59	29.71	.88	89	N.E.	9.1	..	.00	8.5	.85	12
13	4.3	14.3	−1.0	15.3	30.26	30.35	29.91	.44	74	N.W.	15.5	86	....	....	....	13
14	−4.1	3.9	−8.0	11.9	30.33	30.38	30.30	.08	68	N.W.	10.9	53	....	....	....	14
SUNDAY........15	6.7	15.2	−8.4	23.6	30.04	30.31	29.86	.45	81	S.W.	22.7	09	....	.6	.05	15..........SUNDAY
16	17.4	21.8	12.0	9.8	29.82	29.90	29.72	.18	85	S.W.	21.9	44	...	4.1	.38	16
17	16.6	20.0	11.6	8.4	29.91	30.00	29.72	.28	87	N.W.	13.8	48	....	1.3	.12	17
18	4.4	11.5	−0.9	12.4	30.14	30.26	29.87	.39	79	N.E.	8.8	27	...	.8	.07	18
19	28.0	36.3	0.5	35.8	29.52	29.87	29.35	.52	90	S.W.	23.9	22	....	5.9	.63	19
20	13.9	19.3	9.0	10.3	29.97	30.10	29.67	.43	78	S.W.	11.4	77	...	....	....	20
21	5.5	7.4	−2.5	9.9	30.16	30.22	30.10	.12	79	N.E.	8.0	..	....	.7	.07	21
SUNDAY....... 22	10.6	14.2	5.7	8.5	30.16	30.22	30.09	.13	83	S.W.	8.3	14	....	1.0	.10	22..........SUNDAY
23	2.4	8.2	−3.3	11.5	30.31	30.35	30.22	.13	68	S.W.	10.7	81	....	....	....	23
24	−2.8	1.9	−11.0	12.9	30.23	30.31	30.16	.15	65	N.E.	11.7	05	....	...	....	24
25	1.2	6.2	−3.0	9.2	30.13	30.17	30.10	.07	67	N.E.	24.7	37	....	....	....	25
26	−2.1	2.5	−8.5	11.0	30.14	30.17	30.09	.08	75	S.W.	22.1	61	....	....	....	26
27	9.5	18.0	−2.0	20.0	29.99	30.17	29.84	.33	90	S.W.	15.0	..	....	3.3	.30	27
28	15.7	22.0	9.7	12.3	29.91	30.14	29.80	.34	88	S.W.	8.5	..	....	2.0	.20	28
SUNDAY........29	3.8	13.8	−3.5	17.3	30.33	30.38	30.14	.24	72	S.W.	11.5	69	....	.0	.00	29..........SUNDAY
30	6.6	12.0	−1.0	13.0	30.49	30.60	30.35	.25	76	W.	8.0	81	....	....	....	30
31	−0.5	5.2	−8.5	13.7	30.53	30.61	30.43	.18	70	N.E.	8.2	03	....	....	....	31
Means............	8.96	15.4	1.1	14.3	30.109	30.27	29.95	.33	78.1	N 77° W	14.41	.33	.08	45.6	4.43	.......Sums ....
31 Years means for and including this month......	12.18	20.4	4.2	16.2	30.049	......	......	.34	82.3	......	§ 16.15	¶ 33.7	.80	30.8	3.74	31 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	157	2723	83	231	339	2424	3272	1493	
Duration in hrs..	18	211	12	22	34	130	191	113	13
Mean velocity....	8.7	12.9	6.9	10.9	10.0	18.6	17.1	13.2	

Greatest mileage in one hour was 44 on the 19th.
Greatest velocity in gusts was 60 on the 19th.
Resultant mileage, 3,980.

Resultant direction, N.77°W.
Total mileage, 10,722.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 24 years only. § 19 years only.

The greatest heat was 37.0° above zero on the 1st. The greatest cold was 11.3° below zero on the 6th, giving a range of temperature of 48.3 degrees.

Warmest day was the 1st. Coldest day was the 5th.

Highest barometer reading was 30.79 on the 11th: lowest barometer was 29.15 on the 7th, giving a range of 1.64 inches.

Minimum relative humidity observed, was 48 on the 5th.

Rain fell on 2 days.

Snow fell on 15 days.

Rain and Snow on 1 day.

Slight aurora on the 14th inst.

Depth of snow on ground at end of month 30 inches.

Y, 1905.

H. McLEOD, *Superintendent.*

	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	....	....	....	1
	....	1.4	.14	2
	....	.3	.03	3
	....	....	....	4
Su	....	....	....	5 ....SUNDAY
	....	7.6	.80	6
	....	1.5	.15	7
	....	....	....	8
	....	5.5	.56	9
	....	6.5	.66	10
	....	...	....	11
Su	....	4.5	.46	12..........SUNDAY
	....	4.5	.46	13
	....	....	....	14
	....	.5	.06	15
	...	.6	.04	16
	....	3.4	.34	17
	....	1.2	.12	18
Su	....	....	....	19..........SUNDAY
	....	....	....	20
	....	....	....	21
	....	....	....	22
	....	....	....	23
	....	...	....	24
	....	....	....	25
Su	....	0.0	.00	26 ....SUNDAY
	....	0.0	.00	27
	....	1.4	.15	28
M	....	38.9	3.97	.......Sums.........
3 for thi	0.74	24.0	3.16	31 Years means for and including this month.

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Highest barometer reading was 30.67 on the 5th; lowest barometer was 29.32 on the 13th, giving a range of 1.35 inches.

Minimum relative humidity observed, was 53 on the 23rd.

Snow fell on 15 days.

Lunar halos on the 14th and 24th.

Aurora observed on the night of the 4th. Dark cloud bank with luminous upper edge. After midnight a faint arch. Luminous clouds on the 22nd and 23rd.

Depth of snow on ground at end of month 36 inches.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1905.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	3.8	7.9	—3.0	10.9	30.24	30.40	30.01	.39	75	S.W.	7.3	29	....	....	....	1
2	4.9	7.3	—0.6	7.9	29.94	30.01	29.90	.11	81	S.W.	25.1	34	....	1.4	.14	2
3	—2.7	3.8	—8.0	11.8	30.22	30.43	29.98	.45	68	S.W.	28.6	84	....	.3	.03	3
4	0.8	3.5	—2.5	6.0	30.50	30.54	30.43	.11	68	W.	14.6	76	....	....	....	4
SUNDAY........ 5	3.1	8.4	—6.2	14.6	30.58	30.67	30.40	.27	71	N.W.	5.0	68	....	....	....	5 ....SUNDAY
6	11.4	18.2	3.4	14.8	30.12	30.45	29.91	.54	89	N.E.	8.6	.	....	7.6	.80	6
7	13.4	17.7	9.0	8.7	30.13	30.44	29.92	.52	81	N.W.	13.1	60	....	1.5	.15	7
8	4.2	12.0	—3.8	15.8	30.48	30.57	30.30	.27	74	N.W.	6.2	79	....	....	....	8
9	19.7	31.2	—1.7	32.9	29.94	30.30	29.75	.55	89	S.E.	17.3	..	....	5.5	.56	9
10	26.8	30.9	20.4	10.5	29.74	29.91	29.65	.26	90	N.W.	17.9	08	....	6.5	.66	10
11	2.1	18.3	—2.2	20.5	30.36	30.54	29.91	.63	68	N.W.	24.5	98	....	....	....	11
SUNDAY....... 12	0.4	5.4	—7.5	12.9	30.15	30.53	29.60	.93	75	N.E.	8.7	48	....	4.5	.46	12...........SUNDAY
13	9.9	21.0	2.8	18.2	29.44	29.61	29.32	.29	81	S.W.	22.0	..	....	4.5	.46	13
14	2.7	8.9	—6.0	14.9	29.89	29.98	29.61	.37	73	N.W.	22.6	54	....	....	....	14
15	7.5	10.0	4.5	5.5	30.06	30.19	29.97	.22	77	N.W.	7.5	68	....	.5	.06	15
16	3.0	10.0	—9.2	19.2	30.20	30.32	29.99	.33	77	W.	15.7	68	...	.6	.04	16
17	18.5	24.5	7.2	17.3	29.79	29.99	29.65	.34	93	S.W.	15.0	..	....	3.4	.34	17
18	8.6	24.6	—0.2	24.8	30.05	30.39	29.65	.74	73	N.W.	27.3	64	....	1.2	.12	18
SUNDAY........19	2.7	7.9	—5.7	13.6	30.52	30.59	30.39	.20	75	N.W.	18.8	90	....	....	....	19...........SUNDAY
20	24.5	34.9	3.3	31.6	30.18	30.49	30.06	.43	92	S.W.	25.9	..	....	....	....	20
21	17.7	34.8	7.5	27.3	30.40	30.50	30.10	.40	78	N.E.	15.7	56	....	....	....	21
22	10.8	16.2	4.2	12.0	30.42	30.50	30.36	.14	80	N.E.	13.3	..	....	....	....	22
23	17.5	22.0	11.6	10.4	30.30	30.36	30.24	.12	69	N.E.	6.6	50	....	....	....	23
24	20.1	27.0	10.1	16.9	30.18	30.26	30.06	.20	89	N.W.	3.3	46	....	...	....	24
25	16.6	24.6	8.4	16.2	29.87	30.06	29.72	.34	84	N.E.	6.1	37	....	....	....	25
SUNDAY........26	18.2	28.9	8.5	20.4	29.69	29.74	29.65	.09	80	S.W.	13.5	15	....	0.0	.00	26 ....SUNDAY
27	13.6	22.2	3.5	18.7	29.83	29.91	29.74	.17	81	N.W.	23.6	97	....	0.0	.00	27
28	20.6	25.5	16.4	9.1	29.77	29.92	29.68	.24	86	N.W.	12.0	20	....	1.4	.15	28
Means......	10.74	18.1	2.3	15.8	30.107	30.27	29.93	.34	79.2	N 78° W	15.21	44.5	....	38.9	3.97	.......Sums ....
31 Years means for and including this month	15.30	23.3	7.3	15.8	30.015	......	......	.31	80.5	......	§ 18.12	¶ 40.8	0.74	24.0	3.16	31 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	238	1337	153	244	792	2027	2287	3144	
Duration in hrs..	32	133	17	24	55	101	125	168	17
Mean velocity....	7.4	10.1	9.0	10.2	14.4	20.1	18.2	18.7	

Greatest mileage in one hour was 41 on the 18th.
Greatest velocity in gusts was 60 on the 18th.
Resultant mileage, 4,781.

Resultant direction, N.78°W.
Total mileage, 10,222.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 24 years only. § 19 years only.

The greatest heat was 34.9° above zero on the 20th. The greatest cold was 9.2° below zero on the 16th, giving a range of temperature of 44.1 degrees.

Warmest day was the 10th. Coldest day was the 3rd.

Highest barometer reading was 30.67 on the 5th; lowest barometer was 29.32 on the 13th, giving a range of 1.35 inches.

Minimum relative humidity observed, was 53 on the 23rd.

Snow fell on 15 days.

Lunar halos on the 14th and 24th.

Aurora observed on the night of the 4th. Dark cloud bank with luminous upper edge. After midnight a faint arch. Luminous clouds on the 22nd and 23rd.

Depth of snow on ground at end of month 36 inches.

1905.

H. McLEOD, *Superintendent.*

Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
....	....	....	1
....	....	....	2
....	0.0	.00	3
....	0.0	.00	4
....	.9	.09	5 ....SUNDAY
....	0.0	.00	6
....	....	....	7
....	1.8	.18	8
....	....	....	9
....	....	....	10
....	....	....	11
....	....	....	12..........SUNDAY
....	....	....	13
....	....	....	14
....	....	....	15
....	....	....	16
....	....	....	17
.44	....	.44	18
.31	....	.31	19 ....SUNDAY
....	....	....	20
....	....	....	21
....	....	....	22
....	....	....	23
.11	....	.11	24
.45	....	.45	25
.00	....	.00	26..........SUNDAY
.46	....	.46	27
.00	....	.00	28
....	....	....	29
.11	....	.11	30
....	....	....	31
1.88	2.7	2.15	.......Sums.........
1.44	22.3	3.82	31 Years means for and including this month.

Highest barometer reading was 30.56 on the 13th and 15th; lowest barometer was 29.52 on the 19th, giving a range of 1.04 inches.

Minimum relative humidity observed, was 54 on the 11th.

Rain fell on 8 days.

Snow fell on 5 days.

Auroras on the 6th, 14th and 31st.

Fog on 1 day.

Snow on ground at end of month in patches.

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ABSTRACT FOR THE MONTH OF MARCH, 1905.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	11.6	20.0	3.2	16.8	29.99	30.03	29.93	.10	79	N.W.	13.5	75	....	....	....	1
2	12.9	18.4	6.1	12.3	29.97	30.02	29.92	.10	80	N.W.	23.3	97	....	....	....	2
3	21.3	28.0	11.6	16.4	29.83	29.92	29.76	.16	93	S W.	21.8	..	....	0.0	.00	3
4	13.5	21.5	9.6	11.9	29.99	30.20	29.76	.44	69	N.W.	12.7	81	....	0.0	.00	4
SUNDAY........ 5	11.2	17.4	1.0	16.4	30.15	30.25	30.02	.23	86	S. N.W.	10.4	41	....	.9	.09	5 ....SUNDAY
6	12.8	16.5	8.0	8.5	30.38	30.55	30.11	.44	74	S.E.	18.3	93	....	0.0	.00	6
7	15.7	24.8	3.2	21.6	30.34	30.55	30.10	.45	80		15.3	44	....	....	....	7
8	23.8	30.3	18.0	12.3	29.92	30.10	29.86	.24	91	S.W.	10.1	..	....	1.8	.18	8
9	20.6	25 2	17.3	7.9	29.90	30.01	29.76	.25	85	S.W.	11.8	13	....	....	....	9
10	23.1	33.0	17.2	15.8	29.75	29.90	29.68	.22	90	S.W.	22.0	42	....	....	....	10
11	14.2	20.0	6.3	13.7	30.17	30.31	29.90	.41	66	S.W.	22.9	93	....	....	....	11
SUNDAY....... 12	13.1	19.0	3.8	15.2	30.34	30.37	30.29	.08	71	S.W.	22.8	94	....	....	....	12 ....SUNDAY
13	7.2	16.5	—1.0	17.5	30.47	30.56	30.33	.23	70	S.W.	13.2	82	....	....	....	13
14	10.8	20.2	—0.7	20.9	30.46	30.49	30.43	.06	77	S.W.	16.0	57	....	....	....	14
15	18.9	26.8	10.3	16.5	30.48	30.56	30.41	.15	79	S.W.	24.7	95	....	....	....	15
16	24.3	31.8	16.2	15.6	30.33	30.41	30.29	.12	81	S.W.	19.3	33	...	....	.....	16
17	27.0	32.4	15.8	16.6	30.16	30.30	29.96	.34	82	S.W.	13.4	84	....	....	....	17
18	37.5	44.0	29.0	15.0	29.69	29.96	29.54	.42	88	S.W.	23.7	1	.44	....	.44	18
SUNDAY 19	30.4	42.0	23.2	18.8	29.90	30.16	29.52	.64	83	N.E.	15.2	31	.31	....	.31	19...........SUNDAY
20	20.6	26.8	13.1	13.7	30.22	30.26	30.16	.10	80	N.E.	14.9	76	...	....	....	20
21	23.4	31.5	11.0	20.5	30.19	30.27	30.10	.17	79	N.E.	14.0	17	....	....	....	21
22	28.3	37.4	19.3	18.1	30.20	30.27	30.11	.16	77	N.E.	9.5	93	....	....	....	22
23	34.1	41.8	31.0	10 8	30.28	30.34	30.22	.12	76	S.	10.3	30	....	....	....	23
24	37.5	41.5	34.0	7.5	30.03	30.22	29.94	.28	81	S.E.	21.3	38	.11	....	.11	24
25	37.9	41.0	34.7	6.3	29.96	30.01	29.94	.07	92	W.	9.0	07	.45	....	.45	25
SUNDAY.......26	34.8	40.5	30.4	10.1	29.91	30.00	29.79	.21	88	N.E.	6.3	44	.00	....	.00	26...........SUNDAY
27	36.9	42.3	33.7	8.6	29.74	29.86	29.68	.18	92	S.W.	19.3	..	.46	....	.46	27
28	40.0	45.6	35.8	9.8	30.01	30.07	29.86	.21	79	N.W.	15.2	05	.00	....	.00	28
29	42.2	48.5	35.9	12.6	30.04	30.09	30.00	.09	73	N.	9.5	86	....	....	....	29
30	46.2	60.5	38.7	21.8	29 94	30.00	29.87	.13	80	S.W.	23.3	22	.11	....	.11	30
31	38.5	44.8	34.0	10.8	30.13	30.20	30.00	.20	68	W.	21.7	74	....	....	....	31
Means......	24.85	31.9	17.7	14.2	30.093	30.20	29.97	.23	80.3	S 73° W	16.28	50	1.88	2.7	2.15	.......Sums ....
31 Years means for and including this month	24.99	32.1	17.6	14.5	29.984	......	......	.28	77.6	......	§ 17.57	¶ 45.3	1.44	22.3	3.82	31 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	668	1560	146	312	1276	3501	3717	935	
Duration in hrs..	65	116	18	25	91	180	188	61	
Mean velocity....	10 3	13.5	8.1	12.9	14.0	19.5	19 7	15.3	

Greatest mileage in one hour was 36 on the 15th.
Greatest velocity in gusts was 48 on the 15th
Resultant mileage 5,799

Resultant direction, S.73°W.
Total mileage, 12,115.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 24 years only. § 19 years only.

The greatest heat was 60.5° above zero on the 30th. The greatest cold was 1.0° below zero on the 13th, giving a range of temperature of 61.5 degrees.

Warmest day was the 30th. Coldest day was the 13th.

Highest barometer reading was 30.56 on the 13th and 15th; lowest barometer was 29.52 on the 19th, giving a range of 1.04 inches.

Minimum relative humidity observed, was 54 on the 11th.

Rain fell on 8 days.

Snow fell on 5 days.

Auroras on the 6th, 14th and 31st.

Fog on 1 day.

Snow on ground at end of month in patches.

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THE CANADIAN RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF

THE NATURAL HISTORY SOCIETY OF MONTREAL,

AND REPLACING

THE CANADIAN NATURALIST.

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THE

CANADIAN RECORD

OF SCIENCE.

VOL. IX. OCTOBER, 1904. No. 5.

Analcite-Trachyte Tuffs and Breccias from South West Alberta, Canada.*

C. W. Knight.

(INTRODUCTION.)

In this paper are described a series of tuffs and breccias found in the south west corner of Alberta, Canada, some five miles west of the Livingstone Range. They have been carefully mapped in townships 7, 8, 9 and 10, ranges 3, 4 and 5 west of the fifth meridan. Roughly speaking, the district lies about twelve miles east of the eastern boundary of British Columbia and some fifty miles north of the international boundary. Their existence here has been known since the early eighties when G. M. Dawson of the Canadian Geological Survey referred to them in his report on the Rocky mountains.[2]

The occurrence of analcite ($Na_2O.\ Al_2O_3.\ 4SiO_2.\ 2H_2O$) in these pyroclastic rocks makes an interesting study. Its presence has not been previously noted by other writers. No microscopic or chemical descriptions of the rocks have been written. The mineral has lately attracted much attention as regards its origin in igneous rocks; and its formula, which may be written in various ways, especially as regards the interpretation of its one molecule of water,[2] is still uncertain. Its mode of occurence in south west Alberta is unique. Sofar as the writer

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1. Report on the Rocky mountains between lats. 49° and 51°-30′. Report of Can. Geo. Sur. 1886.

2. Bull. 207, U.S. Geo. Sur. p. 8. Clarke and Steiger, 1902.

is aware it has never been noted occuring under the conditions here described. It is found in crystal-tuffs and breccias having the mineralogical and chemical composition of trachyte. Its form and relation to the minerals with which it is associated lead to the belief that it is a *primary* constituent of these volcanics. In other words, the analcite has been deposited from showers of volcanic debris, simultaneously with the other materials, and was therefore a primary constituent of the partially consolidated magma which gave rise to these rocks. Its primary nature is further discussed in a later part of this paper, but it may be noted here that it was only during the past fifteen years that analcite has been recognized as a primary constituent of igneous rocks. Rosenbusch still regards it as a secondary mineral.

The fact that analcite is found in a crystal-tuff of the composition of a trachyte, is believed to establish a new rock type, and the name Blairmorite[1] is here suggested for it. This point is more fully discussed later on.

Therock specimens studied in this paper are nearly all from the museum of the Canadian Geological Survey. The collection was originally placed by Dr. A. E. Barlow of the survey, in the hands of Dr. C. W. Dickson, now of Queen's University, Kingston, for investigation, but as opportunity failed Dr. Dickson he very kindly placed the specimens in the writer's hands. The work was carried on in the geological laboratories of Columbia University, New York. To Professor Kemp and Dr. Berkey of Columbia University, the writer would express his acknowledgement for advice and assistance. The writer's thanks are, however, especially due to the authorities of the Geogolical Survey for the opportunity given him to study a suite of rocks which have proved to be of exceptional interest. Dr. Adams of McGill University, Montreal, added a few specimens to the collection, and also furnished some details of an interesting rock-cut on the Crows Nest branch of the Canadian Pacific Railway, four miles east of Crows Nest Lake.

1. The town of Blairmore is located on the Crows Nest branch of the Canadian Pacific Railway; it is less than two miles from some exposures of the volcanic rocks there described.

General Geology of the District:

Mr. W. W. Leach,[1] who in the summer of 1902 examined the Blairmore-Frank coal field, has, for descriptive purposes, placed these pyroclastics at the top of the Middle and Lower Cretaceous. Accompanying his report is a map showing the distribution of these and other rocks in the district. The volcanics have been traced in a north and south direction at least twenty-four miles. The series attains a maximum thickness of 1500 ft. and where exposed in one of the railway cuts includes some igneous flows of augite-trachyte which contain a great many inclusions similiar to the lava itself. Immediately beneath the volcanics is a thickness of 1850 ft. of various shales and sandstones, while overlying them are gray and black shales and sandstones. The extremely important coal measures of the region lie beneath the three formations just mentioned, although some coal is found above them.

The geological structure of the district is somewhat complex,[2] much faulting and folding being in evidence so that the same strata may outcrop two or three times in an east and west cross-section.

Minerals Found in the Tuffs and Breccias.

The specimens of the volcanics examined consist mostly of crystal-tuffs and breccias, generally of a grayish green or purplish color. The minerals are nearly always present in a fragmentary condition showing rough, angular outlines, although not infrequently the original crystal form has been entirely preserved, and in other cases the rounded condition is suggestive of water action. Only one of the specimens in the collection shows, however, the result of water action in its banded structure.

The following minerals have been identified in the tuffs and breccias: orthoclase, sanidine, analcite, augite, aegirite-augite, aerigite, acmite, diopside, titanite, microcline, anorthoclase, andesine, nephelite, hornblende, apatite, biotite, garnet, magnetite and various secondary minerals, such as chlorite, limonite, calcite, etc. Sodalite is probably present in small quantities and possibly leucite.

---

1. Summary Report Can. Geo. Survey 1902, p. 167.
2. Leach, W. W. Summary Report Can. Geo. Survey 1902, p. 169.

Orthoclase is the most abundant mineral found and is present in almost every case. It is generally fairly fresh. Twinning after the Carlsbad law is quite common while the rarer twins after the Baveno law are found in one thin section examined. The *pyroxenes*, which, with a few exceptions, are all remarkably fresh, include the interesting soda varieties mentioned above; these are recognized by their grass green color, low extinction angles—less than 6°—and the fact that the greatest axis of elasticity lies next the vertical axis. The aegirite-augite has of course higher extinction angles than acmite or aegirite. The *plagioclase felspar* present is andesine, determined by the statistical method and also by measuring extinction angles on crystals twinned according to both the Carlsbad and Albite laws. This lime-soda felspar was only found in two sections, however, and the entire series of tuffs and breccias is characteristically an alkaline one, of trachytic tendency. *Biotite* occurs, but it is rare.

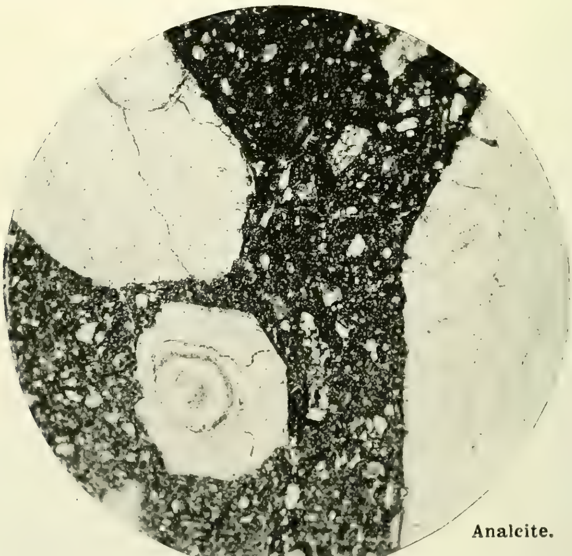

Fig. 1. Analcite-tuff; ordinary light; actual field 2-5 mm. The large white crystals are analcite showiug some of the crystal faces still preserved. Inclusions arranged parallel to the octagonol outline of the mineral are seen in the lower left hand crystal.

The amount of *analcite* present in these pyroclastic rocks varies in the different specimens of which there are forty-three in the collection. In the majority of cases it is entirely lacking while in one it makes up about two-thirds of the material. (Fig. I.) When the crystal form has not been destroyed it is seen to be the icositetrahedron. In some specimens the analcite might be mistaken for certain varieties of garnet. It varies from a reddish brown to a rather dirty cream color, the former being due to iron stains. It will be noted in the analysis of this material given below that 2.85% of ferric oxide is found. Under the microscope it is seen to be clear and colorless in irregular patches, the cloudiness being due partly to the iron stains mentioned and partly to minute inclusions—not always determinable—which are sometimes zonally arranged. This is seen to be the case in the crystal in the lower left hand corner of Fig. I. Optical anomalies are not common. Interesting replacements by calcite have taken place in some of the more weathered specimens. This phenomenon is well shown in Figs. II. and III. Some of the smaller analcites show complete replacement by albite. This seems to have resulted directly from the breaking up of analcite.

The properties of analcite, studied in thin section, are such that it is not always possible to distinguish with certainty this mineral from leucite. Both minerals are isometric, both show optical anomalies; and inclusions, though more characteristic of leucite, are also found in these two minerals. Since, further, the occurence of analcite as a primary mineral in tuffs and breccias has never been described in geological literature up to the present time, it was thought advisable to separate it, by means of heavy solutions, from the other materials and make a quantitative examination. Beforehand, however, it was found to give the characteristic blow-pipe reactions for this zeolite, while small fragments treated with hydrofluosilicic solutions gave the characteristic hexagonal prisms of $Na_2\ Si\ Fl_6$.

The material selected for analysis is shown in Fig. I. It was taken from a railway cut on the Crows Nest branch of the Canadian Pacific Railway four miles east of Crows Nest lake.

This specimen might well be called an analcite-tuff, its clastic nature being apparent at a glance. The large white minerals are analcite (3 to 4 mm. in diameter). A few irregular prisms of a soda-pyroxene occur; they are, however, almost entirely replaced by calcite and to a lesser extent by what is undoubtedly secondary analcite. This latter mineral is perfectly clear and colorless, and is unlike the primary analcite in this respect. The fine grained matrix consists of small fragments of analcite and soda-pyroxene.

Thoulet's solution was used for the separation. On account of the very fine grained matrix a perfectly pure product was not obtained. The result of the analysis, however, as given in table I, No. A., leaves no doubt as to its identity.

It is interesting in this connection to note the experiments of Clarke and Steiger[1] on the action of ammonium chloride upon silicates. The first mineral experimented on was analcite and their work has thrown considerable light on its chemical composition. When a number of analyses of analcite, as given in text-books like Dana's Manual, are studied, it is at once apparent that they differ in a marked degree from the theoretical composition. It is not always possible to account for this difference by impure material used or errors of manipulation. The results of experiments by Clarke and Steiger seem to show that analcite is not a metasilicate as was commonly supposed, but is a mixture of ortho and trisilicates. In most cases the two salts are commingled in the normal ratio 1:1. With this hypothesis the discrepancies in the analyses become intelligible.[2] The variation from the theoretical composition in the analysis made by the writer is due to an imperfect separation by the heavy solution, as is shown by the presence of iron, calcium and magnesium oxides. For comparison the theoretical composition of analcite is given below, together with three other analyses.

1. The action of ammonium chloride upon silicates. Bull. No. 207, U.S. Geol. Sur., 1902.

2. Bull. 207, U.S. Geo. Sur., page 19.

TABLE I.

	A	B	C	D	E
SiO_2	54.39	57.06	55.8	53.92	54.55
Al_2O_3	22.08	21.48	24.1	24.60	23.18
Fe_2O_3	2.85	.13			
CaO	.29	.16			
MgO	.27				
Na_2O	11.75	12.20	12.8	12.23	14.09
K_2O	1.03			1.30	
H_2O at 110°	.55	.58			
H_2O over 110°	7.97	8.38	8.8	8.50	8.18
	101.18	99.99	101.5	100.55	100.00

A. From railway cut near the town of Blairmore on Crows Nest branch of the Canadian Pacific Railway, Alberta, Canada.

B. Wasson's Bluff, Nova Scotia, Canada. Bull 207, U.S. Geo. Sur., p. 8.

C. Brevik, Dana's system of minerology, p. 597.

D. Heldburg, " " " " p. 597.

E. Theoretical composition.

The Primary and Secondary Nature of Analcite in Igneous Rock.

During the past fifteen years the primary and secondary nature of analcite in igneous rocks has been the subject of a good deal of discussion. It was originally thought to occur only as a secondary product, which view is still held by Rosenbusch. The work of Lindgren,[1] (who first recognized analcite as a primary mineral), Pirsson, Cross[2] and others[3] now leaves little doubt that analcite may occur as a primary constituent of igneous rocks. Monchiquite, which was originally described as consisting of olivene and augite in a glassy ground mass, is a good example of a basic analcite-rock. Prof. Pirsson[4] showed

1. Proc. Cal. Acad. Sci. Series 2, Vol. III., July 1890.
2. Report U.S.G.S., 1895, Part II, page 16. Journal of Geology, 1897, page 684.
3. *Washington, H. S*, Am. Jour. Sci., 1898, VI., p. 182-186. *Evans*, Quart. Jour. Geol. Soc., vol. 57, 1901, p. 38. *Ogilvie*, Jour. Geol., vol. X., 1902, p. 500. *Pirsson*, Am. Jour. Sci., 4th Ser., vol 13, 1902, p 161. *Pirsson*, Bull. 237, U.S.G. Sur. 1905.
4. Jour. Geol., 1896, p. 678.

that in certain cases this so called glassy ground mass was really analcite, which was the final product of crystallization. As has been pointed out by Prof. Iddings, the difficulty of distinguishing an isotropic substance like analcite from residual glass is at once apparent.[1] Dr. Coleman has described a dike, closely related to the tinguaites, from the north shore of Lake Superior, which is exceedingly rich in analcite.[2] It contains in some cases as much as 47% of this zeolite. One of the crystal tuffs from Alberta, however, will run even higher than this. Fig. I. is a photo-micrograph of a specimen in which it will be seen that the analcite will run over 60% of the rock. It is practically an analcite-tuff.

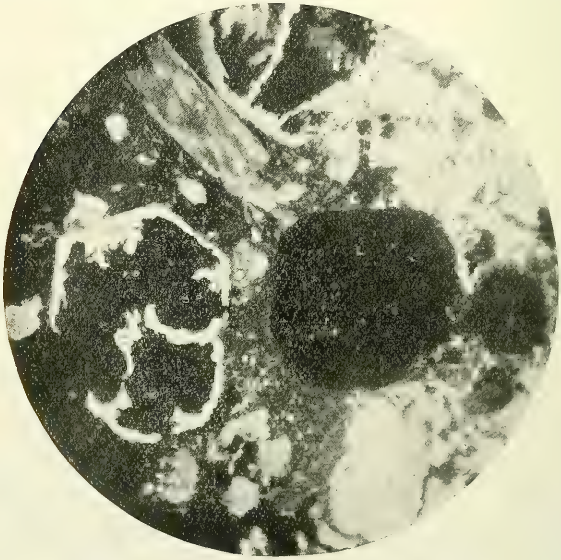

Fig. 2. Analcite replaced by calcite; crossed nicols; actual field is 2·5 mm. The large black crystal with octagonal outline, near the centre of the field, is analcite; it shows no replacement. Immediately to the left is another analcite with hexagonal outline showing replacement by calcite (white) around the edges and ramifying into the centre.

The reasons for believing that analcite is a primary mineral of these tuffs are given below. The word primary means, as already stated, that the analcite has been deposited from

1. Jour. Geo., Vol. I., p. 638.

2. Ont. Bur. of Mines 1898, p. 172. Also Rep for 1899, p. 186.

showers of volcanic debris simultaneously with the other materials of the tuff, and was therefore a primary constituent of the partially consolidated magma which gave rise to these rocks. (1) The analcite almost invariably occurs in crystal fragments or sometimes in nearly perfectly preserved crystals (icositetrahedrons). (2) Though the series of specimens studied are not on the whole fresh, still it is common to find perfectly fresh orthoclase and aegirite closely associated with analcite. This we would not expect to find if analcite were secondary after leucite (as was at one time commonly supposed) because such a radical change in chemical composition could not take place without effecting the orthoclase. (3) The fact that the various minerals sometimes reach a diameter of an inch and a half shows that crystallization took place, partly at least, at considerable depths and therefore under sufficient pressure to retain the necessary water in order that analcite should form. (4) A very insignificant amount of what is undoubtedly secondary analcite does occur, sometimes partly replacing aegirite and sometimes occuring in microscopic veinlets. This material is quite clear and colorless, and differs in this respect from the primary analcite.

It is possible that leucite in very small amount also occurs in the series of rocks, for in the ground mass of a *rock fragment* in a breccia were found roundish, clear, isotropic individuals .005 mm. in diameter. The minuteness of the material made separation of these isotropic crystals impossible; micro-chemical tests, however, were made on the very fine grained ground mass containing these crystals, giving reactions for potash but not for soda, proving the absence of analcite. The potash reaction may have resulted from the orthoclase which also occurs associated with these crystals, so that it cannot be definitely stated that leucite is present.

The Rock Types Found.

There are four rock types which may be distinguished in the specimens examined. About sixty thin sections were studied under the microscope. With one exception all the sections are seen to be characterized by high per cents of soda and potash, while quartz is persistently absent in all of them.

Augite-trachyte. A few of the hand specimens are typical trachytes, showing beautiful flow structures, and consisting essentially of orthoclase in two generations with augite as the ferro-magnesian mineral. Titanite and magnetite are common and persistent accessories, and brown garnets are usually present. Whether these specimens of augite-trachyte were taken from actual flows or whether they are merely rock fragments in the breccias, is not clear from the data accompanying them. A study of the breccias, however, shows that fragments of augite-trachyte are quite common constituents of these pyroclastic rocks. The composition of the majority of the crystal tuffs is also distinctly trachytic.

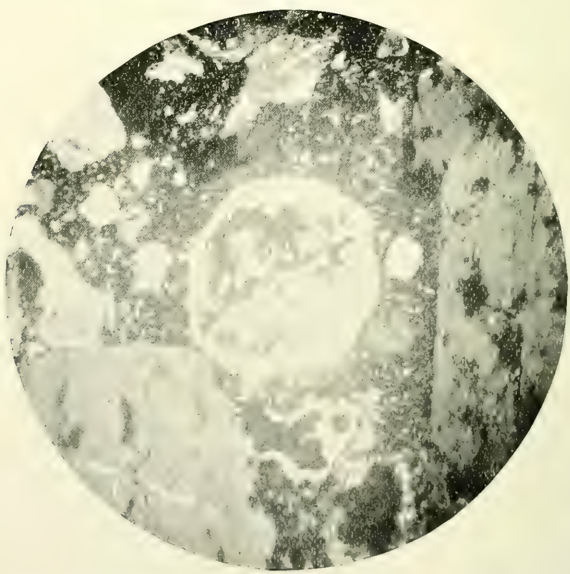

Fig. 3. Analcite replaced by calcite; crossed nicols; actual field is 2-5 mm. The mineral with octagonal outline in the centre of the field is analcite, now almost entirely replaced by calcite (white).

Tirguaite. One hand specimen only in the collection illustrates this type. It is a holocrystalline porphyritic rock with phenocrycts of orthoclase (over an inch in diameter) and augite set in a ground mass of orthoclase laths, nephelite and many aegirite prisms and needles. This rock is interesting because it was no doubt from a magna of this composition that the soda-pyroxenes of the crystal-tuffs were derived. The data accompanying the specimen do not state whether it occurs as a flow or as rock fragments in the breccia.

Andesite. One thin section of a crystal-tuff contains large quantities of the plagioclase felspar andesine. From this it may be inferred that parts of the magna from which these clastic rocks were derived, had the composition of andesite. This type is quite insignificant, the series as a whole being characteristically trachytic.

Analcite-trachyte. The presence of analcite in crystal-tuffs whose other dominant mineral is orthoclase, has resulted in a tuff having the chemical and mineralogical composition of an analcite-trachyte. In proposing a new name for this type it is to be understood, however, that no igneous flows have been found, so that the name *Blairmorite*, as suggested at the beginning of this paper, must at present be applied to the crystal tuff having the chemical and mineralogical composition of analcite-trachyte, in other words, a *blairmorite*-tuff. But a volcanic rock of such composition will no doubt be found in place in some part of the world ; the analcite will occur in well developed phenocrysts (icositetrahedrons), as is shown by the crystal forms found in the tuffs described in this paper. Such a statement does not seem unreasonable since in the series of tuffs and breccias here studied, one small *rock-fragment* of this type was found. It consists of phenocrysts of orthoclase and analcite less than 1 mm. in diameter set in a ground mass of felspar laths (a few of which have the twinning lamellae of the plagioclases) and a few smaller analcites. Some titanite is also present. The fragment was certainly derived from a magma having the composition of an analcite-trachyte, and it is possible that further field work in this district may reveal the presence of such a volcanic flow.

Chemical Composition of Blairmorite.

In order to study the chemical composition of *blairmorite-tuff*, a typical specimen was selected for analysis. The writer is greatly indebted to Dr. Dickson of Queen's University, Kingston, Canada, for his kindness in preparing this analysis, which was done in duplicate. A thin section from the specimen when examined under the microscope, shows it to consist of analcite and orthoclase fragments about 3 mm. in diameter, together with three or four prisms of aegirite augite about 1 mm. long. The finer grained matrix consists of a mixture of orthoclase, analcite, aegirite-augite and small fragments of garnet. Orthoclase makes up the greater part of this matrix. The particular slide examined showed analcite to be in excess of orthoclase; but judging from the relative amounts of alkalies as given in Dr. Dickson's analysis, column II, table II, it seems that the specimen as a whole contains excess of orthoclase.

TABLE No. II.

	I	II	IIA.	III
SiO_2	47.82	54.95	.916	52.83
Al_2O_3	13.56	18.64	.182	20.70
Fe_2O_3	4.73	4.75	.029	2.84
FeO	4.54	1.55	.021	1.19
MgO	7.49	0.60	.015	.41
CaO	8.91	2.27	.041	1.00
Na_2O	4.37	4.91	.079	9.94
K_2O	3.23	7.65	.081	4.87
H_2O+	3.37	3.35	.185	5.28
H_2O-		0.90		.37
TiO_2	0.67	0.42	.005	0.16
P_2O_5	1.10	0.18	.001	0.03
Cl	0.04			0.06
Mn O	Trace	0.34	.005	
Ba O	0.16			
SrO	0.21			
	100.20	100.51		99.62

I. Analcite basalt from dike on east side of Highwood Gap. H. W. Foote, analyst.[1]

II. Analcite-trachyte-tuff from a point some six miles south of the town of Blairmore which is situated on the Crows Nest branch of the Canadian Pacific Railway. The specimen

1. Igneous rocks, Highwood Mountains, Mont. L. V. Pirsson, Bull. No. 237 U. S. Geol. Sur. 1905.

was collected by W. W. Leach. Analyst, Dr. C. W. Dickson, Queen's University. In column IIA, the molecular proportions of this analysis are given.

III. Analcite tinguaite, San José, Tamaulipas, Mexico. H. S. Washington, analyst.[1]

For comparison two other analyses of analcite rocks are given in columns I and III. No. III is an analcite tinguaite described by G. I. Finlay.[2] It is clear, however, from his description that analcite is only an accessory mineral in the rock; and, further, he himself states that: "analcite, chiefly, results by weathering." In the phonolites, a closely related rock of the tinguaites, analcite is also known to occur as a primary mineral; [2] but it was in basic rocks like basalts and monchiquites that this zeolite was first recognized as primary.

A comparison of the analysis in column II with trachytes in general shows that it is fairly typical of this type. The silica is a little below the average, but is too high for leucite rocks like wyomingite and leucitites.[3] The alumina and alkalies also come within the range of the trachytes though the alkalies are a little above the average. The soda is not high enough for the phonolites or tinguaites. The high per cent. of water is of course due to analcite. As is usual in the trachytes the potash predominates over soda, while in the phonolites and tinguaites, on the other hand, we find soda predominating.

If we adopt the new classification of igneous rocks as proposed by Cross, Iddings, Pirsson and Washington,[4] the rock is classified as follows. The standard mineral composition, or *norm*, is first calculated and by means of the relative percents of the minerals so found it is placed in its class, order, range and subrange. Dr. Berkey, of Columbia University, very kindly assisted the writer in these calculations.

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1. Geology of the San José District, Tamaulipas, Mexico. G. I. Finlay. Annals New York Academy of Sciences, XIV, 247-318, 1904.

2. General Geology of the Cripple Creek district. Cross. U. S. G. S., 1895, Part II, p. 16.

3. Rosenbusch p. 364.

4. Quantitative classification of igneous rocks. 1903.

	Percent.		
Orthoclase	45.04	F	Sal.
Albite	25.68		
Anorthite	6.12		
Nephelite + $2H_2O$	9.60	L	
Diopside	3.49	P	Fem.
Magnetite	4.64	M	
Ilmenite	.76		
Hematite	1.44		
Apatite	.31	A	
H_2O	3.11		
	100.19		

Class, $\frac{\text{Sal.}}{\text{Fem}} = \frac{86.44}{10.64} > \frac{7}{1} =$ I, persalane.

Order, $\frac{L}{F} \; \frac{9.60}{76.84} < \frac{1}{7} =$ perfelic $= 5 =$ canadare.

Rang, $\frac{Na_2O + K_2O'}{CaO'} = \frac{160}{22} > \frac{7}{1} =$ peralkalic $= 1$, Nordmarkase.

Subrang, $\frac{K_2O'}{Na_2O'} = \frac{81}{79} < \frac{5}{3} > \frac{3}{5} =$ Sodipotassic $= 3$ Phlegrose.

In closing it may be remarked that *blairmorite* occupies a somewhat similar position to that which theralite (nephelite gabbro) once held. Prof. Rosenbusch gave the name theralite to a rock of this composition and texture previous to its discovery in the Crazy Mountains, Montana, by Wolff.[1]

1. Notes on the Petrography of the Crazy Mts. etc., Northern Transcontinental Survey 1885

Observations upon some Noteworthy Leaf Variations, and their bearing upon Palaeontological evidence.

D. P. Penhallow.

Our attention has been directed somewhat particularly of late to one or two noteworthy instances of leaf variation which seem worthy of record because of their important bearing upon the character of palaeontological evidence, so far as it is represented by fossil leaves. The present discussion is not advanced with a view of proving any new idea, but in the hope that it may serve to somewhat amplify our range of facts as applicable to a view expressed by Ward as long ago as 1888,[1] and since then amply proved by Holm [2] and Berry [3] with respect to *Sassafras officinale* and *Liriodendron tulipifera*. While the evidence thus brought forward amply supports the opinion of botanists generally, that leaves, when considered separately and wholly apart from the parent stem, and especially when presented in a fragmentary condition, afford no proper basis for the scientific recognition of species, any extension of our knowledge which will tend to throw light upon the extent of leaf variation among different species; the range of forms presented by the same species; the distribution of these forms on the plant, and, above all, the conditions under which such variations arise, will no doubt serve a useful purpose in correcting one of the most fruitful sources of error in the palæontological record of the past, since there is no doubt whatever, that the great multiplicity of species recorded in such important works as those of Lesquereux and Newberry and Heer, must eventually undergo revision in the light of such evidence, when it will be found that many forms now separately established are but variants of one species. It is as a small contribution to this end that the present notes are offered.

1. The Palæontologic History of the Genus Platanus. Proc. U. S. Nat. Mus., XI, 1888.
2. Notes on the Leaves of Liriodendron. Proc. U. S. Nat., Mus., XIII, 1890, 15-35
   On the Validity of some fossil species of Liriodendron. Bot. Gaz., XX, 1895, 312-316
3. Additional Notes on Liriodendron Leaves. Torreya, vol. 2, 1902, 33-37

a. *b.*

Fig. 1. LONICERA TARTARICA. *a.* Normal plagiotropic shoots with leaves of average form and size. Growth of several seasons. *b.* A vigorous, orthotropic shoot of one season's growth, with leave of unusual form and size.

In the grounds of McGill University, there are a number of ornamental shrubs which were planted out about 1895. Among these is a clump of tartarian honeysuckle *(Lonicera tartarica)* raised from seed at the Botanic Garden. The clump embraces about ten bushes. Until this year they have presented nothing of an unusual character in their growth. In the spring of 1903 they were top-pruned, but there was not much thinning out. As a result the bushes are now filled with numerous wiry branches which, together with larger and more normal shoots (Fig, 1*a*), bear typical or nearly typical leaves of an oblong or oval form, with a rounded and sometimes cordate base, and an acuminate apex (Fig. 2, 1-7 and Fig. 5, 2-4). According to the description in Gray's Field, Forest & Garden Botany, the leaves should be oval with a cordate base, but this does not apply typically to the shrubs in question, nor does it apply to those I have been familiar with in cultivation. The general form in the present instance, is typified by the series in figure 2. All the shrubs in question show a vigorous growth with the exception of two. As a product of the seasons growth they have extended to a height of about 3 m., this being determined by the development of shoots of unusual vigor and great length. In individual cases these shoots are upwards of 1.5 m. long with a diameter of 1.3 cm. at the base. The fact that some of these shoots originated from buds just below the excision of older branches, seems to suggest that they received an unusual amount of stimulus from the previous pruning. In all such cases, the foliage of such shoots was of unusual size, and it deviated more or less strongly from the type, so much so as to establish a feature which, at a distance of one or two hundred feet, could be easily recognized in contrast with the ordinary foliage.

The two shrubs already referred to as forming an exception to the general vigor of growth, were about 1.5 m in general height, and thus about one-half the stature of the others. One of the these, situated on the southerly side of the clump, exhibited in part, probably to the extent of 30-40%, a remarkable reduction in size and alteration in form of the individual leaf. The second bush is on the

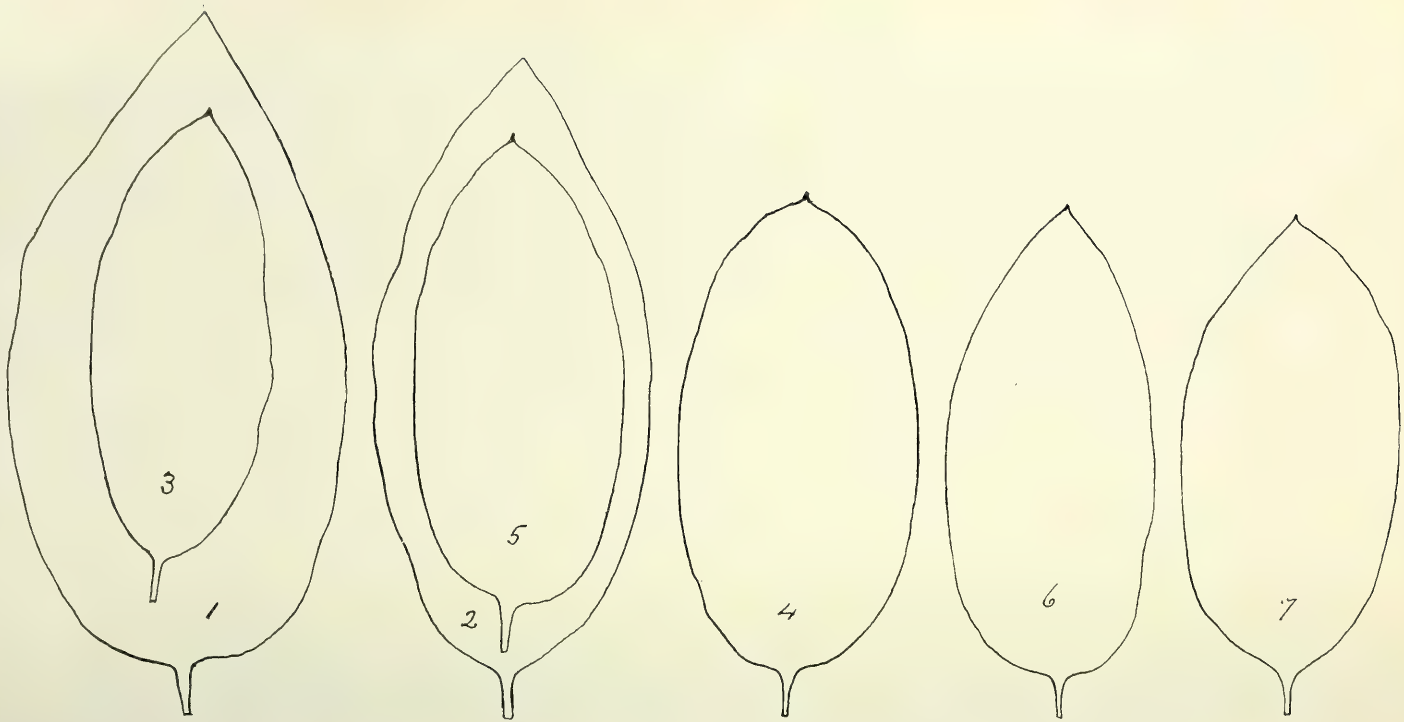

FIG. 2. LONICERA TARTARICA. Leaves of a normal, vegetative and plagiotropic shoot, in acropetal succession from 1–7. $\frac{1}{1}$

westerly side—or more strictly north by west—of the clump, and its very remarkable leaf variation was what first of all directed my attention to the phenomenon. This bush, which had been somewhat severely pruned, was about 1.5 m. in general height. The branches were thick-set, rather short and wiry, so that the whole formed a somewhat compact head quite unlike the loose, plagiotropic branches so characteristic of the shrub. The leaves, instead of lying in one plane which is also common to the shoot, especially when the latter is dorsiventral in position, as is typical of the normal shrub, occupied the most diverse positions, and they also were curled upward from the sides. In figure 4, the series of leaves was taken from a typical branch of this shrub, the sequence of numbers from 1-12 corresponding to acropetal succession for the branch and branchlets, each group of three being taken from a separate branchlet. The more genera character of the foliage is pretty accurately represented by 7. The particular branch from which these examples were taken, was somewhat plagiotropic, and it is a fact of some interest supported by other data, that the smallest leaves were always at the base of the series, the larger being toward the end of the series and so toward the ends of the branches. An inspection of the figures will show that the leaves are all oblong; the base is rounded, never cordate, while it even becomes acute or even somewhat wedge-shaped in consequence of the decurrent blade. (1, 2, 5, 7, 8). The apex varies widely, being either acute and sometimes mucronate (1, 4, 6, 10, 11) as in ordinary foliage, or obtuse and more or less strongly rounded (2, 7, 8, 9.) Together with these alterations, the leaf blade is distinctly relatively thicker and more coriaceous In size, these leaves range from 1.14 sq. cm. to 9.50 sq. cm., the average area being about 5.09 sq. cm.

From the upper extremity of one of the pruned branches of this shrub, there developed a shoot of great vigor, in common with other similar shoots from other portions of the shrub. During the season it reached a length of 1.16 m. with a diameter of 1 cm. at the base. This shoot (Fig. 1*b*) was strictly orthotropic, while its leaves were somewhat plagiotropic, and it presented such remarkable features as to attract immediate attention. In consequence of the erect position of the branch the leaves were strictly decussate, instead of forming one plane with the branch as common to the normal, plagiotropic shoots. The most remarkable peculiarity of the leaves, however, was found in their extreme alteration of form, and their unusual size. In this case the largest leaves were at the base

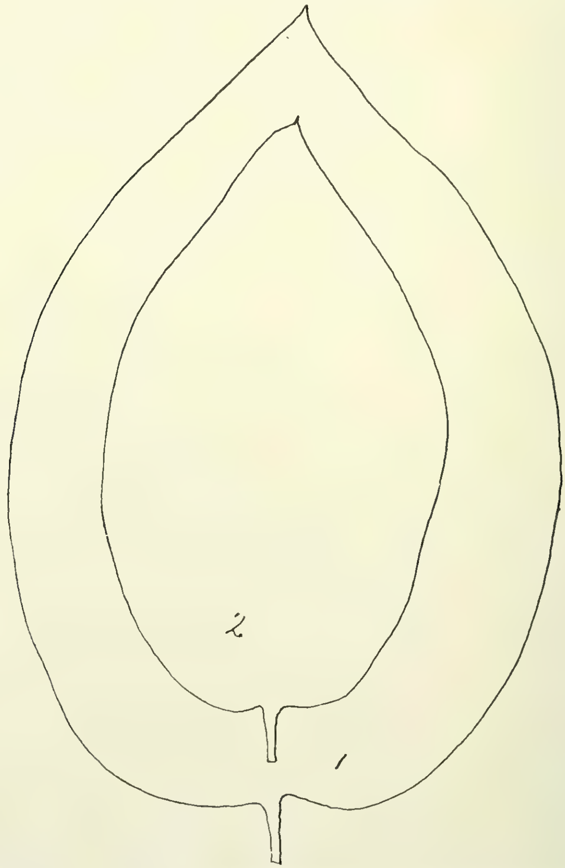

Fig. 3. LONICERA TARTARICA. Leaves of a vigorous and orthotropic shoot of one season. x $\frac{1}{1}$

of the series and the smallest at the end of the branch (Fig. 3, 1 and 2 representing the acropetal succession in the respective positions indicated), the intermediates presenting graduated sizes. As will be seen, these leaves are ovate in form and they have a distinctly cordate base. The leaves of the entire branch show an average area of about 41.61 sq. cm., ranging from 25.85 sq. cm. to 57.37 sq. cm. From this it appears that the same plant produces two sets of leaves under the same general conditions of growth, in which the extreme variation is in the ratio of 1 :50.32, the average variation being in the ratio of 1 :8.17. While we are familiar with the fact that many trees exhibit very striking differences under essentially the same general conditions of growth, the present case appears to be of a most extraordinary nature inasmuch as the different forms appear to be wholly localized and confined to particular regions of the plant ; while the the differences in form and size particularly, are such as, in the case of the basswood, are usually associated with extremes of light and shade. To complete our description of this particular shrub, it should be noted that in addition to growing on that side of the clump which only received the afternoon sum as greatly modified by the proximity of a high building

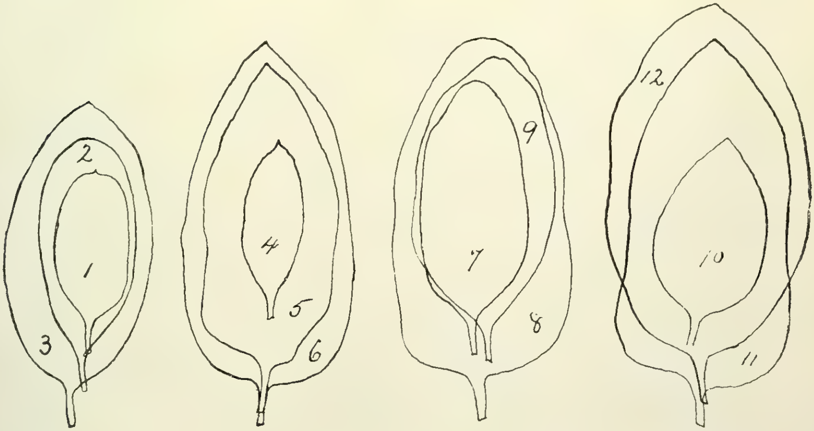

Fig. 4. LONICERA TARTARICA. Leaves from the plagiotropic branches of a much pruned shrub, reduced through correlation. x $\frac{1}{1}$

within 100 feet, it was evidently crowded by the shrubs on each side, and these at any rate established conditions of relative shade by reason of their greater height of three to four feet.

In the case of the first short shrub which I have designated as number four, and which is represented by figure 5, this plant was situated on the easterly side of the clump, and it therefore received the sun only in the early part of the morning, being shaded during the greater part of the day. While this shrub showed about 30 to 40 % of leaves similiar to those of number three (Fig. 4), the majority were strictly dorsi-ventral on plagiotropic branches, and they approximated to the normal type not only in position, but in form and size (Fig. 4, 1-8 in acropetal succession, one of each pair of leaves from the same branch). Here it will be seen that there is marked variation from an orbicular to an oblong-lanceolate leaf, with corresponding differences in size—the largest, (2, 3, 4,) approaching most nearly to the typical leaf, especially with respect to the form of the base. The apex of these leaves is more variable than in other cases, varying from acute to obtuse and mucronate, to retuse. These leaves, which most nearly approach what Gray holds to be the typical form, range in superficial area, from 3.85 sq. cm., to 28.85 sq. cm., with an average of about 13.54 sq. cm. In specimen number 1 (Fig. 2), the leaves from 1-7 represent single members of each pair in acropetal succession, taken from the same branch, This branch was selected because it represented the average character of the prevalent form and size of leaf. It will be noted that although the apex varies somewhat, there is great constancy in the form of the base and the general outline, and not more variation in size than is commonly met with in trees and shrubs generally. These leaves range from 13.00 sq. cm. to 28.33 sq. cm., with an average of area of about 18.28 sq. cm. To recapitulate these dimensions for all our specimens, the following tabulation will be of interest:—

Comparative areas of leaves.

Number of Specimen.	Number of leaf on branch in acropetal succession.	Area in sq. cm.	Average area, sq. cm.	Ratio with No. 1 as(normal) type.	Remarks.
No. 1	1	28.33			
	5	13.51			
	7	13.00	18.28	1:1	Normal leaves.
No. 2	1	57.37			
	2	25.85	41.61	1:2.27	Strongly vegetative shoots.
No. 4	1	7.92			
	2	14.51			
	3	23.90			
	4	28.85			
	5	16.83			
	6	3.85			
	7	6.07			
	8	6.43	13.54	1:0.74	Leaves reduced but approximately normal
No. 3	1	1.56			
	2	2.71			
	3	5.74			
	4	1.14			
	5	5.41			
	6	7.94			
	7	3.33			
	8	4.87			
	10	2.58			
	11	7.58			
	12	9.50	5.09	1:0.27	Reduced leaves.

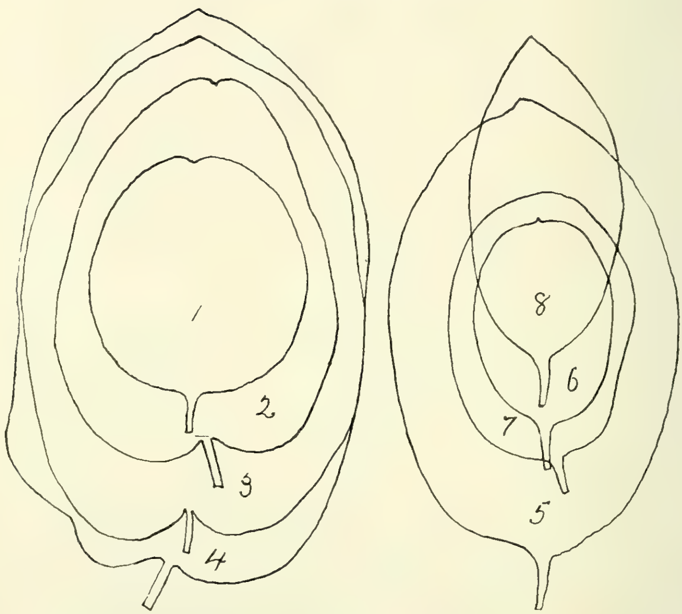

Fig. 5. LONICERA TARTARICA. Leaves from the plagiotropic branches of a pruned shrub, somewhat reduced through correlation. x $\frac{1}{1}$

Apart from the general fact that the growth of all shrubs during the past summer, was characterized by a more than ordinary luxuriance, there appears to be no obvious reason for the phenomenal growth of Lonicera, which requires some special explanation.

In addition to the tartarian honeysuckle. attention has been drawn to three other instances which serve to emphasize the point at issue. Clumps of *Spiraea van houttei* were planted at the same time as the Lonicera, and they have been subjected to the same course of treatment, being top pruned in the spring of 1903. The variation of leaves in this plant is a matter of familiar knowledge, but it offers collateral evidence of much value, as illustrating the conditions under which such variation arises. The strongly defined leaf variation of this plant not only constitutes a conspicuous feature of its growth,

a. *b.*

FIG. 16. SPIRÆA TRILOBATA VANHOUTTEI. *a.* Vigorous shoots of one season, developed after flowering and bearing normal leaves. *b.* Small and wiry flowering shoots bearing reduced leaves, together with more vigorous shoots produced after flowering and bearing small leaves of normal form.

but such variation is always definitely associated with a vegetative or with a reproductive condition of the branches. In the particular shrub selected for observation, there was a somewhat marked luxuriance of growth in the branches of the season (Fig. 6*a*), these being upwards of 1.27 metres long, with a diameter of 1 cm. at the base. Upon such shoots the leaves were altogether normal as to form and size, with here and there an atrophied member of the base of a branchlet (Fig. 7*a*: 3). Leaves of normal form are strongly cuneate, and show a conspicuously decurrent blade. As shown in the series (Fig. 7*a*: 1, 2, 4) the leaves increase in size upwards, but again diminish toward the apex of the shoot, to which position leaf No. 4 belongs. Excluding such abnormal forms as No. 3, such leaves show a variation between 2.78 sq. cm. and 9.65 sq. cm., with an approximate average area of 5.64 sq. cm.

The reproductive shoots produce terminal clusters of flowers which are developed with great luxuriance. This appears to influence a limited development of the branches themselves, which are always small and wiry, usually about 10 cm. in length with a diameter of 1 mm. at the base. Among these, and arising from the same main axis, are a few vegetative shoots also influenced in a marked degree by the reproductive period, but conspicuous by reason of their somewhat more vigorous development (Fig. 6*b*). They range upwards of 15 cm. in length with a diameter of 2 mm. at the base. On such vegetative shoots, which generally develop from near the extremity of the main axis and appear after the period of inflorescence is well advanced or completed, the leaves approximate very closely in form to those of the ordinary vegetative shoot. They are, however, much smaller (Fig. 7*a* : 2, 5, 6). They range in size from 1-34 sq. cm., to 3.11 sq. cm., with an average area of about 2.08 sq. cm. They therefore bear to the leaves of the ordinary vegetative shoot, the relation of 1 : 2.70. On the other hand, the leaves borne upon the short, wiry flowering branchlets, are usually much reduced in size and altered in form (Fig. 7*b* : 1-3). They vary from 0.290 sq. cm., to 1.995 sq. cm. with an average area of about 1.033 sq. cm., thus standing toward the leaves of the vegetative shoot in the ratio of 1 : 5.45. A recapitulation of these relations is as follows :—

SPIRAEA TRILOBATA VANHOUTTEI.

Comparative areas of leaves.

Number of specimen.	Number of leaf on specimen.	Area in sq. cm.	Average area. sq. cm.	Ratio of areas. Flowering branch= unity.	Remarks.
No. 1	1	4.490			Vegetative branch.
	2	9.650			
	3	0.440			Excluded from averages because unusual.
	4	2.785	5.640	1 : 5.45	
No. 2	1	0.290			Flowering branch.
	2	1.995			
	3	0.815	1.033	1 : 1	
	4	0.685			Excluded because of unusual size.
	5	1.805			
	6	3.110			
	7	1.340	2.085	1 : 2.70	

In the common basswood (*Tilia americana*) the leaves present variations in form which are confined within such a narrow range as to offer nothing of an exceptional character ; while variations in size are not only of such an exceptional character as to excite comment, but they occur with great frequency and, in this region at least, constitute a well defined feature of the tree under different conditions of growth and in different situations. Individual trees will show a somewhat uniform development of leaves with a diameter of about 8.5 cm., and a superficial area of about 55 sq. cm. Other trees—and perhaps more generally—show such leaves in part, together with others about 11 cm. in diameter and with an area

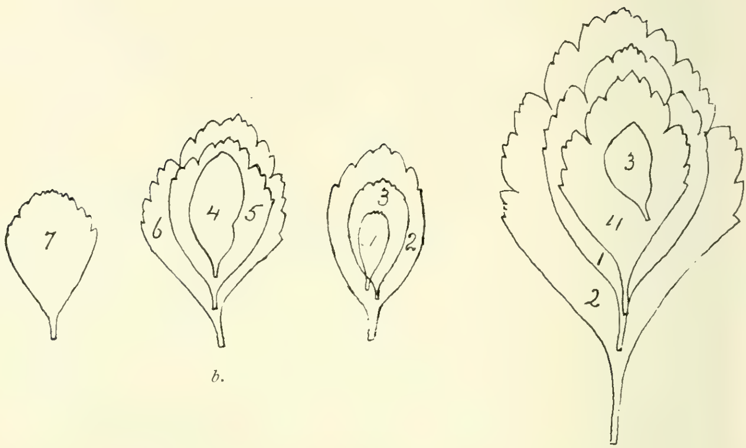

FIG. 7. SPIRÆA TRILOBATA VANHOUTTEI. *a.* Leaves from a normal vegetative shoot of the season. *b.* Leaves from a flowering branch ; 1–3 developed during the period of inflorescence ; 4–7 developed on lateral shoots of the flowering axis after the inflorescence had passed. x $\frac{1}{1}$

of about 94 sq. cm. This latter may be taken as the typical size of the leaf for this region. But the same tree commonly produces leaves of yet larger size on the more vigorous shoots, especially the short branches arising from the main trunk where they get an excess of nutrition. Such leaves not uncommonly attain a breadth of 20 cm., and an area of 276 sq. cm. It is obvious then, that under ordinary conditions of growth in a good soil, the foliage varies somewhat widely, though the general type conforms to that of the second example.

In the woodlands of this district, the linden forms a somewhat abundant undergrowth through the development of suckers of very vigorous growth. In all such cases, the foliage is unusually large, being of the general type of the third example, and therefore conforming to the largest leaves found upon nature trees. When such young growths are much pruned, or when they arise from old stumps, the plant acquires a relatively very extensive root system which supplies it with an unusual amount of food materials. Under such circumstances the foliage is always larger than common, and reaches a maximum diameter of 24 cm. with an area 491 sq. cm. While it is obvious that the primary cause of this very wide variation is due to great vigor in growth as induced by highly favorable conditions of nutrition, it is no doubt influenced by the shade in which such plants grow in most cases. The general result, however, is to produce leaves, the extreme variation in which is in the ratio of 1 : 8.90 ; while the ratio of the average leaf to the extreme of development on undershrubs is as 1 : 5.24. A recapitulation of these facts would give the following :—

TILIA AMERICANA.

Comparative leaf areas.

No.	Area in sq. cm	Ratio of areas.	Remarks.
1	55.18	1:0.58	
2	93.75	1:1	Leaf of average size for most trees taken as unity.
3	276.47	:12.94	The largest foliage of mature trees.
4	491.25	1:5.24	The largest foliage of undershrubs.

Extreme variation 1:8.90

We may now consider the foregoing facts in relation to their bearing upon palæontological evidence, and ascertain if possible, the causes for such variations.

Prof. Ward says : "It is a fact well known to botanists that, in oaks and many other trees, only the leaves on fruit bearing branches can be depended upon for determination of species," (*op. cit.* 41). While this is no doubt true in particular cases, it would be unfortunate were it to be adopted as a working rule of general application, since noteworthy instances of frequent occurrence readily suggest themselves to one as affording evidence in direct opposition to such a view, and the examples now under consideration are of that nature. In the case of Spiræa, the leaves arising upon the fertile branches are always greatly reduced in size and much altered in form Their average area is less than one-fifth that of leaves on normal, vegetative shoots. Such depauperate leaves do not find a place in the diagnosis of the species, but the latter rests upon a description of the larger forms occurring upon the non-flowering branch—forms which are in general, common to the plant as a whole, and which arise only after the period of inflorescence is well advanced or even completed, as also during a time when there is great activity in the formation of new shoots. The cause of the reduced leaves on flowering shoots is obviously to be referred to relatively defective nutrition, or, to put it in another form, to a diversion of energy and its concentration upon the reproductive process, what Goebel would describe as a survival of juvenile forms, representing arrest of development through correlation[1] with reproductive shoots. This is apparent not only through a comparison with vegetative branches, but by reason of the greatly reduced size and ephemeral character of the flowering branches which shortly disappear through a process of natural pruning; while it is further substantiated by the fact that as soon as the fruit is formed, and the energy thus employed has been liberated, the same branch gives rise to relatively vigorous branchlets with larger and more normal leaves, and the whole plant enters upon a period of most vigorous growth. In this we have a simple expression of a widely exhibited and well known law.

In Lonicera the case is somewhat different. There the variation of foliage is of a much more striking character; it does not arise periodically as in Spiraea but sporadically; the forms are more extreme and the variation does not depend so much upon conditions of inflorescence, since the reduced forms of the leaf and the normal forms are found about equally associated with the production of flowers. It has been shown that in the case of this plant, essentially three types of foliage have been produced, and that the reduced forms were found exclusively upon each of two individuals which, chiefly through pruning, were much inferior in stature to their neighbors. Here it is not possible to refer the alteration of form and size to the well known effects of light and

1. Organography, 58 and 143.

shade, since it has been found that in a plant growing in relative shade, the leaves were reduced to less than one-third the average, normal size. On the other hand, strongly vegetative shoots were found to bear leaves which were not only conspicuous for their alteration of form, but notable for being 2½ times larger than the normal and *eight times* larger than the reduced leaves of the same plant growing under the same general conditions of illumination. But here again we have an exception to the usual law of development, since these leaves were directly exposed, and their entire course of development was under the influence of sunlight which served in no way to inhibit their growth. It is clear then, that we cannot find an adequate explanation for such variations, either in diversion or energy incident to the reproductive period, or in the adaptation of the leaf to conditions of illumination of which they seen to have been wholly independent. It will be recalled that these shrubs were top pruned in the spring of 1093. During the following summer they made but moderate growth which was chiefly manifested in the development of numerous, wiry side branches. The plants therefore enjoyed a period of comparative rest, during which there was no doubt a considerable accumulation or energy in the form of reserve food stored within the tissues. The somewhat more than usually favorable conditions for growth, prevalent during the past summer, formed a very happy combination of circumstances and permitted a liberation of the accumulated energy as expressed in shoots of remarkable size, and foliage of unusual form and dimensions. The abnormally large leaves, therefore, may be held to be the expression of unusually vigorous vegetation independently of conditions of light and shade; while the reduced leaves constitute an expression of diminished vigor as first manifested in the weakly branches. This explanation therefore finds justification in certain facts of much significance. (1) The reduced leaves are invariably produced upon small wiry branches indicative of poor nutrition; (2) the most vigorous shoots arise from pruned branches, often close to the point of excision where there would be likely to be an unusual deposit of food materials;

(3) essentially the same relations are manifested in Spiraea; (4) shrubs which had not been top-pruned in 1903, exhibited no special phenomena of growth in 1904, apart from the somewhat general luxuriance common to all trees and shrubs. Finally, the reduced leaves of Lonicera are to be regarded as juvenile forms which have been restored under special conditions of growth, and such reversion has been accomplished through correlation, in opposition to the influence of light, which, acting by itself, would tend to produce the opposite result as Goebel has shown in the case of *Campanula rotundifolia* in particular.[1]

In such types as Weigela, Hydrangea, *Berberis thunbergii*, and *B. vulgaris*, Euonymus, *Ampelopsis quinquefolia*, various species of Vitis, *Shepherdia canadensis*, *Syringa vulgaris* and many others which will readily occur to one, there is no essential variation in the mature foliage, as between the vegetative and the reproductive shoots, but all conform to one type, within certain narrow limits. In *Celastrus articulatus* there is a more or less well defined variation of leaves which places some of them distinctly beyond the type form, but such variation is not in any special sense distinctive of either the vegetative or the reproductive shoots, and these instances serve to enforce the idea that the foliage of the reproductive shoot cannot be taken even generally, as affording the real basis for type forms.

It has been noted that special variations of form and size of leaf often arise upon the same branch or under special conditions of growth. Thus in *Lonicera tartarica* (Fig. 4 : 1-12), it appears that in four sets of leaves, the lowest of each series (1, 4, 7, 10) is always the smallest and deviates most widely from the type, the same rule holding true of the lowest member of the series as a whole (1). This relation was found to be true of a shrub greatly modified by pruning and conditions of nutrition. But the same rule holds true to a more limited extent in a shrub which only partially expresses the effects of such conditions. (Fig. 5 : 1 and 8). In the case of normally developed branches, however, (Fig. 2 : 1-7) this rule does not

1. Organography, 242, 243.

apply, for we there find the lowest member of the series (1) to be the largest, and the others successively smaller. The same law is fully applicable to Spiraea in which the modified leaves always become simplified in form as well as reduced in size, while in Lonicera they are reduced in size without any special simplification. Now in accordance with our present views respecting the evolution of leaves, such simplification of form and such reduction in area, must be regarded as of the nature of reversions to more primitive types, as is so well exemplified in Nephrolepis, from which we may conclude that the Lonicera, which is chiefly distinguished by reduced foliage, is essentially a primitive form of the plant, and the same may also be said of the flowering branches of Spiraea. Such a view would harmonize with our knowledge of the general effects of defective nutrition, a view which otherwise gains force from the fact that the most highly developed foliage of Lonicera on shoots of unusual growth, is obviously the direct product of exceptionally favorable conditions of which ample nutrition must be regarded as one, if not the dominant factor. In these facts, then, we have a means of determining at least some of the developmental stages through which the leaves must have passed.

Instances will readily recur to one, of trees like the common basswood (*Tilia americana*), and the linden (*Tilia europea*) in which there is such constancy in the character of the foliage that, were the leaves to be found entirely apart from the tree, it would nevertheless be possible to determine the genus beyond all reasonable doubt, and even the species might be ascertained with reasonable certainty. The same would hold true of Hydrangea, Berberis, Catalpa, Syringa, Philadelphus and many others. There would be considerable doubt, however, in such a case as that of *Celastrus articulatus*, while there would be positive uncertainty as between the leaves of the young plant and those of the mature stem in *Ampelopsis veitchii*, the mature leaves of *Spiraea trilobata van houttei* and much more in that of *Lonicera tartarica*. In *Ampelopsis veitchii* and *Spiraea van houttei* it would be quite possible in accordance with palaeontological methods, to make two valid species, while in Lonicera there would be at least three possible species from the same plant. To test the impression likely to be made upon a wholly unbiassed mind, the branches of Lonicera representing four specimens, as in the figures 2-5, were placed upon the table side by side and a student who is a keen observer, was asked to give his opinion as to their specific relations. He unhesitatingly answered that certainly three, and probably all four were distinct species, while as a matter of fact they represented only three plants of the same species. It is quite obvious, therefore, that we have here cases which are to some extent the counterparts of what is presented by Liriodendron, respecting which Berry has observed that "When we look over these leaves, it is with difficulty that we can believe they belong to but one species; were they found as fossils they would undoubtedly be referred to as many different species as there are leaves." (op. cit., 37). It is obvious then, that if we are to continue the identification of species by leaves alone, we must, as already pointed out by Holm (op. cit., 312), have recourse to direct comparison with the leaves of existing species if even approximate accuracy is desired. Even under such conditions, however, there will still remain a very large and undesirable margin of error which, however valuable the specific references may be for purposes of identification and comparison, and however important such data may be for stratigraphical purposes, they after all possess but limited value—and in many cases no value at all—for the scientific botanist who sees in plant remains the one means of tracing the phylogeny of existing forms and thus, eventually, of establishing the true geological succession of the innumerable forms which have led to our present flora. If such studies possess any significance, they do serve to emphasize the great importance of giving a secondary place to those leaf remains which have heretofore claimed superior notice because of their prominence among fossil forms and their attractive appearance: while on the other hand they bring into strong relief the necessity of concentrating our attention upon the less attractive fragments of stem, the internal structure of which is certain to reward the diligent and competent student with evidence of the highest value ; and it is probably safe to assert that the palæobotanist of the future will devote his attention more exclusively to the latter source of evidence, utilizing the former only so far as it may prove serviceable for purposes of confirmation.

My attention has been directed recently, to another example of leaf variation which not only serves to emphasize the conclusions already reached in several important respects, but it is remarkable and of more than usual scientific interest because it affords direct and positive proof as to the nature of certain structural alterations and the conditions under which they arise ; while it also exhibits a completion of such changes within so short a period as to make the entire history one of easy record.

About five years ago a somewhat remarkable sport was developed in the conservatories of the F. R. Pierson Company, at Tarrytown-on-Hudson, from the well known, so-called Boston fern, *Nephrolepis exaltata*. This sport showed such unusual characteristics and gave promise of such possibilities, that careful cultivation followed with the production of what is now known as Pierson's fern. In 1902 this plant was exhibited at the March show of the Massachusetts Horticultural Society, and received an award of the Gold Medal as being "by far the most important and remarkable plant that has been shown before this Society for many years." [1] This verdict is fully sustained by the plant, which possesses a decorative effect of the highest value ; but as we are now concerned with its scientific aspects, such considerations must be left to the horticulturist.

From information kindly supplied by the F. R. Pierson Company, it seems that this plant developed abruptly among a large number of plants of *Nephrolepis exaltata* which were being grown for commercial purposes. It did not result from unusual conditions of nourishment and care immediately succeeding a period of arrested development, nor was it the product of any other unusual conditions of environment. It

1. Trans. Mass. Hort. Soc., 1902, Part II, 145, 160.

originated as a sport under such conditions of superior care and abundant nourishment as are generally found necessary to the best growth of the plant. The chances that such a change might have arisen under natural conditions in the wild state, are possible but remote, and the present case is therefore to be taken as an exaggerated expression—an abrupt and strongly marked development—of those alterations which undoubtedly occur in the wild state, but often so gradually or at such remote intervals, as to come under observation only under the most favorable conditions of time and space. It is nevertheless exactly in harmony with recognized alterations under changed environment, such as Goessmann has long since recorded when the wild grape is brought under cultivation, or such as Bailey has frequently directed attention to as arising under cultivation, and such as are well known in botanic gardens.

The special feature of the Pierson fern is manifested in the doubling of the frond, whereby the whole organ acquires a most graceful, plume-like character. Normally the frond of the specific form is once pinnate and upwards of 1.3 m. long; but it is a characteristic of the plant that the fronds are capable of indefinite extension from their tips, a feature which is also manifested in Pierson's variety. The pinnae of the species

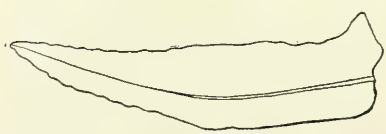

FIG. 8. NEPHROLEPIS EXALTATA PIERSONI. Normal pinna showing auricle on the upper side. x $\frac{1}{1}$

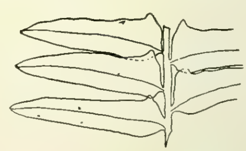

FIG 9. NEPHROLEPIS EXALTATA PIERSONI. Pinnate pinna showing the pinnules to duplicate the pinnae. x $\frac{1}{1}$

are lanceolate, upwards of 8 cm. long and auricled on the upper side. (Fig. 8.) This auricle, as will appear shortly, is a potential pinnule which it may become under favorable conditions. But here again, the indeterminate character which belongs to the unmodified frond as a whole, and not to the separate pinnae, is extended, in the variety, to each one of the pinnae. In a plant of moderate size the modified pinnae attain a breadth of 6.5 cm., and a length of 14 cm., but this latter dimension may vary very much, since it is capable of extension under the circumstances already related.

The peculiar feature of Pierson's fern is to be found in the remarkable alteration affected in the pinnae, whereby the frond becomes twice pinnate. In a fully modified pinna, there may be as many as 50 pinnules which exactly reproduce the characteristics of the pinna from which they have come, even to the auricled base. (Fig. 9.) Such pinnules have a maximum length of 3.2 cm., and a width of 7 mm. It is to be observed, however, that the transformation is not always complete, and that within the limits of individual fronds, or as between different fronds, all stages of transition may be noted. This is first expressed in the fact that from the same rhizome, normal and modified fronds will be produced, the latter being dominant and giving the prevailing character to the plant. But even in the normal fronds, there is nevertheless a well defined tendency to variation as expressed in those of most vigorous growth, whereby the normally crenate margin becomes more deeply indented on the lower side, and the leaflets become lobed or even pinnatifid. (Fig. 10.) When the transformation is completed, each pinna is again completely pinnate toward the apex (Fig. 9) remaining simple or pinnatifid only, in the region of its base, and it is this combination of features which gives to the frond as a whole, its remarkably beautiful aspect. Thus I find that even in the most fully developed modification, the base of each pinna is either unmodified or lobed or pinnatifid for a distance of upwards of 1.5 cm. (Fig. 10 and 11.) In most cases the auricle of the pinna undergoes no alteration, but occasionally it enlarges, chiefly by elongation, and assumes the aspect of a definite pinnule. (Fig. 11.) In this we undoubtedly have an expression of a tendency toward complete doubling of the organ. Wherever the energy of growth is diminished, there the pinnules become confluent and eventually pass by gradual stages, into the condition of normal, simple pinnae.

A question naturally arises in this connection. Does this alteration of external form involve definite structural variations, or is it simply a case of distribution in space? An examination of the normal pinna shows that its length bears the relation to the length of the modified pinna, of 1:1.75. In the normal pinnae the veinlets number 8 per centimetre, and they therefore have an average interval of 1.25 mm. In the modified pinnae, on the other hand, the midribs of the pinnules which are, of course, the anatomical equivalents of the veinlets in the normal pinnae, number 1.66 per centimetre, and they are therefore seperated by an average interval of 6.03 mm. We discover from this that in undergoing alteration, the veinlets of the normal pinnae have become separated in the pinnules in the ratio of 1:4.80. Such a relation at first suggests a simple extension of parts, but while the veinlets become separated by an interval nearly five times greater than normal, the corresponding alteration in longitudinal dimensions of the pinna, in its transformation into the compound form, shows an increase of only three-fourths of the original dimensions. It is therefore obvious that the change has involved an actual obliteration of parts to the extent of one-fourth of the vascular structure as represented in the original veinlets.

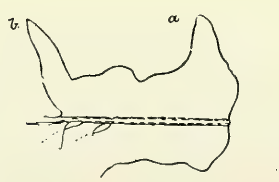

Fig. 10. NEPHROLEPIS EXALTATA PIERSONI. Base of compound pinna showing at *a* the somewhat enlarged auricle; at *b* the first pinnule, and between on both sides, the potential pinnules as exhibited in the lobes. x $\frac{1}{1}$

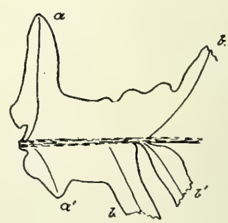

Fig. 11. NEPHROLEPIS EXALTATA PIERSONI. Base of a compound pinna showing at *a* the first pinnule with a corresponding development at *a'* *bb* the first pinnules and *b'* the first free pinnule. x $\frac{1}{1}$

We now come to the relation which these changes in external form bear to the reproductive process. This plant is said to become modified only with respect to its sterile fronds, which is substantially the same as saying that the variety cannot be reproduced through spores since we must recognize that except for variations of degree, the same differences exist between members of an individual, as between different individuals, and we may correctly assume that spores which are produced only on unmodified fronds will be incapable of reproducing the characteristics of the modified frond. This is borne out by the observed fact that propagation depends entirely upon runners which are developed very freely, and through which the plant multiplies with great readiness. I find, however, that the above statement requires some modification, since it is not true in the strict sense.

An examination of a plant which was selected at random, shows that while fruit is produced on the unmodified fronds in the usual way, this capacity also extends to transitional forms where the tendency to modification is as yet but feebly expressed. But more than this, I have found that completely modified fronds also bear fruit. The specimens under observation are too immature to determine what perfection such fruit might attain in all cases, but that which is produced at the base of the pinnae is spore bearing, and from this the inference might be justified, that even the pinnules are productive of spores. We are therefore compelled to recognize the fact that while the modification of the frond is attended by sterilization, this is not complete, and it is probably of the nature of a temporary loss of functional power which may be restored as the variety becomes more firmly established. Fortunately we are able to avail ourselves of information which has an important bearing upon the correct solution of this question. A similar variety of the Boston fern has recently been produced by Mr. L. H. Foster whose name it bears. This fern, however, is characterized by the fact that the modified fronds *do bear* spores, though the plant does not exhibit that luxuriance of growth which is so marked a feature in Pierson's fern.

It is quite clear that transformations of the nature represented by Nephrolepis must have the same bearing upon palaeontological evidence as in the previous cases; but this plant is of scientific interest in another and far more important sense, and we are led to ask, what significance have these facts from the standpoint of evolution?

The various transformations which we have studied in Nephrolepis afford direct and positive proof of the origin of compound leaves by modification of the simple, primary form as stated by Goebel,[1] who illustrates the general course of development by the very striking variations exhibited in *Anadendrum medium*; and by Ward, who has shown that such a course of development is also exhibited in fossil forms. But Goebel directs attention to the general effect of light and shade which operate in such wise that conditions of shade always tend to the development of rounded and simplified, juvenile forms, so that the effect of light would be to reduce the area with a tendency to splitting up or compounding.[2] This is exactly in accord with the changes in Nephrolepis piersoni and the conditions under which such changes arise, since it is found that it demands for its best development, an abundance of light.

The compounding of the leaf in Pierson's fern, being in itself an expression of highly developed vegetative powers, is intimately associated with other changes of a no less striking and significant character. The almost complete obliteration of the sporogenous tissue, and hence obliteration of the usual reproductive function which survives mainly in unmodified parts, is in precise accord with Bower's theory respecting the origin of the sporophyte, and it is to be attributed to "correlation" with the assimilative tissue. But as already seen, Pierson's fern does show a tendency to the formation of sporogenous tissue even on completely transformed parts, thus indicating that with greater stability in the variety, it becomes possible for this reproductive tissue to be reestablished. This is made clear in the case of Foster's fern, in the fact that the sporogenous tissue not only persists from the first, but that the plant shows a corresponding diminution in size; so that as between the two forms, it comes to be a simple case of relative arrest through correlation. We may therefore expect to find that these two plants exhibit different degrees of stability with respect to their special forms, and such differences do exist to

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1. Organography, 158.

2. Ibid. 242.

some extent. Thus in Foster's fern, where there is a relatively low vegetative power with the free formation of spores, there is no special tendency to reversion and the form is apparently well fixed. Unfortunately we have no evidence as to the perpetuation of the sport through the medium of spores, since no attempt has yet been made to propagate the variety in that way, and it is therefore impossible to say if the character is so far fixed as to define a new species. In Pierson's fern, where the vegetative powers are relatively in excess, there is a great want of stability with a constant tendency to reversion. This is expressed in the production of normal fronds, as also in the development of fronds showing all degrees of transitional alteration, and in the very limited extent to which spores are produced on the modified fronds. Finally, it is altogether probable that in these examples we have instances illustrative of the theory of Mutation as formulated by De Vries, giving us a fairly clear conception of the general conditions under which such mutation may arise ; but the evidence falls short of a complete demonstration with respect to the transmission of characters through the reproductive process, and we are therefore unable as yet, to define either of these ferns as a species, although they may eventually prove to be such when proper experiments are made in the germination of the spores.

ALONG THE BRITISH PACIFIC CABLE.

OTTO KLOTZ.

On the 31st day of December, 1900, articles of contract were made by Her Majesty's Government, Canada, New South Wales, Victoria, New Zealand and Queensland on the one part, and the Telegraph Construction and Maintenance Company on the other, for the construction and laying of the Pacific Cable. The contract called for the completion of the whole cable on or before 31st December, 1902. The cable was finished two months earlier and after undergoing the required test of a month, entered upon its commercial career on December 8th, 1902. Thus was the project, that had been advocated with persistence from some quarters for a quarter of a century, made an accomplished fact. The missing link of about 8000 miles across the Pacific between Canada and Australia, in the world's metallic girdle, was now supplied. Before the cable was laid a survey was made of the route and the character of the ocean bed was examined.

From the survey the number of miles (nautical) of cable required for the different sections was found to be as follows :

From Vancouver Island to Fanning Island	3654
" Fanning Island to Suva, Fiji........	2181
" Suva to Norfolk Island............	1019
" Norfolk to Queensland (Moreton Bay)	906
" From Norfolk to New Zealand.....	513

The first section of the cable is about a thousand miles longer than any that had been laid before. This necessitated a considerable increase in copper for the conductor and in gutta percha for the dielectric. The working speed of a submarine telegraph cable depends on, and is inversely proportional to, the product of the total resistance of the conductor multiplied by the total electro-static capacity of the core, so that, other things being equal, the speed varies inversely as the square of the length of the cable. In the long section there were used 600 lbs. of copper and 340 lbs. of gutta percha per nautical mile. On the Fanning-Suva section 220 lbs. of copper and 180 lbs. of gutta percha; and on the remaining three sections the copper and dielectric were in equal proportions of 130 lbs. each.

In the neighborhood of Fiji at a depth of 2500 fathoms, a temperature of 34.1° Fahrenheit was noted, being the lowest temperature taken during the survey. There is very little difference in the temperature of the ocean at great depths, say below 3000 fathoms, over a great extent of the earth's surface, the temperature being only a few degrees above the freezing point, or 32° Fahrenheit. The greatest depth, 3070 fathoms, about three and a half miles, was found on the Fiji-Fanning section, where the bottom specimens consisted principally of radiolarian ooze. This ooze is found at the greatest depths, and was obtained by the Challenger's deepest sounding in 4475 fathoms. The United States steamer Nero sounded in 5269 fathoms, 6 miles (this last being the deepest sounding recorded in the ocean), and the material brought from the bottom was radiolarian ooze. Of the 597 samples of sea bottom obtained on the Pacific Cable survey, 497 were such that they could be divided into distinct types of deposits It was found that

294	samples	referred to	globigerina ooze[1]
65	"	"	red clay
43	"	"	radiolarian ooze
45	"	"	coral mud or sand
27	"	"	pteropod ooze
12	"	"	blue or green muds
11	"	"	organic mud or clay.

The pressure at a depth of 3000 fathoms, in which a considerable portion of the Pacific Cable is laid, is about four tons to the square inch. When the cable is being laid at such depths, it will be approximately twenty miles astern of the ship before it touches the bottom.

Deep sea cables last longer in the tropics than in the northern oceans. The reason is to be found in the fact that in the tropics marine life, from which globigerina ooze is derived,

1. Report by Sir John Murray.

is more abundant than in the more northerly or southerly waters. It is the sun and the warmed surface water that call into life these countless globigerina, which live for a short space, then die and fall to the bottom like dust, making such a good bed for the cable to rest in. In the arctic currents, where the surface is cold, the water does not teem with life in the same way as it does in the tropics, and consequently there is less deposit on the bottom of the ocean.

A submarine cable consists, first, of a core, which comprises the conductor, made of a strand of copper wires, or of a central heavy wire surrounded by copper strips as in the Pacific cable, and the insulating covering, generally made of gutta percha, occasionally of india rubber, to prevent the escape of electricity. As far as cabling is concerned, this is really all that is necessary, an insulated conductor. This, however, would not, in the first place, be sufficiently heavy to lay in the ocean, and, secondly, would be too easily injured and destroyed by the many vicissitudes to which it would be subjected. For this reason, a protection in the form of a sheathing of iron or steel wires surrounds the core ; the nature, size, and weight ot the sheathing being dependent upon the depth of the water and kind of ground over which it has to be laid. The deep sea section, being the best protected from all disturbing influences outside of displacement of the earth's crust by earthquakes or volcanic action, is naturally the one of smallest dimensions ; and for the shore end, which is exposed to the action of the waves, to driftwood, to the grinding of ice in the more northerly latitudes, and to the danger of anchorage, especially of fishing boats, the sheathing must be very heavy. So that while the deep sea cable is somewhat less than an inch in diameter, that for the shore ends is nearly 2½ inches in diameter. The action of the waves is limited to a depth of only about 13 fathoms, so that their influence on the cable, manifested by wear and chafing, is confined to the shore end.

The Pacific Cable is equipped with the most modern apparatus at the various stations, and the cable is worked duplex, that is, messages are sent and received on the same cable at the same time.

Immediately upon completion—Oct. 31, 1902—of the British Pacific Cable, Canada made preparations to extend her longitude determinations, which had been carried from Greenwich to Vancouver across the Pacific, thereby making with the longitude carried eastward via. Madras, a continuous longitude circuit round the world. The writer was placed in charge of the work and with him was associated Mr. F. W. O. Werry, B. A. Each observer was provided with similar astronomic outfits, and at each station occupied, a brick or cement pier was built and a small observatory erected. Mr. Werry occupied Fanning and Norfolk inlands, and the writer Vancouver; Suva, Fiji; Southport, Brisbane and Sydney, Australia; Doubtless Bay and Wellington, New Zealand.

Every night during the campaign the observers compared their clocks over the cable. The comparison was made with an accuracy of two thousandths of a second. By this comparison is measured too the time it takes for a signal to travel over the cable. This of course varies with the distance. On the longest section, over four thousand statute miles, it took thirty-four hundredths of a second, or say a third of a second from the minute a clock ticked at one end, until it recorded in ink that tick at the other end. The following table is self-explanatory.

Section.	Length of cable laid. Naut. miles.	Pounds of copper and gutta percha per naut. mile	Electro-motive force. Volts.	Resistance per naut. mile. Ohmes	Transmissions Sec. Time.	Rate per second. Statute miles.
Bamfield—Fanning	3457.8	600 / 340	50	2.03	.s .3422	11.600
Fanning—Suva	2043.1	220 / 180	55	5.54	.2807	8.400
Suva—Norfolk	981.5	130 / 130	30	9.35	.1404	8.000
Norfolk—Southport	836.7	130 / 130	30	9.35	.1016	9.800
Norfolk—Doubtless Bay	518.7	130 / 130	10	9.35	.0528	11.300

The comparison of the clocks combined with the clock correction determined by each observer from tourist observations on stars, gives the difference of longitude between the two stations. The result is, however, invested with a correction due to the difference in nervous temperament or constitution, technically known as the personal equation of the two observers. To ascertain this quantity, although only a fractional part of a second, special observations are taken for determining the same. The observer with sluggish temperament puts a place too far west; to him the stars do not transmit over the threads in the telescope until they are actually past. On the other hand, the nervous susceptibilities of another man may be so constituted that the observer anticipates an event, imagines the star to be on the thread when in fact it has not reached there, and thereby observes as if he were in reality to the east of his true position by a quantity equal to his personal equation. The work was begun in March 1903 and completed at Sydney Australia in January 1904. The first mutually satisfactory exchange of clock signals between the cable station at Southport, near Brisbane, and Norfolk island cable station and Sydney, was had on September 28th, 1903, so that that day may be considered as the one on which for the first time the earth was girdled astronomically.

On the way to the Fiji Islands a visit was paid to the Hawaiian islands, but it is unnecessary to dilate on their charm, yet it is not all charm and constant blue sky. With Nature it is as Schiller says of man: "Des Lebens ungemischte Freude ward keinem Irdischen zu Theil." A plant originally introduced for ornamental purposes in Honolulu has now spread over the islands and has proved such a curse that the government is doing its utmost for its extermination. It is the lantana.

In Hawaii we received the first Polynesian greeting—the melodious ALOHA, the word being equivalent to our "welcome" or "good-day," but literally meaning "Love to you." The preponderance of vowels in this word as well as in all Polynesian words, gives the language a softness foreign to those of Teutonic root.

I arrived in Fiji in May, which is one of the autumn months in the southern hemisphere. My first impression was that I had landed in a hot-house—the oppressive, warm, moisture-laden atmosphere, where one smells the soil and the rank vegetation, almost overcame me. I began to perspire, and in six weeks lost 20 pounds—that is, in weight. As my coming had been cabled, quarters had been secured for me. Immediately the first night I saw big things, like birds, flying about my domicile. I asked what they were,—cockroaches were the answer. However, I had no fear, as I was too heavy to be carried away. When I was about retiring in a bed canopied with mosquito netting, I saw a spider fully six inches across on the netting. I promptly took aim and killed the arachnid. In the morning I informed the landlady of the incident. She thereupon told me I had done wrong, saying it was not only a harmless creature but useful for eating mosquitoes. The next discovery I made was that my leather boots which were black the night before, were now green—covered with mould, a small herbarium of the lower vegetable organisms. There is some compensation, however, for the common scarlet hisbiscus flower and the leaves of the same shrub are very efficacious for blacking boots. Of course I had to discard my tweed suit, and donned the white flannel coat and trousers I had brought with me, but these also were too warm for one born and brought up where the Great Bear rides high in the heavens. So I provided myself with white cotton garments. There was too much of the *al fresco* in the native costume for me—I wasn't a Fijian.

I was surprised to find that among the white people there (and there are not many), those who indulge in liquor, almost invariably drank Scotch and soda. Upon expressing my astonishment that under a tropical sun, ardent spirits were used in preference to beer or wine, I was told the latter affected the liver; this same explanation was given later too in Australia and in India. Not knowing whether I have a liver or not I can not personally corroborate the theory.

My next experience was when I set up my instrument and gazed in the southern sky. The good old Pole-Star that had kept me straight, or as the astronomer would say, had given me my azimuth these many years, had long sunk in the sea, and in my march to these shores other stars had risen from the southern horizon. The Southern Cross was now with us, but it was not conspicuous. Ninety nine out of a hundred persons must be shown the Cross before they recognize it. Its a poor constellation beside our Dipper or Great Bear. The fact that the ancients did not recognize the Cross as a separate constellation, but included it in Centaur, shows that it is not very conspicuous. The people of the southern hemisphere can boast, however, of having the star nearest the earth, the bright star in Centaur. To give an idea how near it is, let us imagine it to be peopled and that the people can see things going on on the earth, then they would now be seeing the last stages of the Boer war, soldiers moving about South Africa, for the light takes over four years to travel from the earth to Alpha Centauri. Two other phenomena of the southern sky may be referred to, viz : the Coal Sacks and Magellanic Clouds. The first are dark spots in the heavens resembling small black clouds, and are due to the absence (to the naked eye) of stars. Especially one of them is well marked, but the casual observer on a clear night, would not have his attention arrested to infer its true meaning, just as the Magellanic Clouds are in reality a galaxy of stars, appearing as two fleecy, white, drifting terrestrial clouds.

The two large islands, Viti Levu and Vanna Levu, of the Fiji group are quite mountainous, and have extinct volcanoes. These mountains effect the climatic conditions materially. The prevailing winds being the South East Trades, it follows that the southeastern sides of the islands are wet, and the opposite side comparatively dry. The former is clothed with woods and rank vegetation while the latter is more of an open and grass country. The most fertile island of the group is Tavinni, the richness or fertility being due to the vulcanic soil, reminding one of Hawaii.

It is almost impossible to make a botanical collection in Fiji. In the first place so many of the specimens are of gigantic size, and in the second place, even if preserved, they would be sure to turn mouldy. My experience was that of others.

Along the roadside (Suva) many red flowers are seen, reminding one of our clover, for the resemblance is very strong. The plant that bears them is a thorny vine—the sensitive plant, which when touched closes or folds its small leaves.

Commercially the principal products of Fiji are sugar, copra (dried cocoa-nut) and green fruit (bananas, pine-apples, etc). One might be tempted to say that everything grows or will grow in Fiji on account of the richness of the soil, ample moisture and warmth. But this is not the case. Its very exuberance and fertility, and want of seasons of rest for nature's work, are incompatible with the successful growth of grapes, apples, raspberries, strawberries, tomatoes, potatoes and other of our common and valued products. Prodigal as nature is in the tropics, it is the temperate zone that products the staff of life.

I was interested in a visit paid to a plantation where were grown the vanilla bean, turmeric, allspice, coffee, tea, cacao (from which chocolate is made), the cocaine plant, cotton, pepper, pine-apples and ginger. It may be remarked that the vanilla plant belongs to the orchids, and is trained or grown on cotton trees planted for the purpose. Another peculiar thing about the plant is that the flowers are not self-fertilizing, and the fertilization is done by hand. Whether the introduction of bees would obviate this manual labor, I am not prepared to say. The vanilla bean when pulled from the plant, would readily pass for our long green vegetable bean. At this stage it is wholly devoid of aroma. This is only developed in the kilns and by a sweating process, when the alkaloid vanillin is produced.

The South Sea Islanders are essentially vegetarians, although fish form an important part of their diet too. The hunt furnishes them nothing but the wild pigeon and the duck. There is no other game or wild animal. The principal food of the Fijian is the yam, a big root something like our mangle, as a rule though far larger. The next vegetable mostly eaten is the taro, which belongs to the Arum family, and is grown on very wet ground. Probably the finest tree in the South Seas is the bread-fruit tree with its large, glossy, indented, bright-green leaves. It will be remembered that the mission of the ill-fated ship "Bounty," Captain Bligh, whose crew mutinied (1789), was to gather bread-fruit trees for transplanting to the West Indies. The bread-fruit is green, its surface prettily marked, and in shape it resembles a Rugby football, but is not so large. These three vegetables—the yam, the taro, and the bread-fruit may best be described as taking the place of our potato.

We all delight in a piece of coral, its delicate form, its infinite variety of design, but when one has been among the living coral, in the riotous marine flower garden, where the most resplendent colors vie with each other and revel in their warm bath, then the corals of our drawing-rooms appear in their true light, as skeletons, dead things, bereft of their pristine beauty. A visit to a coral reef, resting midst those exquisite blue blue waters at low tide, is one of the greatest charms that the South Sea has to offer. The varied life seen, the intensely rich colors displayed, enchant one. The coral reef is to the naturalist an El Dorado, to the navigator a bête noir.

Another article of commerce is the *bêche de mer* or *trepang*, which may be seen at Suva by the ton in its dried or commercial stage. It is a sea-slug about as thick as the wrist and nearly a foot long. It is one of the greatest delicacies of the Chinese epicure, and no dinner amongst the *bon ton* in China is considered complete without soup of the *bêche de mer*. It is said to take a week to cook. Dinner orders must be given rather early.

The South Sea Islanders, especially the Samoans and Tongans, are cleanly in their persons. The Polynesians, after their daily bath, generally rub themselves with scented cocoanut oil. Formerly sandalwood, which was abundant, served the purpose of perfume by grating it on coral. Now, sweet-smelling flowers are used. Many a time in the early evening was I made aware of my approach to the Samoan quarters by the fragrance borne on the balmy air. Undoubtedly these people of the coral strand are far cleaner than the average white man.

Many months were spent on the coral-ribbed islands, resting in these fascinating waters of the South Seas, where the natives dream life away, oblivious of the "strenuous life" we have invented. There astronomy and time reckoning are based on no solstices or equinoxes, but simply on the yam, their staple food.

From Fiji I sailed for Queensland, Australia, passing *en route* New Caledonia, known as a French penal colony and for its large deposits of nickel.

In Australia, the land of sunshine and drought, of gold and sheep, of eucalypti and rabbits, of kangaroos and emu, of possibilities and development, of inverted nature, the astronomer finds a transparent sky. In the land of the Maori—New Zealand—across the ever-restless Tasman Sea, the element from the antarctic and tropics struggle with each other for supremacy to the detriment of the star-gazer.

Hitherto the basal longitude for both Australia and New Zealand had been brought eastward from Greenwich the international zero meridian, via Madras and Signapore, so that joining that circuit at Sydney to the one across the Pacific completed the first astronomic girdle of the world, and furthermore showed how well the astronomer could proceed step by step, ever determing his distance from Greenwich, until he met his fellow astronomer (at Sydney) coming from the opposite direction, and question his position on the earth. The supreme moment had arrived. Is the east longitude of the one the complement of the west longitude of the other? Does the girdle they have made fit, or is it too small or too large? Thousands and thousands of miles of cable and land lines had been used to transmit the pulsations of the clocks, many links had been forged to complete the chain, many hundreds of stars had been called from heaven to record their constancy, and skilfully the astronomer had welded the whole into one structure.

But no work of man is perfect, eternal vigilance is the price of precision. When the longitude brought from the west closed at Sydney with that from the east, the discrepancy was about a tenth of a second of time; the two astronomers had started in opposite directions around the earth to meet each other, travelling across seas and continents, and finally found their respective trysting places within the same area not larger than an ordinary town lot. May we say, this was a measure of the quality of their work? The world was girdled astronomically.

NOTES.

Ophiothrix fragilis is one of the most common British Ophiurids. Some years ago when at Plymouth, England, I succeeded in obtaining a large number of the larvæ in all stages of development, and I have been engaged for the last two years in working out their structure. The adult, like all Echinodermata, is radially symmetrical, but the larva is bilaterally symmetrical, more markedly so than any other Echinoderm larva which I have examined. Further, it shows during its development, traces of a *metameric* repetition of parts such as is found in bilaterally symmetrical animals like Annelida. This metamerism is exhibited in the cœlom or body-cavity vesicle. This is budded off from the apex of the gut when the larva is 2 days old, and it immediately divides into right and left halves. At the age of eight days, each half divides into a posterior vesicle lying at the side of the œsophegus. At the age of fifteen days each of the anterior vesicles buds off a thick walled posterior portion. The left one becomes the *hydrocœle* or rudiment of the water-vascular system of the adult, whilst the right loses its cavity and becomes a solid mass of cells whose further fate I am engaged in tracing.

E. W. MacBride.

Zoological Laboratory,
McGill University, April, 1905.

The Marine Biological Station of Canada will open for the summer during the month of May, under the Directorship of Prof. E. E. Prince, assisted by Dr. Stafford who will be in immediate charge. The Laboratory will be located at Gaspé where investigations will be continued with respect to the problems relating to fish culture, which have been dealt with at other stations during the last five years.

The Royal Society of Canada will hold its next Annual General Meeting at Ottawa, during the week commencing May 22nd., under the Presidency of Mr. Benjamin Sulte.

The Marine Biological Laboratory at Woods Holl, Mass., will open its eighteenth session on the first of June and continue until the first of October. Twenty private research rooms have been placed at the disposal of the Carnegie Institution, to whose Secretary applications for their occupation should be made. In the Department of Zoology 35 private research rooms for investigators, and 20 research tables for beginners who wish to take up problems under the direction of the staff, are at the disposal of the Director to whom applications should be made. In the Department of Botany a certain number of private rooms and research tables are at the disposal of the Director to whom applications should be addressed. The prospectus offers attractive courses in the several departments under the guidance of recognized specialists.

The Annual Field Day of the Natural History Society will be held this year at Mt. Johnson, Iberville, P. Q., on the 10th of June, leaving the Windsor Street Station at 9 o'clock a.m. The rich and diversified flora which clothes the slopes of Mt. Johnson, covers its bold rock faces and fills the ravine cutting across its eastern section; its peculiar geological structure, now well exposed by quarrying operations; and the interesting place which it occupies in the group of Monteregian Hills, make it one of the most attractive as well as the most accessible of all the locailties the Society has visited in its annual excursions.

The origin of Amber. The recent discovery of amber in the Cretaceous deposits of Staten Island, New York, has directed renewed attention to the origin of this valuable material which is now known from the investigations of Dr. Hollick and Dr. Knowlton, to have been derived in some instances, at least, from various species of coniferous trees of the type of Sequoia and the Agathis which at present constitutes the source of the well-known "Kauri gum" of Australia.

D. P. P.

The Mycelium of Dry Rot. Recent observations of the dry rot as developed in one of the buildings of McGill University, have brought to light certain unusual features in growth which are worthy of notice with a view to having attention directed to similar possibilities elsewhere. The fungus which was the typical *Merulius lachrymans*, passed through an opening in a brick wall of a diameter not exceeding one inch, and thus entered a coal bin constructed of brick walls and cement floor. The fungus was not discovered until the coal was nearly exhausted at the end of the winter, and it was therefore completely dried out. It was nevertheless seen to have travelled along the surface of the brick wall for more than two yards from the point of entrance, and from the wall it spread into the coal for a distance of six inches, often completely enfolding lumps of hard anthracite in its growth. It should be noted that the coal was put into the bin wet. The important question for solution is, "did the fungus convey its nutrient materials from the wood work of the adjacent room for a distance of three yards, as seems probable?

D. P. P.

, 1905.

C. H. McLEOD, *Superintendent.*

DAY	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	....	....	....	1
SUNDAY....	....	....	....	2 ....SUNDAY
	....	....	....	3
	.06	....	.06	4
	.12	....	.12	5
	.37	....	.37	6
	.06	....	.06	7
	....	....	....	8
SUNDAY....	.01	....	.01	9 ....SUNDAY
	.00	....	.00	10
	.08	....	.08	11
	.12	....	.12	12
	....	....	....	13
	....	....	....	14
	....	....	....	15
SUNDAY....	....	0.1	.01	16 ....SUNDAY
	....	0.1	.01	17
	....	....	....	18
	....	...	....	19
	.01	....	.01	20
	...	2.3	.23	21
	....	....	....	22
SUNDAY....	....	....	....	23 ....SUNDAY
	.19	....	.19	24
	....	....	....	25
	....	....	....	26
	....	....	....	27
	....	....	....	28
	.04	....	.04	29
SUNDAY.....	.03	....	.03	30..........SUNDAY
Means......	1.09	2.5	1.34	.......Sums ....
31 Years m for and inclu this month ..	1.76	5.0	2.28	31 Years means for and including this month.

d

n

Direction...).

Miles ....

Duration in l e

Mean velocity n f

Greatest m s

Greatest v

Resultant

Highest barometer reading was 30.39 on the 2nd; lowest barometer was 29.27 on the 6th, giving a range of 1.12 inches.

Minimum relative humidity observed, was 24 on the 28th.

Rain fell on 12 days.

Snow fell on 3 days.

Thunder on the 20th.

Auroras on 3 nights.

Halos en 3 nights.

ABSTRACT FOR THE MONTH OF APRIL, 1905.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY
1	34.1	39.0	29.0	10.0	30.25	30.32	30.21	.11	76	N.W.	21.3	86	....	....	....	1
SUNDAY........ 2	29.9	39.3	21.0	18.3	30.33	30.39	30.28	.11	84	N.W.	14.3	91	....	...	....	2 ....SUNDAY
3	39.0	46.0	30.1	15.9	30.14	30.28	29.92	.36	49	N.W.	13.5	89	....	...	....	3
4	42.4	48.0	37.0	11.0	29.75	29.92	29.69	.23	72	S.	18.3	..	.06	....	.06	4
5	45.6	52.0	41.2	10.8	29.75	29.80	29.70	.10	60	S.W.	15.8	69	.12	....	.12	5
6	37.2	45.7	33.5	12.2	29.42	29.71	29.27	.44	90	N.W.	20.4	..	.37	....	.37	6
7	35.0	40.1	31.2	8.9	29.59	29.64	29.50	.14	62	W.	16.8	62	.06	....	.06	7
8	34.3	42.0	27.4	14.6	29.68	29.72	29.64	.08	59	W.	18.4	60	....	....	....	8
SUNDAY....... 9	40.8	50.9	31.2	19.7	29.72	29.74	29.65	.09	58	W.	21.3	30	.01	....	.01	9..........SUNDAY
10	45.8	48.9	42.5	6.4	29.62	29.67	29.53	.14	75	S.W.	16.8	07	.00	....	.00	10
11	42.5	53.2	31.0	22.2	29.67	29.74	29.59	.15	80	S.W.	6.8		.08	....	.08	11
12	41.7	47.5	36.4	11.1	29.76	29.85	29.63	.22	61	N.W.	9.6	92	.12	....	.12	12
13	47.5	60.9	33.0	27.9	29.70	29.84	29.59	.25	55	S.W.	16.8	73	....	....	....	13
14	39.2	47.8	32.0	15.8	29.75	29.80	29.63	.17	50	N.	10.2	32	....	....	....	14
15	38.3	43.7	31.2	12.5	29.75	29.82	29.66	.16	34	N.W.	11.3	72	....	....	....	15
SUNDAY........16	33.9	39.4	30.0	9.4	29.52	29.66	29.43	.23	82	W	15.4	40	....	0.1	.01	16 ....SUNDAY
17	32.2	36.5	27.3	9.2	29.52	29.70	29.44	.26	81	N.W.	24.8	..	....	0.1	.01	17
18	32.6	38.0	25.8	12.2	29.84	29.93	29.70	23	75	N.W.	23.6	80	....	....	....	18
19	41.8	50.3	30.3	20.0	29.87	29.97	29.73	.24	53	W	27.0	27	....	...	....	19
20	48.4	55.9	42.5	13.4	29.73	29.80	29.68	.12	62	W	21.4	..	.01	....	.01	20
21	34.2	50.6	30.0	20.6	29.85	29.94	29.79	.15	77	N.	20.8	.	...	2.3	.23	21
22	39.6	47.1	31.0	16.1	30.10	30.17	29.94	.23	58	N.W.	13.5	75	....	....	....	22
SUNDAY....... 23	42.3	49.7	34.1	15.6	30.28	30.33	30.17	.16	48	N.W.	13.0	56	....	....	....	23 ....SUNDAY
24	41.5	54.6	34.5	20.1	30.10	30.32	29.89	.43	70	N.W.	25.2	07	.19	....	.19	24
25	44.0	55.8	34.0	21.8	29.93	30.07	29.74	.33	49	N.W.	25.0	56	....	....	....	25
26	54.6	66.5	44.2	22.3	29.60	29.74	29.47	.27	39	W	27.7	87	....	....	....	26
27	50.2	59.5	40.6	18.9	29.68	29.77	29.60	.17	50	N.E.	14.4	84	....	....	....	27
28	55.0	68.2	36.4	31.8	29.78	29.87	29.70	.17	48	S.	8.8	94	....	....	....	28
29	53.9	62.3	50.0	12.3	29.59	29.70	29.49	.21	63	S.W.	25.6	..	.04	....	.04	29
SUNDAY........30	44.7	54.0	39.6	14.4	29.74	29.81	29.64	.17	76	N.W.	11.6	24	.03	....	.03	30..........SUNDAY
Means......	41.39	49.8	33.9	15.9	29.801	29.90	29.70	.20	63.2	N 79° W	17.61	46.3	1.09	2.5	1.34	.......Sums.........
31 Years means for and including this month......	40.81	49.2	33.0	16.2	29.955	......	......	.20	66.8	......	§16.36	¶49.3	1.76	5.0	2.28	31 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	1518	65	79	....	1455	1021	5454	3091	
Duration in hrs..	100	6	10	....	97	57	265	185	
Mean velocity....	15.2	10.8	7.9	...	15.0	17.9	20.6	16.7	

Greatest mileage in one hour was 44 on the 25th.
Greatest velocity in gusts was 60 on the 25th
Resultant mileage 8,386

Resultant direction, N.79° W.
Total mileage, 12,683.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶24 years only. §19 years only.

The greatest heat was 68.2° above zero on the 28th. The greatest cold was 21.0° above zero on the 2nd, giving a range of temperature of 47.2 degrees.

Warmest day was the 28th. Coldest day was the 2nd.

Highest barometer reading was 30.39 on the 2nd: lowest barometer was 29.27 on the 6th, giving a range of 1.12 inches.

Minimum relative humidity observed, was 24 on the 28th.

Rain fell on 12 days.

Snow fell on 3 days.

Thunder on the 20th.

Auroras on 3 nights.

Halos on 3 nights.

1905.

. H. McLEOD, *Superintendent.*

DAY	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY......	....	.00	.00	1 ....SUNDAY
	....	...	....	2
	.68	....	.68	3
	.01	....	.01	4
	.15	....	.15	5
	.09	....	.09	6
	.02	....	.02	7
SUNDAY......	.00	....	.co	8 ....SUNDAY
	.22	....	.22	9
	....	....	....	10
	....	....	....	11
	.00	....	.00	12
	....	....	....	13
	....	....	....	14
SUNDAY......	.26	....	.26	15..........SUNDAY
	.00	....	.00	16
	.16	...	.16	17
	.51	....	.51	18
	03	....	.03	19
	.05	....	.05	20
	....	....	....	21
SUNDAY......	....	....	....	22 ....SUNDAY
	....	....	....	23
	....	..	....	24
	....	....	....	25
	.27	....	.27	26
		....	....	27
	...	....	....	28
SUNDAY......	.00	....	.00	29.......... SUNDAY
	....	.	....	30
	....	....	....	31
Mean...... .				
	2.45	....	2.45	......Sums ....
31 Years mea[n] for and includi[ng] this month	2.90	....	2.90	31 Years means for and including this month.

Warmest day was the 25th. Coldest day was the 1st.

Highest barometer reading was 30.23 on the 4th; lowest barometer was 29.47 on the 19th, giving a range of .73 inches.

Minimum relative humidity observed, was 28 on the 22nd.

Rain fell on 16 days.

Snow fell on 1 day.
Thunder on 2 days.
Rainbow on the 20th.
Auroras on 2 nights.
Lunar Halos on 2 nights.

Direction......
Miles ....
Duration in hrs
Mean velocity..
Greatest mile[s]
Greatest velo[city]
Resutlant mil[es]

ABSTRACT FOR THE MONTH OF MAY, 1905.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	38.0	47.5	33.1	14.4	29.92	30.03	29.83	.20	54	N.W.	20.5	50	....	.00	.00	1............SUNDAY
2	45.3	54.0	33.3	20.7	30.02	30.09	29.96	.13	47	N.W.	18.0	86	....	...	....	2
3	42.9	47.2	40.1	7.1	29.91	29.96	29.86	.10	94	N.E.	9.8	..	.68	....	.68	3
4	52.9	63.3	42.4	20.9	30.14	30.23	29.92	.31	51	N.E.	11.4	96	.01	....	.01	4
5	52.1	56.8	46.0	10.8	30.11	30.22	29.98	.24	62	S.W.	21.6	..	.15	....	.15	5
6	61.2	66.8	52.0	14.8	29.96	30.06	29.72	.34	64	S.W.	14.0	42	.09	....	.09	6
7	56.6	61.4	45.5	15.9	29.73	29.91	29.60	.31	66	S.W.	25.9	48	.02	....	.02	7
SUNDAY....... 8	51.0	60.8	39.9	20.9	29.88	30.00	29.72	.28	62	S W.	12.2	55	.00	....	.00	8............SUNDAY
9	48.9	53.8	45.5	8.3	29.76	29.98	29.61	.37	71	N.W.	24.4	24	.22	....	.22	9
10	54.1	66.0	42.1	23.9	30.09	30.13	29.98	.15	39	N.W.	12.0	99	....	....	....	10
11	60.7	69.4	46.2	23.2	30.04	30.12	29.91	.21	39	S.W.	6.6	77	....	....	....	11
12	59.5	68.0	47.5	20.5	29.94	29.97	29.91	.06	41	N.E.	13.4	87	.00	....	.00	12
13	58.1	69.5	45.8	23.7	29.96	30.00	29.94	.06	63	S.W.	13.9	60	....	....	....	13
14	63.1	69.4	58.0	11.4	29.86	29.97	29.78	.19	68	S.W.	12.8	12	....	....	....	14
SUNDAY........15	58.7	65.7	51.8	13 9	29.77	29.80	29.74	.06	92	S.E.	6.1	..	.26	....	.26	15............SUNDAY
16	54.6	63.0	48.3	14.7	29 83	29.86	29.79	.07	87	N.E.	10.2	3	.00	....	.00	16
17	56.6	69.5	48.3	21.2	29.75	29.83	29.69	.14	82	S.E.	6.5	68	.16	...	.16	17
18	52.9	60.2	47.5	12.7	29.55	29.69	29.48	.21	91	N.W.	10.6	17	.51	....	.51	18
19	46.1	53.7	42.2	11.5	29.59	29.70	29.47	.23	64	N.W.	21.3	39	03	....	.03	19
20	46.3	53.3	38.3	15.0	29.80	29.94	29.69	.25	67	N.W.	16.9		.05	....	.05	20
21	49.8	57.4	42.3	15.1	29.97	29.99	29.94	.05	60	W.	15.4	24	....	....	....	21
SUNDAY........22	53.6	63.1	44.9	18.2	29.93	30.01	29.88	.13	45	N.W.	17.6	81	....	....	....	22............SUNDAY
23	46.1	53.9	35.8	18.1	30.05	30.09	30.01	.08	50	N.E.	7.5	63	....	....	....	23
24	56.4	68.4	41.8	26 6	29.99	30.05	29.93	.12	46	S.W.	12.7	84	....	....	....	24
25	64.5	77.1	50.0	27.1	29.90	29.95	29.82	.13	61	S.W.	7.0	70	....	....	....	25
26	60.1	63.2	55.3	7.9	29.87	30.02	29.79	.23	90	S.W.	11.7	1	.27	....	.27	26
27	55.6	65.0	44.2	20.8	30.08	30.16	30.00	.16	58	N.W.	6.0	71		....	....	27
28	61.2	71.0	50.8	20.2	29.95	30.00	29.91	.09	63	S.W.	14.4	64	...	....	....	28
SUNDAY........29	59.2	68.5	50.0	18.5	29.89	29.96	29.84	.12	55	S.W.	20.4	48	.00	....	.00	29.......... SUNDAY
30	55.5	62.2	49.4	12.8	29.95	30.02	29.85	.17	51	N.E.	13.0	93	....	..	....	30
31	52.7	61.7	41.8	19.9	30.07	30.14	30.02	.12	57	N.E.	8.5	94	....	....	....	31
Mean......	54.01	62.3	45.2	17.1	29.913	30.00	29.83	17	62.6	N 86° W	13.62	50.7	2.45	...	2.45	......Sums ....
31 Years means for and including this month......	54.90	64.2	45.9	18.3	29.934	......	......	17	66.1	......	ɛ 14.31	¶ 51.4	2.90	....	2.90	31 Years means for and including this month.

ʜ ANALYSIS OF WIND RECORD.

Direction	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	450	1299	136	75	869	2741	1973	2587	
Duration in hrs..	44	118	20	9	84	193	121	154	1
Mean velocity....	10 2	11 0	6.8	8.2	10.4	14.2	15.0	16.8	

Greatest mileage in one hour was 35 on the 7th.
Greatest velocity in gusts was 48 on the 7th
Resultant mileage, N.86° W.

Resultant direction, 4,645.
Total mileage, 10,130.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 24 years only. ɛ 18 years only.

ʜ Velocity for part of month from City Hall records.

The greatest heat was 67.1° above zero on the 25th. The greatest cold was 33.1° above zero on the 1st, giving a range of temperature of 41.0 degrees.

Warmest day was the 25th. Coldest day was the 1st.

Highest barometer reading was 30.23 on the 4th; lowest barometer was 29.47 on the 19th, giving a range of .73 inches.

Minimum relative humidity observed, was 28 on the 22nd.

Rain fell on 16 days.

Snow fell on 1 day.
Thunder on 2 days.
Rainbow on the 20th.
Auroras on 2 nights.
Lunar Halos on 2 nights.

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INCLUDING THE PROCEEDINGS OF THE NATURAL HISTORY SOCIETY OF MONTREAL AND REPLACING

THE CANADIAN NATURALIST

CONTENTS

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1914

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FOUNDED 1827 INCORPORATED 1832

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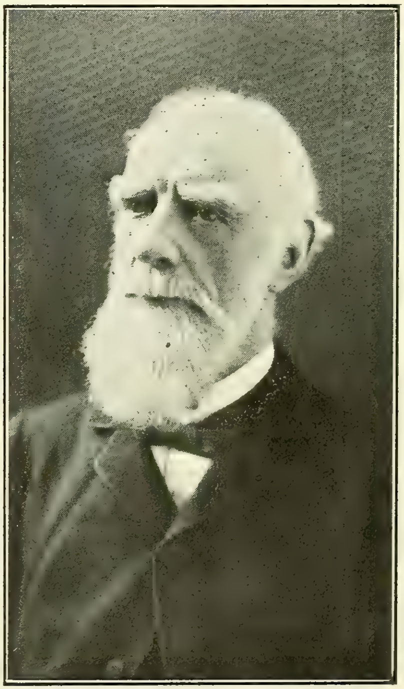
The last issue of the "Record of Science" took place in October, 1905. It was thought necessary at the time, owing to the financial situation of the Society, to suspend the publication. But there was no expectation that the suspension should be other than temporary. Application has been, year after year, made to the Government of the Province of Quebec for a restoration of the grant made in former times to the Society, but hitherto without success; and as the publication of the "Record of Science" was made conditional upon the receipt of the grant, its suspension has continued. But, during the last year, the Society resolved to resume the publication as an important part of its work, trusting that ways and means for meeting the cost should in some way be found. In the present issue, however, and in the two following ones, the purpose is to put on record the more important transactions of the Society, in the interval since the last issue was made.



Lord Strathcona and Mount Royal

THE

CANADIAN RECORD

OF SCIENCE

VOL. IX. APRIL, 1914 NO. 6

LORD STRATHCONA AND MOUNT ROYAL.

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

Referring to the death of Lord Strathcona and Mount Royal, which took place on January 21st, 1914, the Natural History Society of Montreal passed the following resolution at the first meeting of the Society which followed the event:

"The Natural History Society of Montreal places on record its sense of the heavy loss it has sustained in the death of Lord Strathcona and Mount Royal, who, while resident in this city, took a deep personal interest in the affairs of the Society and acted for several years as one of its Vice-Presidents, and who, since 1900, has been its Honorary President. His extensive travels in the wilds of Canada, and his keen observation of all that came under his eye gave him a wide acquaintance with the phenomena of nature, so that he was a very practical naturalist and was always able to contribute to the discussions of the Society. He also responded liberally when appealed to for aid in furthering the objects of the Society in carrying on its undertakings. The members recall with pleasure the geniality of his bearing and hold his personality in grateful remembrance. The Society extends sincere sympathy to the Baroness Strathcona and her family in the great sorrow which has befallen them."

As this minute briefly indicates, the much lamented late Honorary President of the Natural History Society of Montreal was possessed of a large and accurate knowledge of the facts of Biology. The thirteen years he spent in the bleak territories of Labrador made him very familiar with the Arctic fauna and flora of those northern regions. So few were the living forms to be seen in and among the barren rocks of the inhospitable tableland that a very intimate acquaintance with the species that came under notice was easily acquired.

Donald Alexander Smith had the mental equipment which enabled him to make the most of the situation in which he found himself. Born at Forres, Morayshire, Scotland, on August 6th, 1820, of a good Highland stock, Grant and Stewart blood intermingling with that of the Smiths in his veins, he inherited a fine constitution, which stood him in good stead up to his 94th year. He received a sound elementary education in his native town at a school on the Cowlair's foundation. What was of no less consequence, he had inculcated upon him in his father's house not only habits of frugality, but principles of truth, honour and integrity which laid the foundation for the illustrious career which followed. In his 18th year he set out for Canada, having received the appointment of a junior clerkship in the Hudson Bay Company's employ, several of his relatives having previously served the company. It took 50 days to make the voyage in a sailing ship. When he reached Montreal, in 1838, he was sent by Sir George Simpson, then governor of the company, to the recently-established Labrador Department, in the bleakest corner of the earth, from which the Moravian missionaries among the Eskimos had reported that foxes, minks and martens were plentiful. It was the month of September before he reached his destination, which was at Hamilton Inlet, the company having two trading posts in that district.

An earlier traveller had described the territory as "without almost any vegetation, scarcely a tree, shrub or plant to be seen, except a few dwarf willows and great patches of lichens." Here he spent thirteen quiet years, but uneventful though they seemed, the manner in which they were passed affords a key to his subsequent marvellously successful life. Most of his time, of course, was taken up with trading with the Indians, who brought furs to the posts. But he had a great deal of leisure time on his hands, which he filled up with canoeing, boating, and shooting and fishing for recreation in summer. The long nights of the eight months' winter, when the thermometer often reached 50° below zero, he employed in reading, with an occasional journey on snowshoes or on dog-sledges to outlying parts of the territory adjoining the main stations of the company. On one occasion, it is stated, that he ventured on a winter journey all the way to Montreal, to seek medical treatment for an affection of the eyes, without leave of the governor, but was brusquely sent back with a reprimand to the vacant post of duty, encountering untold hardships on the way. The life spent so largely in the open air, and all the exercises which he underwent in his early manhood contributed to build up the rugged frame and to knit compactly the muscles of the man as he was known in after years. His splendid physique was a fit instrument for the very capable intellect which it embodied. Most young men in his circumstances would have succumbed to ennui and quitted the monotonous life he was compelled to live; but Donald, the name which he was reluctant to relinquish when made a peer, the name by which he was endeared to his mother while she lived, and which he loved to hear from the lips of Lady Strathcona to the end, found delightful and profitable occupation in the library which the company had stocked with standard works on every subject. He not only read the books but digested their contents very thoroughly, and thus developed the well furnished mind which was the wonder of many in his after life. Few topics could be started in his presence to which he was not able to make a contribution, so diversified had been his reading in his younger years. Philosophy, History, Political Economy, Medicine and Divinity his stalwart understanding had studied and made its own. Left alone with his books and his thoughts, he had pondered much over the great problems besetting human life. The self-discipline through which he passed during these solitary winters in Labrador made him the strong man, independent alike in his thinking and acting, that he afterwards showed himself. Among other volumes in the "post's" library were works on Zoology and Botany, and these he perused with great care, so as to enable him to identify the few animals and plants inhabiting the country which he was wont to traverse. Although the descriptions and nomenclature of the books he studied differed not a little from those now employed, he knew the things and was able to differentiate them, while confessing that he could not attach to them their technical specific names. He knew all about the polar bear, the walrus, the eider-duck, and the wild goose, as well as about the fur-bearing animals, in which as a trader he was an interested expert. In like manner, he recognized the mosses, and lichens, and stunted shrubs which were found growing in the crevices of the rocks or on their surface. He also acquired a clear insight into the peculiarities of the Eskimos, of the Montaignais and other Indian tribes, with whom business brought him in contact, of whom he was ever ready to become a champion. And as he appreciated their finer native qualities, so they reciprocated his kind sympathy with them, by reposing in him implicit confidence. He was to them at once physician and priest, healing their sick, marrying them, and burying their dead. His dealings with the natives helped to make him a keen, shrewd judge of men. His shaggy brows gave to his eyes a telescopic look significant of his penetrating perception and farsightedness. The fuller intercourse he had with mankind developed his instinctive politeness which rested on consideration for others. He became affable to a degree and no one had a finer courtesy. All these qualities he early showed, and the influence of the culture he acquired in his many-sided reading in the wilds of Labrador continued perceptible throughout his long life.

Two useful habits he formed at that time which were of service to him ever afterwards. One was that of composition. He became master of a terse, incisive style of writing. Twice a year, when the semi-annual mail arrived and departed, he sent long letters to his mother in Scotland, detailing his experiences and giving an account of how he passed his time. It is to be hoped that these communications have been preserved, and, when his full biography comes to be written, their publication will be of the greatest interest.

The other valuable habit which he early formed was the saving one. There were, of course, few temptations for the spending of money at Hamilton Inlet in any case; but he made it one of his maxims to lay by one-half of his earnings, even when, in the period of his apprenticeship, his salary was only two shillings a day. Thus was laid the foundation of his subsequent fortune. His fellow-employees in the Hudson Bay Company, perceiving his financial capacity, and greatly trusting his honesty, made him their adviser in the use to which they put their money, and this gave him influence with banking institutions, the final outcome of which was his becoming President of the Bank of Montreal.

After leaving Labrador, he spent ten more years on the shores of Hudson's Bay, and was then raised to the dignity of Chief Factor in the company's service. In 1868, his thirty years of faithful and efficient service was requited by the great corporation and he was made chief executive officer of the company, with headquarters at Montreal, taking the place so long occupied by Sir

George Simpson, who had so summarily dismissed him when he made his unauthorized visit to Montreal for medical treatment. Shortly after this, Donald Smith became a member of the Natural History Society.

His later career is so well known that there is no need to dwell on it here. His mental activity found new directions for its exercise as a railway magnate, as a friend of education, and as a statesman, in all of which he achieved great distinction.

Now that the Canadian Pacific Railway is a great running concern, the very foremost of all railway companies, one who cannot recall the early history of the enterprise has no idea of the formidable obstacles that had to be surmounted in the way of its construction. They were strong men who ventured upon the tremendous task, and Donald A. Smith was in many respects the strongest of them all. It was a great stroke of finance when he, N. W. Kittson, J. J. Hill, and George Stephen acquired the St. Paul and Pacific Railroad Company. Its possession made the building of the Canadian Pacific Railway possible; and it was because the spell of the great northwest was upon him, because he loved it on account of old associations, and had unlimited faith in its future, that Donald Smith set his heart upon seeing the enterprise of building the iron road over the mountains carried through, and inspired his associates with some of his own enthusiasm so as to keep their faces towards the stupendous task. Lord Lansdowne well characterized the work, when it was finished, when he said: "The construction of the Canadian Pacific Railway stands alone in the history of great achievements in railway building." And how large a share Donald A. Smith had in the bold undertaking, we learn from the lips of J. J. Hill, his rival, and at one time associate, in railroad building: "The one person to whose efforts and whose confidence in the growth of our country and success in early railway development is due is Sir Donald Smith." It was fitting, therefore, that he should, on November 7th, 1885, have driven home the golden spike, which symbolized the completion of the gigantic enterprise, accompanied by the clan slogan, "Hold fast, Craigellachie." The company further honored him afterwards by calling the highest peak of the Selkirk Range of Mountains, through which the line passes, after him, "Sir Donald," Her Majesty, the late Queen Victoria, having, in 1886, conferred upon him the knighthood of St. Michael and St. George.

Donald A. Smith's interest in educational matters dates from the time when the British Association for the Advancement of Science held its annual meeting in Montreal, on the invitation of the Natural History Society. He was then brought in contact with eminent educationalists and was inspired by their enthusiasm. But it is an interesting fact that his first donation to an educational institution was made in response to an appeal from his minister, Rev. Dr. Barclay, on behalf of the Trafalgar Institute, to which he gave $10,000. This appeal set his mind aworking regarding the necessity of better educational facilities for women, which ended in the erection and endowment of the Royal Victoria College for Young Ladies. His later services to McGill University as its Chancellor and the munificent benefactions made to the institution from time to time the people of Montreal are proud to call to mind, as well as the present to the city of the splendidly equipped and endowed Royal Victoria Hospital, the joint gift of himself and his kinsman and our former fellow-citizen, George Stephen, now Lord Mount Stephen. But Lord Strathcona's interest in education and his benefactions on its behalf were not confined to Canada, his adopted country. During the period of his sojourn in Great Britain, as High Commissioner for Canada, he became successively Lord Rector and Chancellor of Aberdeen University, to the finances of which he made handsome contributions, the banquet which he provided for the faculties and graduates of the university during the period he filled office therein, being unequalled in splendour in the history of that or any other university. He also made a substantial contribution to the finances of Cambridge University, of which he became an honorary graduate.

Donald A. Smith was suddenly involved in politics. Sensitive to the honour of the great trading company of which he was the official head in Canada, when it sold to the Dominion its rights in the territory over which it had long exercised sway, and there was trouble, in 1869, over the delivery of the country to the Canadian Government, he felt called upon to do what in him lay to see that the bargain was fulfilled and the transfer made. Believing that his former relations to the people on the banks of the Red River would dispose them to listen to him, he offered to the Canadian Government to proceed at once to Fort Garry and endeavour to quiet the disturbance which had taken place against the admission of Lieutenant-Governor McDougall into the territory. Accordingly he was appointed by the Governor-General to enquire into and report upon the causes and extent of the disaffection. Armed with this document, he hastened to the scene of trouble, and ultimately succeeded in undermining the influence of Riel over the settlers around Fort Garry, although he undoubtedly put his life in danger before accomplishing this end. His quiet air of self possession, his coolness and ready judgment stood him in good stead; and so, before the Red River expedition, under Colonel Wolseley, reached the scene of hostilities, the leader of the rebellion had left the country.

When, in due time, the Province of Manitoba was constituted, he was urged to allow himself to be nominated for a seat in its first Legislature. The call was one which he felt he could not decline, and he was accordingly elected, as he was also to the Federal Parliament, when Manitoba was assigned a proportion of seats therein. It was not all plain sailing with him, however. Some of the settlers from Ontario and other sections of the east could not at first rid themselves of the suspicion that in all things he sought to promote the interests of the Hudson Bay Company as his first concern. But in time the genuineness of his patriotism became assured, and nowhere, in after years, was he more honoured and appreciated than in the City of Winnipeg and the great west generally.

His influence in the House of Commons also rose by degrees, and was not lessened when, in 1873, he, although by temperament a Conservative, refused to condone the proved offence of Sir John A. Macdonald, of trafficing in the electoral franchise, and voted against him, showing independence and pluck. He was too fairminded a man to be an out and out partizan, and this fact made it possible for him to continue in the office of High Commissioner for Canada in London, by successive Governments, although he received his appointment from the Conservatives. He represented Montreal West for two consecutive Parliaments; and only resigned his seat when appointed to the High Commissionership in 1896. How he bore himself in that responsible position is matter of recent universal laudation. His devotion to the interests of Canada which he was in London to promote language fails adequately to describe. But while faithful to his great trust, both his heart and his mind expanded in the position which he occupied, and his vision widened so that no portion of the great British Empire was a matter of indifference to him. He became an imperialist of the imperialists. His sovereign took note of the widening scope of his interests and influence and called him to her House of Lords on June 22nd, 1897. Here again truth is greater than fiction: the simple Scottish laddie was to be a peer of the realm; and Montreal was not overlooked when this highest possible honour came to him. He would have his fellow-citizens share in it and so he chose his title Baron Strathcona and Mount Royal. The motto, too, of his coat of arms was fitting: *Perseverance.* No subject ever rendered more conspicuous service to his sovereign than he did when he raised, equipped, sent into the field and sustained, the Strathcona Regiment of Horse, 600 strong, at a time of sore trial for British authority in South Africa. It was a fitting tribute to this great statesman that a tomb in Westminster Abbey should have been offered for receiving his remains when he passed away, in his 94th year; and although that distinguished honour was declined by his family, it was altogether in keeping with the best British traditions that a service to his memory was held in the great national temple, the most illustrious in the land joining in the tribute of admiration and respect.

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*SOME RARE FUNGI FOUND AT ST. ANDREWS, N.B.

This one of the several St. Andrews of Canada seems to us a particularly favourable locality for the collection and study of fleshy Fungi. The late Dr. Penhallow confirmed this opinion when a list of its Fungi was submitted to him, as has Prof. Peck, the State Botanist of New York, to whom difficult and uncommon species have been sent for identification. Our study of them has been only occasional, and almost altogether confined to a small island near St. Andrews. From the rarer forms, which I shall mention, and the enormous quantity of commoner varieties appearing every summer and autumn, an idea may be gained of the interesting forms of this plant-life likely to be found in all the country round about.

Of the white-spored Agarics: Agaricaceæ, the genera Amanita, Amanitopsis and Lepiota are each represented on the island by several species, almost all appearing in great abundance, no especially rare ones

* Read before the Natural History Society of Montreal, by Adaline Van Horne, Feb. 26, 1912.

yet found among them, however. The next—Armillaria is represented by thousands of its common variety, mellea, and also by the very rare imperialis of Fries. In one spot only, in woods of spruce and black birch, have we ever found this species. It appeared for several years as a group of three or four individuals. After bringing it home frequently in the vain attempt to identify it, I finally sent it to Prof. Peck, who wrote giving the name and saying:—"It is a magnificent species, and I am very glad you sent me this specimen, which I am preserving for the Museum Herbarium." It is a large plant 4 to 8 or 9 inches high, having a cap of brownish fawn colour, or even whitish, very tough and covered with fleshy scales, the margin strongly incurved. Gills pallid, then yellowish, crowded, decurrent. Stipe 3 to 4 or 5 inches long, fleshy, compact, very thick, and attenuated at the base like a cone. Ring double, whitish, grooved underneath. For the last three years most diligent search has not revealed any trace of this little group of mushrooms. A road was laid out a short distance from their habitat about the time of their disappearance, which may account for it. Mr. Vroom, of St. Stephen, a town about twenty miles from St. Andrews, told me that this past autumn he had found a remarkable fungus in great abundance about St. Stephen. After some study he identified it as this Armillaria imperialis. Although a close observer of Fungi, he had, if I remember rightly, not seen it before last season. In European works on Mycology, it is described as rare, occasionally found in pine woods. Of the five species of Tricholoma and three of Clitocybe, on my list, the only ones worthy of mention as being unusual are first—the *Tricholoma subacutum* of Peck, described by him some years ago, but not mentioned in many of the American books, not even in McIlvaine's huge work: "One Thousand American Fungi." So that, if not rare, it is at least uncommon. It is a grayish mushroom of medium size, having the umbo in the centre of the pileus extended into a distinct, though not sharp point, as the name indicates—thereby being very noticeable. *Tricholoma equestre,* named by Linnæus, we found only once in late autumn. It has a striking appearance. Its pileus is 3 to 4 inches broad, fleshy, compact, convex, later expanded, obtuse, pale-yellow with slight reddish tinge, its disk scales often darker, the margin wavy. Flesh, white yellow tinged. Gills close, nearly free, sulphur-yellow. Stem stout, pale-yellow, 1 to 2 inches long. The *Clitocybe nebularis* of Batsch—Clouded Clitocybe, is recorded as being rare in America. It takes its name from the clouded gray appearance of its cap, which is thick, at first convex, but flat when mature, 2 to 4 inches broad. Flesh white. Gills narrow and crowded, white or yellowish. Stem 1 to 2 inches long. It is found in woods in autumn, sometimes in clusters. Its edibility is still disputed.

Of the genus Collybia, I do not remember to have seen a single species either on the island or about St. Andrews. Also no Mycena nor Omphalia. Of Pleurotus, only the ordinary ostreatus. Hygrophorus, however, we have represented by several species, two very interesting ones. The *Hygrophorus pudorinus* of Fries, or Blushing Hygrophorus, is a very beautiful mushroom. It is found in the late autumn in coniferous woods, some seasons in greatest profusion. Groups containing hundreds of specimens are not unusual. The whole fungus is suffused with a delicate pink or flesh colour. The cap smooth, darker pink towards the centre, viscid, convex, then plane, 2 to 3 inches broad. The gills thick, distant adnato—decurrent. Stem 2 to 3 inches long with white floccose squamulæ at the apex. Flesh white. The fungus has a delicious perfume of jasmine. It is edible and has a taste, which seems to be just like its fragrance. We found a few of these mushrooms before 1904. In the summer and autumn of that year fungi of all sorts were extraordinarily abundant and fine. A number of unusual species were then noted, which were not observed before, and which have not appeared since. In October of that favourable season, this Blushing Hygrophorus appeared in the large groups I mentioned. We had failed to identify it up to that time, although we found later that it had been long known in Europe, and described in the French Mycological works. Just about this time, Dr. Peck sent us the report of the New York State Botanist for 1903, in which he described and illustrated it, I think, for the first time. Of *Hygrophorus chrysodon Fries,* we found a few specimens two or three years only. McIlvaine says of it: "A pleasant excellent species, whose rarity is regrettable." It takes its specific name from the golden tooth-like squamules or the involute margin of its white pileus, which, when dry, is shining. There are also minute adpressed golden squamules at the disk. The pileus is shaped like that of Hygrophorus pudorinus and of similar size. The white stem has pale-yellow squamules at the apex arranged in the form of a ring. The broad, thin, white, distant gills are decurrent and crisped. It may be imagined how beautiful this species is.

Of the ten varieties of the interesting genus Lactarius, we have found, perhaps, *Lactarius rufus.* Scopoli is the only one worthy of special mention, as it is considered rare. It is found in damp woods, is known by its rather large size, zoneless dark red pileus, and its intensely acrid, white milk. The flesh is pink tinged. It is said by all authors to be poisonous. Seven beautiful species of Russula are constant visitors each season. None of them rare kinds.

Of the genus Cantharellus—the Cantharellus cibarius Fries the Chantarelle, which, although reported as abundant in America and growing in great luxuriance on the island and all about St. Andrews on the edges of coniferous woods, I must mention because of its beauty and exquisite taste. It has the colour and fragrance of ripe apricots and is considered one of the best if not the best of all the mushrooms, but it is a dish which must be cooked with great care in order that the delicate flavour may not be lost. For great heat not alone destroys it, but renders the mushrooms tough. After long experimenting, we find that they should be slowly simmered over a moderate fire for three or four hours, then the usual condiments and thickening, and a little sherry added. In Europe, where the Chanterelle is very expensive, it is much prized, and all authors give it extravagant praise. We, who live in the localities it favours, are fortunate, indeed, to have this Epicurean dainty growing in such profusion.

Cantharellus infundibuliformis (Scopoli) is not included in all American works. It is frequently found about St. Andrews. Always a large species, it is occasionally observed to be considerably over a foot in height, when it is very striking and magnificent. It is funnel-shaped, with rusty yellow, rugose scaly pileus, ashy yellow gills, which become pruinose, thick, distant and dichotomous. Stem yellow, smooth. hollow.

The most interesting and rare species of this group is *Cantharellus brevipes* Pk. We had become very familiar with Cantharellus cibarius, C. infundibuliformis, and C. aurantiacus, and with descriptions of others as given in our books, and flattered ourselves that we were rather well acquainted with the genus. So that one day when my father came in with a handful of mushrooms, and before showing them to me, asked if there was such a thing as a lilac-coloured Chantarelle, for he thought he had found one. In the haste of ignorance, I promptly said there was not, and great was my surprise and excitement at seeing several fine specimens bearing every superficial characteristic of C. cibarius except that of colour. It had some of the same soft yellow, but was for the most part tinged with a distinct lilac or purplish hue. I at first thought that some specimens of Cibarius had become host plants to a secondary fungus, but closer examination showed that this was not so. None of our books described anything like it except McIlvaine, who included in his Cantharellus group a Cantharellus brevipes Peck, but his description differed so as to size, form, length of stem, and several other minor features and his illustration did not resemble our specimen, although his was described as lilac-tinged—that we gave up the identification in despair and sent one or two of the mushrooms to Prof. Peck. He was away from Albany on field work at the time, and when he returned, the specimens were too decayed to recognize. He wrote that he was much interested in my description, and asked that more specimens should be sent. The group my father found consisted of 8 or 9 individuals, and we had plucked them all in our study of them, so there were no more to send, and diligent search everywhere in likely habitats failed to discover any more. Each year about the time of the date of their finding, we looked in the old place, but none appeared until four years later, when my father in passing the spot found a group, again consisting of 8 or 9 individuals. This time we were more fortunate in getting fresh specimens to Prof. Peck, who said they were very finely developed examples of C. brevipes. He had seen it only once before, when he had described it in the New York State Botanist' 23rd report. It was a gratification to learn that our find was so rare a species.

Of Marasmius, we find three species, only one of which the M. cohaerens of Fries is uncommon. That we have only once observed in late autumn when heavy rains had long prevailed. Of the few remaining rather insignificant genera of the Leucosporæ, Lentinus is the only one represented with us by a single ordinary species 'lepideus Fries.

Proceeding to Rhodosporeæ, the rosy-spored Agarics, we have found no representatives of Volvaria, Pluteus or Entoloma, but of Clitopilus or Sweetbread mushroom we have three common varieties.

Of Ochrosporeæ—brown-spored, the group Pholiota is represented by the handsome and somewhat rare Caperata (Persoon), which appears solitary. Its pileus is 3 to 4 inches broad, yellow, fleshy, but thin in proportion to its size and robust stem, ovate, then expanded, obtuse, viscid only when moist, wrinkled in pits at the sides. (This is a marked feature.) The stem 4 to 6 inches long, more than one inch thick, solid, stout, cylindrical except for the tuberous base, shining, white, scaly above the membraneous ring, and broken into squamules at the apex. Gills adnate, crowded, somewhat serrated, pale cinnamon colour. Pholiota is distinguished from all other genera of the brown-spored series by the possession of a distinct ring.

Flammula is represented by one species—*Flammula alnicola marginalis Pk.* found once in the rich season of 1904 and not observed since.

The genus Cortinarius is distinguished especially by the rusty ochreaceous colour of the spores, and by the webby character of the veil. In the young plant fine webby filaments stretch from the margin of the cap to the stem, and in many species these are so numerous that they at first conceal the gills, but they wholly or partially disappear with advancing age and sometimes leave but little trace of a collar on the stem. In some instances a few filaments adhere to the stem, on which the spores fall. In consequence of which a rusty stain or band of brown is seen on the upper part of the stem. In young plants the colour of the gills is generally unlike that of the mature ones. Later on, the gills become dusted by the spores and assume their colour, hence it is that the gills of all the species are of a uniform colour, and it is important to know the colour in the young state. Of our ten species, the *Cortinarius armillatus* of Fries is rare. Its pileus is 3 to 5 inches broad, red brick colour, at first cylindrical, then campanulate, at length flattened, dry, at first smooth, soon fibrillose. Flesh pallid, stem 3 to 6 inches long, solid, firm, and remarkably bulbous. Bulb about an inch thick, villous and fibrillose at the base. Exterior veil woven, arranged in 2-4 distinct cinnabar rings on the stem, partial veil continuous with the upper ring, arachnoid, reddish white, It is a very noticeable species and has an odour of radish. *Paxillus involutus* Fries is our one species: a common one of the small genus Paxillus, which ends the series of the Ochrosporeæ.

Of the Porphyrosporæ—Purple-spored Agarics, our only rare example is *Agaricus hemorrhoidarius*—Shulzer —closely related to the common field-mushroom—A. campestris. Walking once along one of the island driveways, I noticed a small group by the roadside of what I thought to be fine specimens of A. arvensis, which indeed this hemorrhoidarius closely resembles in appearance. I gathered them and held them in my hand while continuing my walk. On looking down a few minutes later, I saw what was apparently blood on my hand. I thought, of course, it must have been scratched when gathering the mushrooms, then I saw that the red fluid was exuding from the broken stem of one of the mushrooms and that every part of it turned red and had a congested appearance wherever bruised. In the 45th Report of the New York State Botanist, it is said to be a rare or overlooked plant in the United States, first recorded by Prof. Peck, who found it only once growing under a hemlock tree. Hypholoma with two species closes our list of the Porphyrosporæ. The final series Melanosporæ or black-spored Agarics is represented by Coprinus atramentarius and Panaeolus retirugis, both common fungi.

Of the large family Polyporaceæ and its huge genus Boletus, we find a number of species, mostly common varieties. Its *Boletus Chromapes,* Frost, and *Boletus cyanescens,* Bulliard, are uncommon forms. The former appears to the superficial glance as very like many another Boletus. It has a pale-red pileus and whitish tubes, which become brown. But in the stem, we look for its distinguishing characteristic. It is equal or slightly tapering upward, rough spotted, pallid, but at the base without and within a bright chrome yellow. This yellow foot is a peculiar and constant feature, by which the species may be easily recognized. *Boletus cyanescens*: a curious form is now and again found as an isolated specimen on the island or about St. Andrews. It is recorded as a sparse grower in the United States. Its cap is rather variable, but usually one of the pale buff, grayish yellow or somewhat brown shades so common among Boleti. The flesh is rigid, white, instantly changing to light blue and then to indigo colour when the cap is broken or bruised. The tubes free, white or yellowish, round and changing color like the flesh. It does not look tempting, but is said to be edible and excellent. Passing on to the family Hydnaceæ, we find the genus Hydnum represented by three not at all rare species, though not observed to be abundant in our locality. Of Helvellaceæ, we find sparingly *Helvella lacunosa* Afzel, and *Leotia lubrica* Persoon, the latter a small plant not irregular in appearance, rather like Helvella, but with a very soft, gelatinous, yellow stem. *Gyromitra escutenta* Fries of the same family, I found only once on the island at the very end of October after all other fungi had disappeared. It is of remarkable appearance and easily recognized, having a dark, chestnut red, irregularly lobed cap with brain-like convolutions. The margin attached here and there to the stem. When cut through, it was found to be hollow, whitish within, and irregular, with a few distinct ribs. The stem is whitish and slightly scurfy. *Mitrulla vitellina* Saccardo var *irregularis* Peck, another of the odd-shaped fungi belonging to this family, is not reported as very common, although in favourable seasons it is fairly abundant with us. It has a beautiful yellow colour, and looks charming in the bed of damp moss it loves to grow in. The pileus is clavate, often irregular or compressed, somewhat lobed, obtuse, glabrous, tapering below into the short yellowish or whitish stem. It is usually one or two inches high. Its caps are curved and twisted or so irregularly-shaped that two plants are not often found quite alike. As it differs from the European species in being so irregular, Prof. Peck has added *var irregularis* to its name. Its flavour is said to be very delicate and fine, and it is sometimes eaten raw as a salad. Closely related is *Spathularia velutipes,* Cooke and Farlow, of the same golden colour. It is shaped like an apothecary's spatula, hence its generic name. It is distinguished by the broad, flattened ascophore running down opposite sides of the stem. *Hypomyces lactifluorum*—Schweinitz. Parasitic on large forms of fleshy fungi, frequently some species of Lactarius. The host plant is often so transformed as not to be recognizable. The gills entirely obliterated so that the hymenium of the Agaric presents an even orange coloured surface, on which the sub-globose perithecia are thickly bedded. I do not know that this fungus is rare, but it is puzzling to the finder, who sees it for the first time. Moderately large specimens are frequently found at St. Andrews. But one favorable season many years ago, an extraordinary group of them was seen, the specimens so large that they looked like quarters and halves of big pumpkins scattered over the ground.

The family Clavariaceæ I have left to the last, although it belongs between Thelephoraceæ and Tremellaceæ. Its most conspicuous genus Clavaria is represented by eight beautiful species. One the *Clavaria purpurea* Persoon in the discovery of which we take greatest satisfaction and pride. It is always a pleasure to me to think of the finding of this rare and beautiful Clavaria as associated with one, who has been a member and friend of this Natural History Society for many years, Mrs. Girdwood, whose love and enthusiasm for Botany and whose great knowledge of it in all its branches is an inspiration to all who have the privilege of accompanying her in rambles through the woods. As we were walking together on the island in August, 1908, we came upon a patch of many semi-transparent little plants of beautiful Amethyst hue, growing in a damp patch of moss and somewhat shaded by the low-growing branches of a spruce tree. Certainly it was Clavaria, but very different from any form we had seen before. The little plants are fusiform, flexuous, hollow, 3 to 5 inches high, unbranched and as a rule growing singly, although some are united at the base. This species we could not find described in any of our English or American works on Mycology, but it was given in the French book of Constantin et Dufour under this name Clavaria purpurea. I sent a specimen to Prof. Peck who confirmed the attribution and said it was the first time he knew of its having been reported in America. Although this list of rare species is not a long one, and the collecting of them is spread over a period of about fifteen years, I am hoping that it is an indicator of the treasures that may be found in the future, and that Botanists who are doing research work in marine flora at the St. Andrews Biological Station may have leisure, while there, to study the fungi, which lie at the station's very door. The road, which approaches the buildings runs through deep woods, principally of conifers, and in the dark shadows one sees the gleam of the rich colour of the fungi, which flourish there in great variety and profusion.

MOUNT ROYAL ONCE AN ACTIVE VOLCANO.

*By J. S. Buchan, K.C., B.C.L.

In a paper which I read before the Natural History Society, published in the "Record of Science," Vol. 8, in January, 1901, entitled "Was Mount Royal an Active Volcano?", I endeavoured to bring together the evidence bearing on the subject, which, however, as stated in the paper, was a matter of great difficulty, as the records

*Read before the "Natural History Society", April 28th, 1913 containing the story of the Mountain have for the most part been swept away by the action of the elements during the immense period of time which has elapsed since the forces that brought the Mountain into existence were in action.

In the paper in question, it was noted that while it did not amount to a certainty, the evidence on the whole, and particularly the nature of the Essexite forming the Mountain which indicated that it had cooled at depth, tend to show that Mount Royal, or at least that part of it which now forms the mass of the Mountain, had not been an active Volcano, that the Mountain as we see it to-day was a lacolite, a mass of hardened trap, which while in a state of fusion filled a great subterranean cavity, or to be more exact, several distinct cavities which did not reach the surface, and which owing to its hardness remained when the softer limestone by which it was covered had disappeared through the action of the elements.

In support of this opinion, it seems to me the evidence still stands, as regards the great mass of the Mountain as it appears to an observer from what may be called the outside, but when it is examined from certain points on the summit, there is room for the opinion that there may also have been active conditions present, that what we know as the Mountain now, was only part of the movement, and that there may at some time have been great volcanic activity connected with it.

This brings us to a consideration of what may be called the further evidence bearing on the question. To an observer placed at certain points on the top of the Mountain, it will be seen that there are three principal peaks, one on the northeastern side, one to the southwest and the Westmount or Little Mountain which is still a covered lacolite, and that these elevations enclose a practically level plain, over 200 feet below their present summits, in which are included the Mount Royal and Cote des Neiges Cemeteries, the field near the Park Ranger's house including a small depression near the road leading to the Look-out, and the Cote des Neiges Valley, in all an area about a mile in length by half a mile in width.

Except at the northern end, which evidently received the full force of the Arctic currents and the icefields which they carried, the outside of the Mountain slopes more or less from the summit, but to the observer viewing the interior plain, it will be seen that the sides rise somewhat steeply from the plain, thus giving it generally a crater or cup-like appearance, except at the western entrance to the Mount Royal Cemetery and the southwestern end of the Cote des Neiges Valley, where the rim of the cup has been broken down and carried away by the heavy currents with their floating icefields which evidently flowed through them, the force of which is shown by the worn surface of the rocks where the covering of drift is removed.

If we examine the bottom of this cup, we find it is a solid bed of Essexite, except where a few fragments of limestone are found which have evidently been subjected to intense heat and changed to a form of marble.

To the thoughtful observer, viewing the landscape from some point on the Summit, this plain in its centre presents one of the puzzles of the Mountain. Lying as it does, about 200 feet below these summits, the question naturally arises, by what means was this great basin excavated and what became of the tremendous mass of materials which was removed from it. It is scarcely possible that it could have been removed by the action of water, or if it had been that it would have left the depression in the form which it has to-day, since although the fierce currents which swept through it have left their marks deeply graven in the rocks, the channels through which they flowed into it are comparatively small and narrow which would not have been the case if they had been of sufficient strength and volume to remove this great mass even if it were the softer limestone, and much

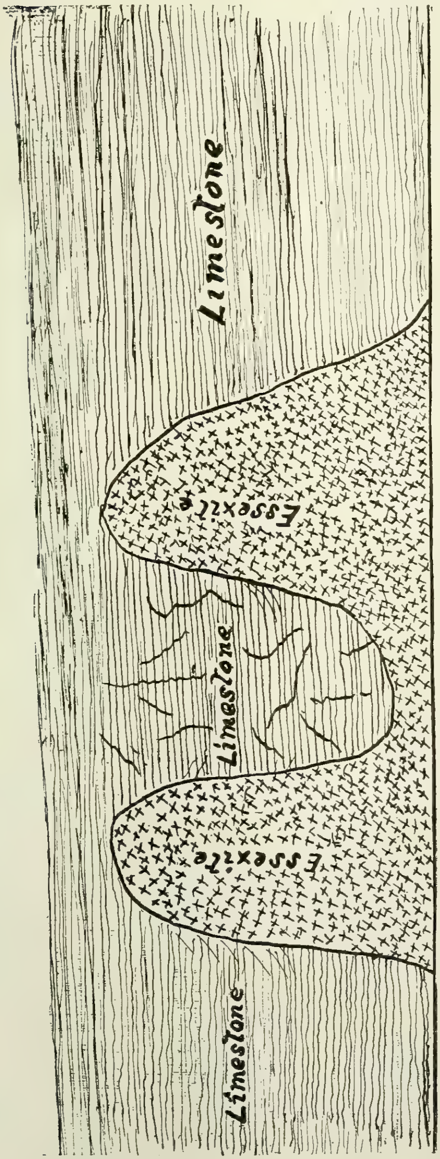


Fig. 1

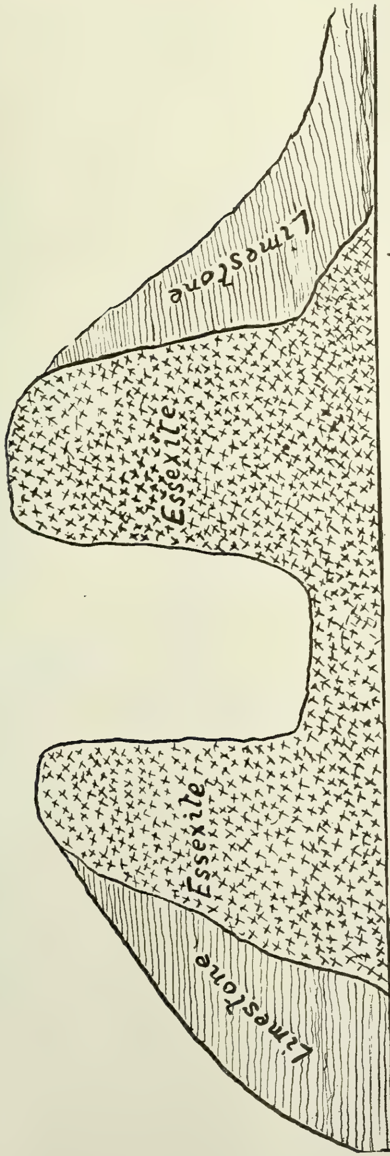
less so if the contents were the Essexite which now form its sides and floor.

If, on the other hand, we assume that the solid masses of Trap which now stand on each side of the Valley were formed by the intrusion of liquid matter from some great subterranean reservoir, into two cavities which existed where they now stand, with a considerable wall or mass of limestone between them, as shown by the sketch Fig. 1, which may have been fractured in many places but was of sufficient strength to contain it until the lava had become hardened, we have the conditions under which the elevations on the two sides of the valley could have formed.

We may also assume, from the well-known general conditions present in Volcanos, that the energy which projected the lava into these cavities may have for the time, spent itself, and that the Mountain remained in a quiescent condition a sufficient time, possibly for long ages, as in the case of Vesuvius before the eruption of A.D. 79, and so allowed the melted matter to become cooled.

If then, as is also frequently the case, there was a renewal of activity at a later period, there would be nothing improbable in supposing that the already fractured and weakened limestone between the two rigid masses of Trap was blown out of its bed, not probably at once, but by a series of long continued explosions, until there was formed an immense crater, a mile in length and half a mile in width. The fact that the ground at Cartierville is strewn with huge blocks of limestone and Essexite may have some bearing on this point, although it is possible they may have been carried there by ice.

It is to be noted here that at the Westmount end of the crater the conditions are somewhat different from those which prevail in the walls surrounding the other part of it, which are of solid Essexite. At this point the wall, especially at the northeastern end, is princi-



Section of Mountain through Mount Royal Cemetery
Fig. 2

pally limestone, but it shows for a large part at least that it has been subjected to the action of intense heat, while in some places where excavations have been made there are comparatively thin sheets of Essexite which appear to have been laid up against the limestone, as might have been caused by a moderate volume of lava flowing against it and perhaps held in place by some obstruction until it cooled. At the other end of the Valley near the Cote des Neiges Cemetery gates, there is a small plain which forms the lowest part of the crater. At this point the wall and the floor consist of Essexite, but in a brecciated condition and of a finer and less crystalline character which would indicate that it had cooled more rapidly on the open floor of the crater and included in it the broken fragments produced by the exploding gases.

If this is what occurred we have in it an explanation of how this great depression, Fig. 2 was formed, which explanation is otherwise difficult to find.

No remains of lava streams are found, so far as I am aware, in the neighborhood of our Mountain, and had they existed it is scarcely probable that they would have been altogether removed, especially when much softer materials have survived.

We may thus fairly assume that any volcanic activity which may have taken place on Mount Royal, after the opening of the crater, was confined for the greater part at least, to explosions of gases, throwing out ashes and cinders and such lighter materials as may have formed a cone of great height, but so loosely laid down that it was easily removed by the waters of the glacial sea which afterwards swept over its summit. At the same time it need not be assumed that these operations were of a minor character or on a small scale as even in the absence of a true lava flow, the eruption may have been attended with tremendous violence.

The question has naturally been asked "Will Mount Royal awaken again?" To such a question, it is obvious that a positive answer could not be given, unless by one endowed with the gift of prophecy. At the same time, if we can form any conclusion from the evidence before us, we are, I think, fully justified in saying that it is very unlikely there will be a recurrence of active conditions.

In one respect, the life of a Volcano may be compared to human life. It has its period of youth, of maturity, of old age and then death. In its old age the only evidence of life shown by a volcano is a slight escape of gases and possibly warm springs in its neighbourhood. In the case of Mount Royal, nothing of this kind, so far as I am aware, has ever been observed. Besides this, the evidence shows that there has been no eruption during or since the Pleistocene period. At various points in the crater, there are beds and banks of sand and gravel washed up by the glacial sea of that period, which beds have not been disturbed as they would undoubtedly have been if there had been an eruption since they were formed, all of which goes to support the opinion that in all probability Mount Royal will not again become an active Volcano.

NOTES ON THE NATURAL HISTORY OF THE BEAVER IN CANADA.

* By Professor A. Willey, F.R.S., McGill University.

The natural history of the beaver has been the subject of so much narrative and speculation that it is difficult to say anything new about it, so far as its more obvious peculiarities are concerned. Everybody knows how largely the beaver has bulked in the history of Canada, and that there was a time when the entire trade

*The substance of this article was communicated to the "Natural History Society", November 25th, 1912.

of the country was based upon a beaver standard, a full-grown beaver-skin being regarded as the unit of currency; and those of us who may have read the late Mr. Horace T. Martin's book on the "History and Traditions of the Canadian Beaver" (Montreal, 1892), will understand that it has formed the theme of a good deal of poetry and literature besides.

In some of its habits and instincts the beaver exhibits a certain degree of analogy with the musk-rat or musquash, and there is a striking agreement in the contour of the body; but the resemblances are superficial. These rodents have acquired their water-loving propensities independently, and the necessities of adaptation to the rigours of a northern climate have led to somewhat similar modifications. Both of them include the succulent roots or rhizomes of *Nuphar advena,* the large yellow pond-lily, in their diet; they build winter lodges which rise above the water-level, the beaver using mud and chipped branches from which the bark has been stripped for food, the musk-rat mud and rushes; their eyes and ears are small and the toes of their hind-feet are united by a web. The fur, with its outer covering of coarse guard-hairs and the soft wool or under-fur below, is very much the same in both. But whereas the scaly tail of the beaver is flattened from above downwards, the scaly tail of the musk-rat is flattened from side to side. Moreover, the lodge of the musk-rat only lasts for a season, while that of the beaver is repaired and added to from year to year. The construction of the winter lodge of the musk-rat has been described by C. L. Herrick (Mammals of Minnesota, Minneapolis, 1892).

The musk-rat is in fact related to the true rats and mice; as shown by the structure of its teeth and other characters of the skull, it is a typical member of the subfamily (Arvicolinæ) of the mouse family (Muridæ) to which the common Water-Vole of Europe and Northern Asia belongs, only it has gone farther than the latter in its adaptation to an aquatic life. The toes of the amphibious vole are not webbed and the tail is not flattened, but its hind-feet are large and it is a good swimmer, according to one observer "striking out with its hind-legs after the fashion of a frog" (F. G. Aflalo). In the same way the musk-rat and the beaver employ the hind-feet in swimming, leaving the fore-feet or hands free to carry loads.

The beaver has a family (Castoridæ) to itself, and although belonging to the order of gnawing animals, called indifferently Rodentia or Glires, it has no direct relationship with the Muridæ. Strange as it may appear, the nearest existing relatives of the beaver are the squirrels, chipmunks, wood chucks, and marmots, all members of the squirrel family (Sciuridæ).

Thus we see that the beaver occupies an isolated position in systematic classification and it might have been expected that the development of the young would exhibit novel features, inasmuch as it has long been known that various Rodents, as, for example, the rabbit, mouse, and guinea-pig, present great differences in the very early stages of their life-history. Nevertheless nothing had been done to penetrate into the pre-natal of the beaver when I took up the investigation of it three years ago. Without going into details, it may be said that the embryology of the beaver will afford a new paradigm for that of the class Mammalia as a whole

One of the most ingenious attributes of the beaver is its capacity for suiting its labours to the nature of the district which it inhabits, so that it behaves differently in different environments, in other words, it possesses considerable power of accommodating itself to its surroundings, the only *sine quâ non* being the presence of water and vegetation. The first really authentic account of the habits of the beaver was written by Samuel Hearne, a servant of the Hudson Bay Company. In 1770, at the age of 24, he was sent out with Indian guides from the company's fort near the mouth of the Churchill River, to discover a fabulous copper mine and a mythical north-west passage to China. Although his quest for these objects was something of a wild-goose chase, he discovered the Coppermine River and came within sight of its mouth, accomplishing the entire journey on foot, a remarkable performance occupying about two years in its achievement and involving great hardships. His report to the company was well received and was worked up subsequently into a book, which was published in 1795, three years after his death, at the age of 47. The "Journey to the Northern Ocean" has recently been re-edited from the original quarto edition of 1795 by Mr. J. B. Tyrell for the Champlain Society of Toronto (1911).

Hearne's fascinating description of the beaver community in the region of the Great Slave Lake finally disposed of many grotesque stories which were current at that time. It was quoted in part, though not very accurately, in an appendix at the end of Lewis H. Morgan's volume on "The American Beaver and His Works" (Philadelphia, 1868). This work of Morgan's contains the first description of the beaver canals, and is altogether one of the best natural history monographs of a mammal ever published in the English language, only rivalled perhaps by Sir Emerson Tennent's monograph of the elephant. An important chapter on the beaver, based on first-hand knowledge, will also be found in the first volume of Mr. Ernest Thompson Seton's great work, entitled "Life-histories of Northern Animals" (New York, 1909). The family life of the beaver in and about their houses makes the setting of steel traps opposite the submerged doors of their abodes a distressing matter to reflect upon. Hearne says that the Northern Indians captured the beavers by demolishing the houses; but then some of the things those people were capable of doing were almost beyond belief.

Next to the beaver canal the most wonderful piece of construction is the beaver dam, which Morgan described in great detail from examples which he found in the Lake Superior Iron District of Upper Michigan. The dam is the most imposing, as well as the most fatal of the beaver's accomplishments. Its object is the formation of an artificial pond to ensure a permanent waterway to the entrances of their lodges and burrows. Like the lodge it begins in a small way and is added to and repaired from year to year. In course of time the ponds become so large as to flood the surrounding lowlands, thus killing the trees and giving rise eventually to the beaver meadows. Morgan's "Great Dam at Grass Lake" was the most remarkable of the many examples that came under his notice. It was 260 feet long, measured with a tape line along the crest; 6 feet high at the centre of the great curve, with a slope of 13 feet on the lower face.

By a singular coincidence it happened that about the same time that Lewis Morgan was assisting in the exploitation of the iron mines at Marquette, Alexander Agassiz was developing the copper mines at Calumet in another part of Michigan. He also turned his attention to the beaver and intended to write up his observations but was forestalled by Morgan, whose work he generously appreciated. An interesting letter from Agassiz to Mr. Morgan, written in 1868, shortly after the publication of the latter's book, is preserved in the recently published "Letters and Recollections of Alexander Agassiz," edited by G. R. Agassiz (Boston, 1913).

The beaver meadows attracted the notice of Sir Archibald Geikie. Describing, in his "Geological Sketches" (New York, 1882, p. 201), an excursion to the Uintah Mountains, to the south of the Bad Lands of Wyoming, he says: "No sooner had we reached the valley bottom than abundant traces of vanished glaciers made their appearance in the form of perfect crescent-shaped moraine mounds thrown across the valley* * * Each mound of rubbish had served as a more or less effective barrier in the pathway of the stream, ponding back its waters into a lake that had eventually been converted into a meadow. But far more effective than the glacier-made dams had been those of the beaver. The extent to which the valley bottoms in this and the other mountain ranges of Western North America have been changed by the operations of this animal is almost incredible. In a single valley, for example, hundreds of acres are gradually submerged, and their cotton-wood or other tree-growth is killed. In this way the floor of the valley is cleared of timber. The beaver-ponds, eventually silting up, become first marshes and then by degrees fine meadows.''

In this passage quoted from Geikie we have a lucid picture of the contrast between the factors of inertia, instinct, and intelligence. Ice, unconscious and unknowing, alters the surface of the land by the sheer weight of its physical properties; the beaver, conscious but unknowing, likewise changes the face of nature; finally man, conscious and knowing, transforms everything to suit his purposes. Lodges, dams, and canals are intelligent works, but the ultimate consequences, namely, the beaver-meadows, are unforeseen.

It is the beaver-made dams, not the glacial dams, about which people, farmers and engineers, anglers and hunters, complain. Without discussing the foundation of the complaints or attempting the quixotic task of stemming their tide, one is free to pose this question: Is it not an extraordinary and unaccountable circumstance that one of the most marvellous instincts implanted in the fur-bearing animals, which had full play for a thousand years before Columbus discovered America, should now have become an object of local and individual protest?

From the depth of the peat deposits above the beaver dams about Calumet, A. Agassiz estimated that several of these colonies must have been at least 900 years old. If we accept this estimate as being roundly correct, it is amusing to note that just at the time when the Calumet colonies were being started by emigrants from outlying districts, the beaver in Europe was providing one of the favourite dishes at the celebrated monastery of St.

Gellen in Switzerland. Amongst the "Benedictiones ad mensas" which have been handed down in the archives of that venerable establishment, there is one dedicated to the beaver: "Sit benedicta fibri saro, piscis voce salubri"—Blessed be the flesh of the fish-like beaver. Beaver remains have been found abundantly amongst the famous pile-dwellings of the Stone Age clustered around some of the Swiss lakes, but the beaver itself vanished from Switzerland some time during the 18th century. These and other facts relating to the European beaver are contained in an article on the history of the beaver in Switzerland, Germany, Norway, and North America, by Dr. A. Girtanner (St. Gallen, 1885).

Although it has been found impracticable to farm the beaver for its fur in the same way as the silver fox is being farmed on Prince Edward Island, it should be remembered that while there is no animal more easily exterminated, there are few so easy to encourage. In a "Check List of the Vertebrates of Ontario," issued by the Department of Education in Toronto (1905), the author, Mr. C. W. Nash, says with reference to the beaver: "A few years ago this valuable fur-bearing animal was perilously near to extinction in our Province, but owing to the protection wisely afforded it, the beaver is again becoming abundant in Northern Ontario. In Algonquin Park, where it is strictly preserved, they may be seen to great advantage."

In consequence of the measures of protection which have been adopted by the Provincial Governments, both in Ontario and Quebec, the life of the beaver is doubtless ensured for many years to come; but it seems a pity that there should be any difference of opinion upon such an elementary principle as to the preservation of an ancient and valuable type, whose existence adds greatly to the natural beauties and amenities of Canadian woodland scenery. It is not to be wondered at that in the midst of the storm and stress of the Middle Ages in Europe the beaver should have been allowed to depart with a blessing. But it is doubtful whether there is anything that can exactly fill the place of the beaver in the natural and national life of Canada, if it should vanish from the scene.

The flattened scaly tail is not the external feature which renders the beaver unique. Alone amongst mammals the beaver has an arrangement on the second toe of each hind-foot for cleaning the fur. At first sight it looks like a double claw and was so described by Cuvier and many later writers, including Audubon and Bachman, Lewis Morgan, E. T. Seton, and others. So far as I have been able to ascertain, the suggestion that it serves as a cleaning claw first emanated from D. Girtanner (*op. cit.* 1885). He noticed that alongside and below the normal claw of the second hind-toe there is an accessory "nail-plate," which can only serve to comb the flanks of the animal, the heavy paunch deriving advantage from such a special provision to facilitate cleaning. E. T. Seton (*op. cit.* 1909, Vol. I. p. 469), figures what he calls "the split nail of the second toe on hind-foot," which he thinks may be "possibly for use as a comb and louse-trap."

What seems to be an accessory claw on the second hind-toe of the beaver is in reality a crest-like ridge developed from the nail-bed in front of and below the regular claw. The upper free rim of this crest is cornified and presents a sharp edge to the true claw, leaving a narrow chink through which the fur can be combed. The crest is a specialization of the lip of the claw-bed; this is continued round the outer side of the base of the claw and produced forwards as a vertical crest. Only the edge of the crest is hard; the sides are soft and filled with dense white fibrous tissue like the substance of the toe-ball. The claw is not separately movable upon the ridge; they move together as one piece with the terminal phalanx with which they are connected.

If we seek for analogies for the cleaning claw of the beaver, we should find nothing like the mechanism just described. A North African rodent, known as the "gondi" (*Ctenodactylus*), has rows of cleaning bristles arching over the claws of the hind-feet. Referring to this genus, the Swedish zoologist, Tycho Tullberg in his systematic monograph of the Rodentia (Upsala, 1899, p. 152), says that the four claws of the hind-feet are very small, thin, and sharp; above them there are numerous curved, stiff bristles arranged in rows, which serve the same purpose as corresponding structures which are found in the Chilion rodents, *Chinchilla* and *Octodon,* namely, to comb the soft fur.

Cleaning claws are known amongst birds. In the heron family (Ardeidæ) which includes herons and bitterns, the claw of the middle toe is serrated along its inner border. The nearly related families of the storks and ibises are without any serrated claw. An exactly similar kind of serrated claw on the middle toe is found in the members of the Nightjar family (Caprimulgidæ); while the nearly related Frogmouths (Podargidæ) are without it. Again we meet with it in the Barn Owls (Strigidæ), but not in the nearly related Horned Owls (Bubonidæ).

A serrated claw is found in the same position in several small families of the order Steganopodes or Totipalmatœ (all four toes connected by a web), including the Cormorants, Darters, Gannets, and Frigate-birds [see British Museum Catalogue of Birds, Vol. XXVI]. Leaving these out of consideration for the sake of simplicity, we may fix our attention on the fact that the serrated middle claw, an exceptional feature in the class of birds, occurs identically in three entirely distinct families (Ardeidæ, Caprimulgidæ, Strigidæe), whilst it does not occur in the nearest relatives of these families.

Such observations as have been made touching upon the use of the serrated claw indicate that it serves to clean the rictal bristles near the mouth and the adjacent feathers of the head. In Gilbert White's "Natural History of Selborne," edited by R. Bowdler Sharpe (London, S. T. Freemantle, 1900), Letter 37 (Vol. I, p. 154), recounts the feeding of a Nightjar upon Melolonthid beetles which were swarming about a large oak. The letter goes on: "But the circumstance that pleased me most was that I saw it distinctly, more than once, put out its short leg while on the wind, and, by a bend of the head, deliver somewhat into its mouth. If it takes any part of its prey with its foot, as I have now the greatest reason to suppose it does these chafers, I no longer wonder at the use of its middle toe, which is curiously furnished with a serrated claw."

To this the editor (R. B. S.) adds the following footnote: "The use of the serrated claw in the nightjar has been discussed by many ornithologists. It is not likely that the foot has any seizing power, but as the bristles which beset the bird's gape may become clogged with the wings of the insects on which it feeds, it is possible that White saw the bird in the act of cleaning its rictal bristles by means of the comb on its claw."

The development of identical or analogous structures in adaptation to a common need on the part of dissimilar organisms, whilst their nearer blood relations show no trace of the modifications in question, is a phenomenon of widespread occurrence, but its precise theoretical significance is rather obscure. Adaptation itself is still one of the great unsolved mysteries of organic life.

Montreal, March 20th, 1914.

THE CRAFTY FOX.

Away back in the early nineties, on a farm in the County of Two Mountains, a fine specimen of a red fox was seen one day leisurely crossing the hills.

Having a little leisure time on my part, I took my rifle out of its case, and strapped on a pair or snow-shoes, and my foxhound was ready to accompany me without further hint.

It was a mild day, after a heavy fall of deep soft snow, in the early part of January, so I provided myself with a couple of steel spring fox traps. I knew from previous experience that reynard would not run far, but would run to earth the first chance he got, if pursued by a swift hound, when his brush and fur got loaded up with the soft snow.

When the hound took up the scent and started to run on the trail, the fox ran about a mile straight on his course, then swinging around in a circle, he doubled back in the direction he came from, and ran to earth in a little sand hill, in a small thickly wooded hemlock patch of trees, after being pursued less than a couple of miles.

The sound of the baying hound, apparently coming for some time from the same place, I went over in that direction and found the hound scratching out the sand at the mouth of the open hole, in an attempt to get at the fox.

I tied up the hound, then set the two traps in the fox hole, securing them by small chains to a near-by tree. I then led my hound home and kept him tied up for a few days, in case that he would return to the fox hole and get caught in the traps.

A couple of days afterwards, I visited the traps, but found nothing disturbed. Two days later, I visited the traps with the same result. I then was absent for a couple of days in the city, and when I returned, on the following day, I found that the fox in trying to make his escape out of the hole, had got caught in one of the traps, and set off the other.

To my great surprise, I found that the captured fox had devoured a partridge at the mouth of the hole. On examining the fresh tracks in the surrounding snow, it was clearly seen that the the partridge had been brought to the captured fox by another fox, who had done a good deal of reconnoitring around the hole before approaching near enough to give its hungry comrade a well-timed meal.

I got a companion to visit the place where the partridge had but recently been devoured, with nothing left but the scattered feathers, and everything proved conclusively that probably the hunger cries of the fox had touched the tender heart of one of its comrades, who had brought the partridge to the starving and captured fox.

I collected a bunch of some of the larger partridge feathers, some of which I still have, as a souvenir of a touching and pathetic event.

In those days, the foxes were a regular pest to the farmers in that vicinity, from the frequent depredations they made on their barn-yard fowls, and we always tried to destroy the foxes at every opportunity offered, by trapping or shooting them.

On one occasion, when my hound was running a fox trail, re seemed to have run ris quarry to earth, out on an opening, where there were very few trees, on a hill on the Robertson farm, commonly known in that vicinity as Burnside. The dog manoeuvring around a fallen tree for some time, keeping up a constant baying, I approached the place, and when I got within one hundred yards of the fallen tree, I took in the situation. I found a large maple tree, broken off almost squarely, in a decayed spot in the trunk, about eight feet from the ground. From the half decayed wood the colour was a yellowish brown, and on the top of this stump reynard was lying curled up like a sleeping cat, but very much awake, and apparently enjoying the way he had fooled the hound.

The fallen maple tree was heavily branched on all sides, and in falling the trunk was supported by the branches, four or five feet up from the ground, which only made a jump of about three feet for the fox to get from the trunk of the tree to the top of the stump, where he was so well hidden by the sameness in colour of the new break in the half rotten wood and his own yellow coat.

I only had a shot gun with me on this occasion, and I tried to get within fifty or sixty yards, to take a shot at the fox, but before I got within that distance the fox, watching his opportunity, jumped back on to the trunk of the tree, then on to the ground from the opposite side to myself and hound, after being well rested, and fresh for another long run.

Occasionally, when my foxhound would start out on a fox hunt on his own accord, and run a trail, always by scent, sometimes for several hours at a time, I have known foxes, when they got tired running, and wanted to make the hound lose their trail, run along on the top of a rail fence, for several yards at a time, then jump back on the ground or snow again in an attempt to make the hound lose the trail. This always made the hound lose a good deal of time before he could find and take up the track again, to continue the run, but in time the hound also got wise, he would be seen climbing up, and take a sniff or two on the top rail, then run on a few yards, and repeat the operation, until he got the track on the ground or snow again, and continue running on the trail.

W. A. OSWALD.

Montreal, March 30th, 1914.

REPORT TO ROYAL SOCIETY OF CANADA FOR THE YEAR 1904-5.

By Professor Nevil Norton Evans.

On behalf of The Natural History Society of Montreal, I beg to submit the following report for the consideration of the Royal Society:

Clearly recognizing with Herbert Spencer the great value,—material, intellectual, and moral,—which a study of nature has for the individual and for the community, the Natural History Society has endeavoured to advance such study, not only among its members, but also among the general public, by means (1) of its regular monthly meetings with their scientific communications; (2) free evening lectures, generally illustrated, for adults; (3) Saturday afternoon talks, also illustrated, for young people and children; (4) opportunities for study offered by its museum and library; (5) the publication of its scientific journal; (6) excursions into the immediate neighbourhood of the city, and trips further afield, under competent scientific leadership; and (7) a general active interest in scientific matters affecting the well being of the community at large.

With regard to the work accomplished, in pursuance of these objects, during the past year, along the several lines indicated, the following short account may be given.

(1) Regular monthly meetings have been held as usual, the programme having been as follows:

1904, Oct. 31.—"Observations upon some leaf variations and their bearing upon palæontological evidence," by Dr. D. P. Penhallow.

1904, Nov. 28.—"Additional Toadstools, edible and poisonous, collected on the Island of Montreal," by Rev. Dr. Campbell.

1905, Feb. 6.—"The relations of Fungi to the higher forms of life, with special reference to the action of decay," by Dr. D. P. Penhallow.

1905, Feb. 27.—"The development of Bacteriology," by Dr. Otto Klotz.

1905, Mar. 27.—"The results of Scientific work in connection with Flour Milling," by W. A. Gray, Esq. (Chemist to the Ogilvie Flour Mills Co).

1905, May 1.—"Public discussion concerning the Tussock Moth and the general care of Shade Trees," by Dr. James Fletcher.

(2) The annual Somerville Course of Lectures for 1905 was as follows:

1905, Feb. 2.—"The South Seas," by Dr. Otto Klotz, Dominion Astronomer.

1905, Feb. 9.—"The place of Plants in the Economy of Nature," by Dr. D. P. Penhallow, Professor of Botany, McGill University.

1905, Feb. 16.—"The Russia of To-day," by Abner Kingman, Esq.

1905, Feb. 28.—"A Trip to the Northern Part of Hudson Bay and the Arctic Islands, on Dominion s.s. Neptune," by Commander A. P. Low.

1905, Mar. 2.—"The Geological Resources of Canada," by Dr. H. M. Ami, Dominion Geological Survey.

1905, Mar. 9.—"The Various Races of Men," by Dr. E. W. MacBride, Professor of Zoology, McGill University.

(3) The Young People's Half-hour Series of Talks on Natural History for 1905 was as follows:

1905, Feb. 4.—"The story of a piece of Coal," by J. S. Buchan, K.C., B.C.L.

1905, Feb. 11.—"The story of a Yeast Cake," by Dr. D. P. Penhallow.

1905, Feb. 18.—"The Sleep Movements of Plants," by Professor Carrie M. Derick, M.A.

1905, Feb. 25.—"Some of Mother Nature's Inventions," by Harry Bragg, Esq.

1905, Mar. 4.—"The story of a Grain of Wheat," by W. A. Gray, Esq.

1905, Mar. 11.—"The story of Sugar and Syrup," by Milton L. Hersey, M.Sc., City Analyst.

1905, Mar. 18.—"King's Cobweaver's Pipies," by C. T. Williams, Esq.

The three courses of lectures above enumerated have been well attended, the numbers being markedly above those of former years. The average attendance at the Somerville Lectures was about two hundred, and over 1,500 children listened to the talks given for their benefit.

(4) The donations to the museum have not been quite as numerous as usual, but have been of an exceptionally valuable character. Unfortunately, the room is so completely taken up that it is impossible to exhibit new specimens. Ever increasing numbers of visitors are registered, over 10,000 having been counted last year; among these are a large number of classes, accompanied by their teachers, from the city schools, especially from the Roman Catholic, who show great interest in examining and studying the collections.

The contributions to the Library increase every year, there being at present 3,500 volumes upon the shelves, while upwards of 2,000 volumes await proper accommodation.

(5) "The Canadian Record of Science" has been published as usual, the articles being most original ones. Under the able editorship of Dr. Penhallow, it is to be hoped and expected that this journal is about to enter a new and more important era in its existence, if a small government grant, for which application has been made, can be obtained.

(6) The annual Field Day was held at Shawinigan Falls and was most successful in every way. The weather was ideal, the arrangements for the comfort of the excursionists were well carried out, and the number of those attending was the greatest on record for any similar occasion—over 450.

(7) As one of the efforts made by the Society to keep in touch with the practical life of the people, may be mentioned the discussion on the Tussock Moth, already referred to, and steps were taken to aid in the extermination of the pest. The importance of guarding against

the depredations of this insect, which elsewhere is recognized as one of the most destructive to shade trees, engaged the attention of the Society early this spring, and measures were taken, in conjunction with the civic authorities, to destroy the egg clusters before the period of hatching.

As has already been indicated, the general work of the Society has for some time past, been much hampered by lack of suitable accommodation. The building on University Street, owned by the Society, and which has been its home for nearly half a century, has become far too small for the requirements, this being especially noticeable in connection with the museum and library, and also with respect to accommodation for the important series of lectures which the Society annually conducts. Steps are now being taken to acquire a more suitable property.

As one development in harmony with its endeavours to bring people more closely into touch with nature, the Society is glad to welcome the movement of recent years, which has found expression in the establishment of special recreation grounds under the charge of the Parks and Playgrounds Association, and especially to the efforts of Sir William Macdonald with respect to an extension of Nature Study in the schools throughout the province. These and all other activities, which tend to cultivate in the young an interest in and a love of nature, are in the very best interests of all classes of the people.

During the last twelve months, seventeen new members have been enrolled, and a special effort is just being started to bring about a very considerable increase in the membership in view of the probable extension of the premises of the Society. Two of our oldest and most respected members have passed away during the last year—Dr. D. C. MacCallum and Mr. J. A. Mathewson.

Officers.

The list of officers for the session of 1904-1905 is as follows:

Patron—His Excellency the Governor-General of Canada.

Hon. President—Lord Strathcona and Mount Royal.

President—Prof. D. P. Penhallow.

Vice-Presidents—Frank D. Adams, Ph.D., F.R.S.C.; Rev. Robt. Campbell, M.A., D.D.; B. J. Harrington, Ph.D., F.R.S.C.; Albert Holden, J. H. Joseph, E. W. MacBride, M.A., Sc.D.; Dr. Wesley Mills, Hon. J. K. Ward.

Hon. Recording Secretary—F. W. Richards.

Hon. Corresponding Secretary—C. E. H. Phillips.

Hon. Treasurer—Chas. S. J. Phillips.

Hon. Curator—A. E. Norris.

Members of Council—J. A. U. Beaudry, C.E., Chairman; J. S. Buchan, K.C., B.C.L.; Joseph Fortier, John Harper, Edgar Judge, H. McLaren, B.A.; Alex. Robertson, B.A.; C. T. Williams.

Superintendent—Alfred Griffin.

The Society is much indebted to the indefatigable efforts of Mr. Alfred Griffin, the Superintendent, who is not only a very enthusiastic member, but a most efficient worker.

REPORT TO THE ROYAL SOCIETY FOR THE YEAR 1905-6.

By Dr. Albert G. Nicholls.

The following report of the work of the Natural History Society, for the session of 1905-1906, is respectfully submitted for the consideration of the Royal Society of Canada.

The officers and members of the above Society have pleasure in reporting a most successful year's work. Keeping in mind the purpose for which the association was formed, namely to encourage the study of nature among its members, to foster the love of natural objects among the general public, and, in a word, to disseminate and popularize these special branches of science, they have to a large extent followed the methods which have proved so successful in former years, but with the expectation in the comparatively near future of embracing an even larger scope. In general, the objects mentioned have been carried out by means of regular monthly meetings of a largely scientific nature; free evening lectures of a popular kind; weekly afternoon talks, usually illustrated, for children and young people; opportunities for study offered by the museum and library; the publication of its scientific organ, "The Canadian Record of Science"; excursions to places of interest in the vicinity of Montreal and an active interest in those scientific matters of importance to the well being of the general body politic.

To particularize the work done on the above lines the following account may be given:

The regular monthly meetings have been held as usual. Papers of a scientific character were presented as follows:

1905

Oct. 25.—"An Account of a Blazing Beach on the Main Coast," Prof. D. P. Penhallow.
—"A Notice of some Fossil Plants from the Pleistocene of the Abitibi River," Prof. Penhallow.
—"Note on the Geology of the Abitibi District," Dr. Wilson.

Nov. 25.—"Fungi collected at Cap-a-l'Aigle," Rev. Robt. Campbell, M.A., D.D.
—"Relations of Sun Spots and Sun Clouds," Mr. Chas. J. Stuart.

1906.

Jan. 29.—"The Distribution of Forests in Tertiary Time and their Relations to the present Great Plains," Prof. Penhallow.

—"Some Recent Studies respecting the Nuclei of the Lower Forms of Plant Life," Miss Carrie M. Derick.

Mar. 26.—"Some Recent Developments on the Production of Plant Hybrids," Miss Carrie M. Derick.

Apl. 30.—"A Remarkable Tumour of the White Birch," Prof. Penhallow.

—"Distribution of Plants in the Cretaceous Period," Prof. Penhallow.

The Annual Somerville Course of Lectures was given as follows:

Jan. 18.—"Lime, Soda, and Soap," Prof. Nevil Norton Evans, M.Sc., McGill University.

Jan. 25.—"The Labrador Eclipse Expedition," Rev. I. J. Kavanagh, S.J., M.A., B.Sc., Science Master, Loyola College.

Feb. 1.—"Food Adulteration in Canada," Dr. J. T. Donald, Official Analyst to the Dominion Government.

Feb. 8.—"Jamaica, the Isle of Springs," Theo. L. Wardleworth, F.L.S.

Feb. 15.—"The Origin of New Forms of Plant Life," Carrie M. Derick, Assistant Lecturer in Botany, McGill University.

Feb. 22.—"South and East Africa as seen during the Meeting of the British Association in 1905," Dr. John B. Porter, Prof. of Mining and Metallurgy, McGill University.

The Young People's Half-Hour Series of Talks on Natural History for 1906 was as follows:

Jan. 20.—"Buds," Carrie M. Derick, M.A.

Jan. 27.—"Story of a Piece of Wood," J. S. Buchan, K.C., B.C.

Feb. 3.—"A Talk on Plants," S. S. Bain, Esq.
Feb. 10.—"A Can of Salmon," Harry Bragg, Esq.
Feb. 17.—"By-Paths in an Invisible Garden," Dr. A. G. Nicholls, M.A., M.D.
Feb. 24.—"How Paper is Made," Chas. S. J. Phillips, Esq.

The attendance of members and others on the above courses has been very gratifying and shows an increased interest in matters scientific.

A matter worthy of special note is the Conversazione which was held under the auspices of the Society in the Natural History Building, on February 22nd. This meeting, the first of the kind held for ten years, was graced by the presence of His Excellency Earl Grey, to whom a fitting address was presented by the Society, together with a souvenir of historical interest. The conversazione was entirely satisfactory from every point of view.

The donations to the museum have not been particularly numerous this year, but have been of considerable importance.

Contributions to the library continue to be made, there being now about 5,500 volumes in the care of the Society.

The Canadian Record of Science keeps up its good record for scientific and general excellence, and, under the able editorship of Dr. Penhallow, it is hoped that it will appear at regular quarterly intervals, and make its way to the front as the standard scientific journal of the kind for the whole of Canada. To this end it is hoped that a grant from the Government, for which application has been made, will be re-established.

The annual Field Day was held at Mt. Johnson and was very successful. The attendance was very large and the arrangements for the comfort of the excursionists were well carried out.

In the report of last year reference was made to the interest in the question of the depredations of the Tussock Moth on our shade trees. As a consequence of this crusade, measures, which unfortunately were only partially successful, were adopted, in conjunction with the civic authorities, to limit the ravages of this insect. As a result of our efforts, the dangers accruing from this pest have been more forcibly brought home to those most directly concerned, and this spring we expect that more vigorous measures will be adopted towards the extermination of the pest. As another example of the wide-reaching interest of the Society, may be mentioned the fact that attention was called to the wanton destruction of sea-gulls in the Lower St. Lawrence, and steps were taken to memorialize the Federal Government to inquire into the matter and to take the necessary steps to put a stop to the evil.

During the past year, the work of the Society has been hampered by the lack of sufficient and suitable accommodation for the prosecution of its distinctive work.

More especially has this been noticed in connection with the museum and library, a great amount of the material being inaccessible on account of the lack of the space to display it. In this connection, the Society has taken an important and decisive step in the direction of better things. It has disposed of the old building, which has so long been its home, and a scientific landmark in the city, and has acquired a most desirable site, consisting of about 10,000 square feet on the best portion of Drummond Street, where its temporary quarters have been located.

On this ground, it has been decided to erect a modern building, which will meet the increased requirements of the Society, and be a credit to the City of Montreal. To this end an influential and numerous building committee has been struck and immediate steps are to be taken to carry the Society's desires into effect. As a consequence of these changes, it has been found necessary to store the various specimens and books in suitable places, so that for the coming year they will not be available for reference, and to this extent the Society's usefulness will be curtailed until the new home is an accomplished fact. Realizing this, and with the idea of in some measure compensating for it, the Society has decided to extend its work on the line of free public lectures to be given in different centres of the city and with the co-operation of the various bodies, like the Tuberculosis League, the Local Council of Women, the Pure Milk League, the Hygiene Committee, the Westmount School Commissioners, the Alexandra Hospital, and St. Paul's Hospital. The subjects that will be dealt with will include matters of hygiene, public health, decoration, materials and forms of construction, and will be dealt with in popular ways by competent lecturers. Some of the lectures are designed to meet the special requirements of artisans, and where necessary will be delivered both in English and French.

It is confidently expected that this number will be still more increased in view of the greater attractions which will be afforded by the increased facilities which it is hoped will be offered by the Society in the not very distant future. We have to regret the death of one of our members, that of the late Hon. R. Prefontaine.

The Society is greatly indebted to Mr. Alfred Griffin for his valuable and enthusiastic services placed at its disposal.

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Superintendent—Alfred Griffin.

REPORT TO ROYAL SOCIETY OF CANADA FOR THE YEAR 1906-7.

(By Prof. Nevil Norton Evans.)

The Natural History Society of Montreal is at present passing through a transition stage in its history, the old building on University Street, which it had occupied for so many years, having been sold and the new building not having been yet erected, leaving it for the time being without any proper home. The books, collections, and other effects of the Society have been packed up and stored away; a fine lot on Drummond Street near Sherbrooke Street has been purchased, and two old dwelling houses standing upon it serve as temporary, though very inadequate, quarters of the Society.

But the possession of such limited accommodation has by no means lessened the Society's activity. On the contrary, the temporary loss of its library, museum and other conveniences has stimulated it to increased effort along lines more or less independent of these accessories.

The regular monthly meetings have been held at the temporary quarters and, strange to say, the attendance has been much larger than during many years previous; unfortunately, on more than one occasion a great many people had to be turned away for lack of room, but the general interest has grown rather than diminished. The subjects discussed have been as follows:

"Polar Rotation," by Mr. Chas. J. Stuart.

"A Visit to Some Mexican Volcanoes," Dr. F. D. Adams.

"Notes on Botanical Specimens Presented by Miss Bickley," by Dr. D. P. Penhallow.

"Infectious Diseases," by Dr. C. K. P. Henry.

"A Modern Scourge, Tuberculosis," by Dr. A. G. Nicholls.

"Bermuda, Historical and Geological," by J. S. Buchan, K.C.

"The Pulp Wood Industry of Canada," by Dr. D. P. Penhallow.

The Somerville Course of Free Lectures was held this year in the Assembly Hall of the Montreal High School, and drew large audiences. The list of subjects and lectures is here appended:

"Earthquakes," by Dr. F. D. Adams.

"Origin and Development of Certain Salt Marshes on the New England Coast," by Dr. D. P. Penhallow.

"The Ice Story of the St. Lawrence," by Dr. H. T. Barnes.

"Suspension of Life in Plants," by Prof. C. M. Derick, M.A.

"Dew," by Rev. I. J. Kavanagh, S.J., M.A., B.Sc.

The talks to children in the Assembly Hall of the Montreal High School, were, perhaps, not quite as well attended as in former years, when both before and after the talk the children roamed through the museum, and interesting specimens were pointed out and described; probably, too, the fact of the talks taking place in the new and unfamiliar building had much to do with keeping away certain of those little ones who were in the habit of coming with grown perpersons. But there is no doubt that when the public become acquainted with the new and greatly improved quarters which the society hopes soon to possess, renewed interest in the work will be felt by the children quite as much as by any other section of the community. The work of the Society last winter in this particular branch is given below.

"Our Bird Neighbours," by R. H. Boehner, M.A.

"The Story of a Rain Drop," by J. A. Bancroft, M.A.

"Seeds and Fruits on Their Travels," by Prof. C. M. Derick, M.A.

"The Quest for Food," by Rev. I. J. Kavanagh, S.J., M.A., B.Sc.

"Flour," by J. S. Buchan, K.C.

An entirely new departure was made last season in inviting the co-operation of the Local Council of Women, The Canadian Handicrafts' Guild, The Tuberculosis League, The Pure Milk League, The Hygiene Committee, The Westmount School Commissioners, The Alexandra Hospital, The St. Paul's Hospital, The St. Lambert Literary Society, and the Grand Trunk Literary and Scientific Institute, and with their aid carrying out several courses of lectures to artisans, and delivering these—many in French as well as in English—as far as possible in such parts of the city as would be most convenient to those whom it was desired to reach. The lectures may be regarded as having fulfilled the object for which they were instituted, in the sense that they directed the attention of a large body of our citizens to questions of the highest importance and utility as having direct application to their daily occupations, in the improvement of the home life, and in a better understanding of correct hygienic conditions. The attendance upon the lectures and the characters of the audiences have been all that could have been expected, and another season of effort will be certain to bring yet more gratifying results. The following were the subjects offered:

"Lime, Plaster of Paris and Cements," by Prof. N. N. Evans, M.Sc.

"In the Chemistry Building, McGill University. Three lectures.

"Timber, Its Origin, Properties and Uses," by Dr. D. P. Penhallow, in the Peter Redpath Museum, McGill University. Four lectures.

"Tuberculosis," by Dr. A. G. Nicholls, in St. Luke's Church; Dr. C. N. Valin (in French), in Montcalm School; Dr. C. N. Valin (in French), in Sarsfield School.

"Infectious Diseases," by Dr. C. K. P. Henry, in Chalmers' Church; Dr. J. J. Ross, at the Grand Trunk Institute; Dr. C. C. Gurd, at St. Lambert.

"The Care of Children," by Dr. Ritchie England, in St. Mary's Hall; Dr. Ritchie England, at the Grand Trunk Institute.

"House Sanitation," by Rev. I. J. Kavanagh, S.J., M.A., B.Sc. (in English and French), at Sarsfield School.

"Civic Virtues," by G. W. Stephens, M.L.A., at the Grand Trunk Institute; G. W. Stephens, M.L.A., at Montcalm School.

"Furniture and Decoration," (with illustrations from the Handicrafts Shop), by Cecil Burgess, Esq., at St. Lambert; Dr. Stuart Nicol, at the Grand Trunk Institute; Prof. H. Armstrong, at St. Luke's Church; Mme. Rodier (in French), at Montcalm School; Mme. Rodier (in French), in Sarsfield School.

The Annual Field Day was held on Saturday, 2nd June, at St. Gabriel de Brandon, and a very large number of the members and their friends took the opportunity of visiting the little town so picturesquely situated among the Laurentian Hills on the shores of Lake Maskinonge.

The Society has continued to watch with vigilance the development of the Tussock Moth in the City of Montreal, and it is gratifying to observe that as a result of its endeavours there has been a marked abatement of the threatened damage to our shade trees. This has come through a greater activity and more careful attention on the part of the city authorities and an awakened public interest, which has led property holders generally to exercise a more thorough care of their trees.

Provisional plans and estimates for a building worthy of the Institution and its work, and in keeping with the fine neighbourhood in which it is to stand, have already been made, and an active canvass of the friends of the Society is now going on. It is hoped that the whole of the money required for the building and its requirements will soon be raised, and that actual work thereon will be begun in the near future. With a home in every way adequate to the work which the Natural History Society feels it should be doing, in and for Montreal, we confidently look forward to entering upon a new lease of life replete with fresh zeal and courage.

Officers.

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Hon. President—Lord Strathcona and Mount Royal.

President—D. P. Penhallow, D.Sc., F.R.S.C.

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Superintendent—Alfred Griffin.

* CENTENNIAL OF CHARLES DARWIN.

Of the many men born in the year 1809, none, not even Gladstone, has filled so large a place among men of learning and thought as Charles Darwin. It may be said without exaggeration that he is the greatest naturalist who has ever lived. Numerous societies, including his alma mater, the University of Cambridge, England, have held celebrations in his honour, and it is fitting that the Natural History Society of Montreal, the oldest organization in Canada for the prosecution of Natural Science, should have put in its proceedings some notice of the event. Darwin may be regarded as an illustration of his own theory of evolution. Heredity demonstrated its force in him, for was he not the grandson of Erasmus Darwin, author of several works bearing on Natural History, among others a whimsical one on the ''Loves of the Plants,'' in which there were some hints looking in the direction in which his more famous grandson afterwards travelled? He was first destined by his father, who was a medical man, for his own profession, and afterwards for the ministry of the Church of England, but he did not feel himself drawn to either calling. He rather took up the subject of Natural Science, under the guidance of one of his professors, and he soon won distinction in his chosen line of work so that when captain, afterwards Admiral Fitzroy, wanted a naturalist to accompany him on the surveying voyage of the ''Beagle,'' he was offered and accepted the position. In 1839, he published a journal of his researches on that voyage. This was followed, in successive years, by publications on the structure and distribution of Coral Reefs, Geological Observations on the Volcanic Islands visited, also notices of the Geology of Australia and the Cape of Good Hope and Geological Observations in

* Portion of a Somerville Lecture delivered by Dr. Robert Campbell, March 3rd, 1910.

South America, the "Geology of the Falklands," "The Formation of Mould," and a monograph of the Cirripedia. These publications, though following in the ordinary paths of Naturalists, contained many original suggestions. But it was his giving to the world his work on the "Origin of Species" which caused him all at once to spring into fame. This proved to be an epoch-making book. It is his monumental work on which his reputation largely rests. It has been well described by Alfred Russell Wallace, who issued about the same time a book suggesting the same theory, as displaying "untiring patience in accumulation, wonderful skill in using large masses of facts of the most varied kind, wide and accurate physiological knowledge, acuteness in devising and skill in carrying out experiments, and an admirable style of composition, clear and persuasive." This was a handsome tribute from a contemporary author who might, to a certain extent, be counted a rival. But it was in no wise exaggerated. The work has exerted an influence greater perhaps than any scientific volume that ever came from the press, Newton's "Principia" alone excepted. And its influence has not been confined to the realms of Natural Science. The theory which is pronounced, and which Herbert Spencer termed "evolution," went down to the bottom of things, and it has given a new direction to speculations in Physics, Psychology, Moral Philosophy, Biblical Criticism and Theology, as well as Politics. The value of this work does not depend on the correctness of his theory. It contains a compendious statement of well-sifted facts bearing on the life history of plants and animals; and it has given birth to an enormous and valuable literature, both *pro* and *con*.

Before entering upon a consideration of this, Darwin's most famous work, it is necessary to define what is understood by the term "species." It may be considered from a twofold point of view, Morphological and Physiological,—that is to say ,as regards anatomical structure and form, in the one case, and as to the ability for individuals belonging to any group of organized beings to intermarry and produce a fertile offspring, in the other. Both considerations are to be kept in view in determining what is to be regarded as a species, but especially the latter point. It is found, for instance, that the male mule, which is a cross between the horse and the ass, cannot give birth to another mule. Plants, in like manner, may be crossed, but the hybrids thus produced are infertile. This is one of the mysteries of the realm of nature. How organized beings came to be thus divided up into groups, and surrounded by a wall of separation, was the problem which Darwin set himself to solve. The task he placed before himself was this: to show that all the various forms of vegetable and animal life with which the globe is now peopled, or of which we find the remains preserved in a fossil state in the great earth museum around us, have come down from at least four or five progenitors, animals and plants in an equal number. But his speculation did not stop at that point and he adds, "Analogy would lead me one step further, namely, to the belief that all animals and plants have descended from some one prototype and that probably all the organic beings which have ever lived on this earth have descended from some one primordial form into which life was first breathed by the Creator."

The main propositions by which he would bring us to that conclusion may be summed up, as follows:

(1) That observed and admitted variations spring up in the course of descent from a common progenitor. (2) That many of these variations tend to an improvement upon the parent stock, possessing some quality that is profitable or advantageous. (3) That by a continued selection of these improved specimens, as the progenitors of future stock, its powers may be increased illimitably. (4) That there is in nature a power continually and universally working out this selection and so fixing and

augmenting these improvements. His argument turns on the changes produced on domestic plants and animals.

These changes show at least that nature's productions are capable of being greatly modified by the interposition of man. The varieties in the pigeon family are made to do large service in Darwin's discussions; yet marked though the results in breeding, under man's oversight, have been in their case, they remain only varities because they freely breed between themselves and the male offspring is fertile, showing that he is not a hybrid. Indeed the reference to pigeons as well as cats and dogs may be turned against Darwin, for all these creatures entered into the menage of the ancient Egyptians 5900 years ago, as Antiquarians tell us. By this time one might expect that they should, through variation and the several influences Darwin rests on, have given rise to a new species. But aside from that the author of the "Origin of Species" has adroitly assumed that, because man has been able to make use of variations in domesticated organisms for his profit and advantage, such changes have been for the profit and advantage of the species thus domesticated, and that if they have profited under human selection why might they not in like manner profit by variation under the processes of nature?

Heredity is undoubtedly the most influential factor in the production and moulding of the forms of living things. The child takes after his parents, sometimes being more like his father and at other times more like his mother. He is indeed not an exact counterpart or reproduction of either, but there is generally noticeable a family likeness. What we now see is a circuitous course —the tree yielding fruit which in turn gives birth to a tree like itself; the egg laid by the bird hatching out a bird like the mother one. Thus there is a perpetual round. The question debated of old, whether the egg or the hen was first, has not yet been settled, but what is the order of procedure at present? We know that every species gives birth to a reproduction of itself, with some measure of variation. Arguing from what is now the order regulating all life, we are justified in believing that it has been so since life first began upon the earth.

Heredity is a persistent fact, so far as our observation can carry us. But within the limits of species there is found an enormous measure of variation. Neither Darwin nor any one else has exaggerated this undoubted fact. We often hear the similes, as like as two blades of grass, or two peas; whereas no two blades of grass, or two leaves on a tree, or two peas, are seen to be alike when looked at through a powerful lens. Yet none of these variations are found to leap over the bars that fence them off from other species. It is a wonderful and curious fact that miscegenation is prohibited in the realms of life.

Mr. Darwin, indeed, starts out in his quest with correct ideas, speaking of the obvious objection, "that the term 'selection' implies conscious choice in the animals which become modified, and it has been urged that as plants have no volition natural selection is not applicable to them. In the literal sense of the word, no doubt, natural selection is a false term." Yet he frequently juggles with the word in the course of his narrative, and in his deductions from the facts he relates. And while he thus guards himself, at the outset of his constructive work, his unwary readers are led to treat literally what he, when challenged, only means figuratively. Further on he adds: "So again it is difficult to avoid personifying the word 'Nature,' but I mean by Nature only the aggregate action and product of many natural laws and by laws the sequence of events as ascertained by us." I do not charge him with any intentional unfairness or desire to mislead, but I take it that being so confident of the truth of his theory and so fully enamoured of it, he thought everything was to be interpreted in the light of it.

Darwin made free use of the observations and speculations of previous students of Natural History, so far as they had any bearing on his quest. What is spoken of as the ladder of life had been frequently commented on,—the gradations of structure from simple forms, at the bottom, to complex ones at the top, as seen in living things, and of their relations to one another,—Algae, nearly allied to Lichens, Lichens to Fungi, Fungi to Hepaticae, Hepaticae to Mosses, Mosses to Ferns, and then the series of Phænogams, leading up to the Compositae.

Similarly animal life begins with the Amœba and ascends to man.

It has been observed before his day that large groups of species of widely different habits present the same fundamental plan of structure,—all the vertebrates, for instance,—and that parts of the same animal or plant, the functions of which are very different, likewise exhibit modifications of a common plan.

The existence of structures in a rudimentary and apparently useless condition, in one species of a group, which are fully developed and have definite functions in other species of the same group,—the flaps of seals and whales,—had been dwelt on. The modifications produced on living organisms when placed in new conditions, and the effects resulting from Geographic Distribution, were facts well known. And specially the revelations of palæontology, showing a succession of life, simpler in the older rocks, and more complicated as we examine the more recent formations, were highly suggestive. Familiar with all these facts, the enquiring mind of Darwin felt that the universe held in its bosom profound secrets which had not yet been brought to light, and he determined to fathom them so far as it was within the power of man to do so.

All his subsequent publications took their colour from his views as to the origin of species, and their general aim was to show the singular endowments possessed by plants and animals, in some regards equal to the highest gifts bestowed upon man. Effects of cross-fertilization, in which the vegetable kingdom, the contrivances by which orchids are fertilized by insects—''Insectivorous plants''—''power of movements in plants,'' ''Descent of man,'' and numerous monographs.

When confronted with the admitted fact that nature at present offers an insuperable bar to the mixing of species, so as to produce a fruitful offspring, he offered the following suggestion which has stuck in the ideas of his disciples, as if it were undoubtedly true: ''That one existing animal has not been derived from any other existing animal, but that both are the descendants of a common ancestor which was at once different from either, but in essential characters intermediate between them both.'' He admitted that he could produce no such intermediate form, and also that the known facts of Geology were against the theory. These are his candid words: ''Geology assuredly does not reveal any such finely graduated organic chain; and this is the most obvious and serious objection that can be urged against the theory. The explanation lies, as I believe, in the extreme imperfection of the geological record.''

Darwin attempted to formulate a philosophy of life along certain lines, but it would not be correct to call him in early life an atheist.

''Agnostic'' was the term invented by Huxley to represent the attitude of mind of the group of naturalists who accepted the theories I have outlined. Nor was their air of humility merely affected.

Speaking of the protoplasm, which is the primordial form of all life, Huxley defined it as ''matter potentially alive and having within itself the tendency to assume a definite form''; and added, ''what is the cause of this wonderful difference between the dead particle and the living particle of matter, appearing in other respects identical? that difference to which we give the name of life? I, for one, cannot tell." Darwin did not eliminate Deity from the universe, even when he first propounded his theory. The closing sentence of his treatise on the "Origin of Species," summing up what he had advanced in it, is not unworthy of the great naturalist: "There is a grandure in this view of life, with its several powers, having been originally breathed by the Creator into a few forms, or into one, and that, whilst this planet has gone circling on according to the fixed law of gravity, from so simple a beginning, endless forms most beautiful and most wonderful have been and are being evolved." However, later in life he wrote as follows: "Disbelief crept over me at a very slow rate, but was at last complete. The rate was so slow that I felt no distress." An older philosophy of of the universe is that which dispenses with a Creator and Divine Ruler altogether. The Roman Poet Lucretius propounded it and it was championed by Robert Chambers in his "Vestiges of Breation," and found an eloquent exponent in Professor Tyndall, who, in his address at Belfast, when retiring from the presidency of the British Association, in 1874, declared that "matter has in it the promise and potency of all life." The theory of spontaneous generation, which Chambers championed, has been thoroughly exploded; but Professor Hæckel, of Germany, a well known monist who has gone far beyond Darwin, contends for the position that all atoms are living, and rejects everything which cannot be explained, including soul in man or God in Heaven. The theory of "Natural Selection" was thought by Darwin to be an important discovery, and it kindled in his mind such intense enthusiasm that he thought many things went to support that theory which a cooler, less impassioned observer could not regard in the same light. Only one in many cells generated matures, does it select itself? Do the others select not to mature?

There is the greatest need that terms used in this discussion be clearly defined and then strictly adhered to. Let us begin with the word "Nature." Latin *natura* signifies the sum of all that has come to the birth and indicates the result of the forces at work in the universe; but it is quite improper to speak of it as if it were itself a force. Darwin indeed protests that he so understood the term; and if he used it otherwise it was only figuratively. Yet he constantly employed it as if it were a persistent agent, always and everywhere at work. And whatever reserve of meaning he retained in his own mind, when thus employing the word, there can be no doubt as to the significance put upon it by the larger portion of his readers. The term is constantly used in the loose sense. It has been pointed out how the phrases which Darwin made use of to indicate the method by which he conceived species to be generated, "Natural Selection," "Survival of the fittest," "Struggle for life," convey to the mind of the ordinary reader that the creature thus in issue is a sentient being, planning a course for itself and doing conscious battle on its own behalf. Darwin says he did not mean that, but he uses language and arguments as if he did, and certainly misleads his unthinking followers. "Law" is another word which is used loosely and made to do large service in the discussion of life's problems. Now, it, too, properly employed, only indicates the method in which force acts, it is not a force itself. It is usual to speak of the law of gravitation. But it is so employed to show how the force acts which we call gravitation, to conceal our ignorance, but it is not the acting force. The orbit in which the planets revolve around the sun, or the moon about the earth, is found to be mathematical, and Kepler calculated the facts in the case, and his calculations being found good by astronomical observers are called laws.

But they did not disclose the force by which the planets are guided in their courses. Are we to believe that the earth and the sun began their mutual career by an agreement between themselves that they should maintain the mathematical relationship which, we observe, exists? We should be as fully justified in endowing them with a conscious personality, as Darwin was in ascribing to plants self-determination of their career, when he spoke of "Natural Selection."

So, too, the word "time" is made to play a large part in Darwin's theory. But here again the term is only an abstraction, signifying the succession of events and things, but not a force or agent. Yet Darwin speaks of 300,000,000 of years as able to yield all the diverse and complicated phenomena of life as it now exists and as it has existed in the several areas of which the rocks bear the records, all proceeding from a single protoplasmic cell. When he explains himself, he indeed tells us that he means that little changes in succeeding generations might, when put together in so prodigious a period, result in the great multitude of varied living things. Lord Kelvin, however, as great an authority in Physics as Darwin was in Natural History, and who has studied with care the facts adduced by Darwin in support of his theory, without being convinced by them, declared that the globe cannot possibly be more than 20,000,000 years old. This conclusion he arrived at by calculating how long it must have taken the earth to have cooled to its present condition from its primeval molten state. Be that as it may, it is enough to say that if changes, even the slightest, have not been observed looking to the formation of new species since men began to take cognizance of life as it now is on our planet, the mere multiplying of eras cannot be supposed to secure results. The multiplying of nothing by infinity would still yield nothing.

It was one of Darwin's theories that the varieties which are ever and anon appearing among the ordinary forms of species might have a better chance, those of them that the surroundings favoured, than the typical specimens, and thus new species might be gradually formed. But since he thus speculated, the good monk, Mendel, discovered a principle bearing upon this point, which wholly confutes Darwin's notion. The force of heredity is shown by innumerable experiments and observations to be persistent, so that accidental variations have no chance to compete with the ordinary form of a species.

Since Darwin's day, too, Jean Henri Fabre, the great French entomologist, predisposed to Darwinism, has shown, however, that insects are not able to plan for themselves or acquire new ways by experience, but obey a blind impulse, having no power to adapt themselves to unlooked for situations.

Then, there is a question which has never been answered by the evolutionists: If it is a law of all life to be ever moving towards something higher, how is it that further development has ceased at man? The latest estimate made by people calling themselves scientific, of the period of his existence upon the earth is 20,000,000 of years—only a wild guess. Surely, by this time, assuming the correctness of the guess, there should be some tokens of the acquisition of wings or some other sign of his rising a step higher in the scale.

Except Hæckel and Wallace, the latter holding the same theory, although somewhat modified, the men of science of this day has given up the notion that species have formed themselves by any inner potentiality or plans of their own, however the selection, which is a fact, is to be accounted for.

CONTRIBUTIONS TO CANADIAN PALÆONTOLOGY.

"The Manus in a Specimen of Trachodon, from the Edmonton Formation of Alberta."

"A New Genius and Species of Ceratopsia, from the Belly River Formation of Alberta."

"On the Fore-Limb of a Carnivorous Dinosaur, from the Belly River Formation of Alberta, and a New Genus of Ceratopsia, from the Same Horizon, with Remarks on the Integument of Some Cretaceous Herbivorous Dinosaurs."

"On Gryposaurus Notabilis, a New Genus and Species of Trachodont Dinosaur, from the Belly River Formation of Alberta, with a Description of the Skull of Chasmosaurus Belli."*

By Lawrence M. Lambe, F.G.S., F.R.S.C., F.G.S.A., Vertebrate Palæontologist to the Geological Survey.

The Geological Survey of Canada has continued for many years now its explorations in the rocks along the Red Deer River and in the Valley of the Belly River, Alberta, with most encouraging results. Rich rewards have been reaped in the shape of rare fossils, and these have afforded scope for the application of the skill of Mr. Lambe, the expert Vertebrate Palæontologist of the Department. He has greatly added to his already well-established reputation by these last contributions to fossil lore. The remains of new monsters of the Saurian type are brought to light in the above series of interesting papers, which have appeared in *The Ottawa Naturalist,* Vol XXVII, May and December, 1813, January and February, 1914, from which brief extracts are here offered.

The first of the papers has particular reference to the osteology of the front feet, or hands, of a specimen of Trachodon discovered last summer in the Edmonton formation (Upper Cretaceous) or Red Deer River, Alberta, by the Geological Survey-Vertebrate Palæontological field party, under Charles H. Sternberg. This specimen is now being mounted in high relief preparatory to being placed on exhibition in the Museum of the Geological Survey, Ottawa. The skeleton of this Trachodon is almost complete from the front magin of the snout to the sixth caudal vertebra, but the remainder of the tail is missing. This defect, however, can be remedied to a great extent in mounting the specimen, as fortunately a

* Communicated by permission of the Director of the Geological Survey.

large portion of the tail of another individual of similar size was found at the same locality, and can be used to take the place of the missing vertebra.

"The specimen is in an excellent state of preservation as a whole, and is one of the most complete of the skeletons of Trachodon mounted in the museums of this continent."

STYRACOSAURUS, GEN. NOV.

Styracosaurus Albertensis, sp. nov. is described in the second paper: "The skull of this species is remarkable for the largeness of the nasal horn-core, the remoteness of the same from the acute rostral apex, and for the great development of backwardly directed spike-shaped processes on the posterior margin of the coalesced parietals.

"The name selected for this genus has reference to the shape of the large processes on the frill, which resembles spikes, and must have made this bristling reptile in life a veritable moving *chevaux de frise*.

"This specimen brings to light an entirely new phase of frill development which is unique among the horned dinosaurs. It may be regarded as one of the most complete and best preserved of the Ceratopsian skulls hitherto discovered in Cretaceous deposits of this continent."

Referring to the contents of the third paper, it is remarked: "An unusually perfect skeleton of a carnivorous dinosaur, lately added to the collection of the Geological Survey, is of special interest on account of the preservation in it of one of the front legs. The specimen * * * * forms part of the very large collection of reptilian and other remains made last summer by the Vertebrate Palæontoligical party, which explored the rich dinosaur beds below Berry Creek.

"The structure of the fore-limb in the large carnivorous dinosaurs of the Cretaceous has been to a great extent conjectural. In this new specimen the right limb is preserved, and it is hoped that the left one will be revealed, as the work of removing the sandstone matrix proceeds. The discoverer of this splendid speciment was Charles Sternberg, Jr., who was one of the Vertebrate Palæontological field party of 1913.''

Protorosaurus, gen. nov.

''This genus is proposed for the reception of the Belly River Cretaceous ceratopsian species, originally described by the writer under the name *Monoclonius Belli.*

''It is now evident that this Belly River form is generically distinct from both Monoclonius, Cape and Ceratops Marsh, and that its affinities are with Torosaurus Marsh, to which it apparently leads in a direct line of descent, and from which it differs by well-marked primitive characters.

''With the skeleton of *P. Belli* were found well preserved impressions of the integument, of the same general character as that of the Trachodonts.''

The last of the four papers describes ''a skull representing a new genus and species of Trachodont, and of that of *Chasmosaurus belli,* both forming part of last summer's collection.

''The skull of the Trachodont is remarkable for its splendid state of preservation. The elements composing it are singularly free from breaks and displacement. There is little or no discoloration, and the specimen is as close an approach to perfection as can be expected in a fossil vertebrate of large size.

''For the genus and species represented the name *Gryposaurus notabilis* is proposed, the generic name having reference to one of the most striking features of the skull, viz., the prominence attained by the upper marginal curve of the nasal bones.

''The discoverer of these remains was George F. Sternberg.''

Y, 1914.

Meteorological C. McLEOD, *Superintendent.*

DAYS.	THERM Mean.†	Max.	Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
1	-0.2	6.9	85	...	...	...	1
2	5.5	12.6	58	...	...	...	2
3	19.4	25.0	32	...	...	...	3
SUNDAY........4	24.1	28.9	0	...	...	...	4.....SUNDAY
5	16.0	21.8	94	...	...	...	5
6	13.1	21.5	51	.01	...	.01	6
7	27.7	30.9	0	.02	0.5	.05	7
8	19.8	24.8	0	...	0.6	.03	8
9	19.6	21.9	0	T	1 0	.24	9
10	18.7	24.0	13	...	1.5	.15	10
SUNDAY.......11	0.2	7.7	91	...	0.5	.02	11.....SUNDAY
12	3.8	18.4	1	...	8.0	.80	12
13	-22.9	-15.0	65	...	...	...	13
14	-16.9	-8.1	85	...	...	...	14
15	-1.1	8.9	0	...	0.1	.01	15
16	14.0	20.3	0	...	0.1	.01	16
17	19.5	23.3	0	...	T	T	17
SUNDAY.......18	3.9	9.7	88	...	...	...	18.....SUNDAY
19	17.6	26.3	0	...	2.3	.13	19
20	8.4	25.0	60	...	T	T	20
21	6.3	8.9	0	...	7.0	.70	21
22	-0.1	3.7	88	...	...	...	22
23	15.1	31.3	12	.01	...	.01	23
24	34.4	39.0	0	.72	1.2	.79	24
SUNDAY.......25	4.4	26.0	93	...	...	...	25.....SUNDAY
26	0.6	4.0	0	...	1.0	.10	26
27	24.0	36.0	0	.01	0.4	.08	27
28	29.1	35.0	15	.34	1.0	.44	28
29	32.5	39.3	48	...	...	...	29
30	33.0	43.6	85	...	...	...	30
31	11.7	21.9	0	...	6.0	.70	31
Means......	12.29	20.1	34.26	1.11	31.2	4.27	......Sums
40 Years means for and including this month.	12.66	29.90	32.17¶	0.872	29.78	3.75	40 Years means for and including this month.

ANALYSIS

Direction	N	N.E.	E
Miles.............	588	3861	7(
Duration in hours...	37	253	7
Mean Velocity......	15.9	15.2	9

The greatest mileage in one hour was 41 o
The greatest velocity in gusts was 65 on t
Resultant mileage, 3190.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

¶ 33 years means.

§ 27 years means.

ABSTRACT FOR THE MONTH OF JANUARY, 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER † Mean.	THERMOMETER Max.	THERMOMETER Min.	THERMOMETER Range.	*BAROMETER † Mean.	*BAROMETER Max.	*BAROMETER Min.	*BAROMETER Range.	‡ Mean relative humidity.	WIND General direction.	WIND Mean velocity in miles per hour	Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
1	-0.2	6.9	-5.0	11.9	30.32	30.37	30.27	.10	64	E	11.0	85	...	...	...	1
2	5.5	12.6	-2.8	15.4	30.28	30.32	30.26	.06	70	NE	9.0	58	...	...	...	2
3	19.4	25.0	12.4	12.6	30.18	30.27	30.08	.19	66	NE	11.4	32	...	...	...	3
SUNDAY........4	24.1	28.9	19.9	9.0	30.03	30.07	29.98	.09	66	NE	25.4	0	...	...	...	4.....SUNDAY
5	16.0	21.8	11.7	10.1	30.17	30.20	30.08	.12	63	NE	18.6	94	...	...	...	5
6	13.1	21.5	6.2	15.3	30.03	30.20	29.75	.45	70	SW	10.4	51	.01	...	.01	6
7	27.7	30.9	23.7	7.2	29.64	29.71	29.58	.13	78	NW	12.4	0	.02	0.5	.05	7
8	19.8	24.8	17.0	7.8	29.61	29.66	29.55	.11	72	NE	9.2	0	...	0.6	.03	8
9	19.6	21.9	17.1	4.8	29.38	29.54	29.17	.37	84	NE	9.3	0	T	1.0	.24	9
10	18.7	24.0	7.2	16.8	29.47	29.82	29.15	.67	77	NW	8.5	13	...	1.5	.15	10
SUNDAY.......11	0.2	7.7	-7.5	15.2	29.94	30.04	29.74	.30	63	W	16.6	91	...	0.5	.02	11.....SUNDAY
12	3.8	18.4	-15.0	33.4	29.58	29.92	29.27	.65	73	NW	24.0	1	...	8.0	.80	12
13	-22.9	-15.0	-27.1	12.1	30.26	30.43	30.07	.36	56	W	23.6	65	...	...	...	13
14	-16.9	-8.1	-25.4	17.3	30.45	30.57	30.21	.36	53	W	17.6	85	...	...	...	14
15	-1.1	8.9	-8.6	17.5	29.98	30.17	29.87	.30	73	NE	10.4	0	...	0.1	.01	15
16	14.0	20.3	8.9	11.4	29.75	29.88	29.65	.23	80	SE	7.6	0	...	0.1	.01	16
17	19.5	23.3	9.7	13.6	29.86	30.13	29.64	.49	67	NE	18.5	0	...	T	T	17
SUNDAY......18	3.0	9.7	-0.4	10.1	30.24	30.34	30.12	.22	57	W	16.8	88	...	...	...	18.....SUNDAY
19	17.6	26.3	5.0	21.3	29.80	30.08	29.62	.46	77	W	17.2	0	...	2.3	.13	19
20	8.4	25.0	5.0	20.0	29.79	29.86	29.68	.18	68	NE	18.3	60	...	T	T	20
21	6.3	8.9	3.7	5.2	29.50	29.70	29.33	.37	77	N	19.8	0	...	7.0	.70	21
22	-0.1	3.7	-5.3	9.0	30.05	30.21	29.82	.39	63	W	19.1	88	...	...	...	22
23	15.1	31.3	-3.3	34.6	30.04	30.26	29.70	.56	71	SW	15.7	12	.01	...	.01	23
24	31.4	39.0	26.0	13.0	29.54	29.63	29.43	.20	83	W	19.1	0	.72	1.2	.79	24
SUNDAY.......25	4.4	26.0	-4.6	30.6	29.94	30.28	29.47	.81	55	NW	19.0	93	...	...	...	25.....SUNDAY
26	0.6	4.0	-5.0	9.0	30.31	30.36	30.26	.10	73	NE	10.3	0	...	1.0	.10	26
27	21.0	36.0	1.7	34.3	30.04	30.33	29.93	.40	81	SW	13.8	0	.01	0.4	.08	27
28	29.1	35.0	24.3	10.7	30.28	30.53	29.97	.56	79	NE	11.2	15	.34	1.0	.44	28
29	32.5	39.3	21.4	17.9	30.13	30.48	29.83	.65	77	SW	20.4	48	...	...	...	29
30	33.0	43.6	21.9	21.7	29.90	30.31	29.78	.53	57	NW	30.2	85	...	...	...	30
31	11.7	21.9	5.8	16.1	29.98	30.36	29.43	.93	67	NE	18.8	0	...	6.0	.70	31
Means......	12.29	20.1	4.3	15.8	29.955	30.130	29.764	.366	69.66		15.92	34.26	1.11	31.2	4.27	......Sums
10 Years means for and including this month.	12.66	20.90	4.72	16.17	30.049	.....	.....	.347	81.39		15.80	32.17¶	0.872	29.78	3.75	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction..........	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles..............	588	3861	708	304	540	1474	2239	2070	
Duration in hours...	37	253	72	33	35	80	119	112	3
Mean Velocity......	15.9	15.2	9.8	9.2	15.4	10.6	19.3	18.5	

The greatest mileage in one hour was 41 on the 30th.
The greatest velocity in gusts was 65 on the 30th. Total mileage, 11844. Resultant direction, N21°10'W.
Resultant mileage, 3190.

The greatest heat was 43.6° above zero on the 30th. The greatest cold was 27.1 below zero on the 13th, giving a range of 70.7°.

The warmest day was the 24th. The coldest day was the 13th.

The highest barometer reading was 30.53 on the 28th. The lowest barometer reading was 29.15 on the 10th, giving a range of 1.38 inches.

The minimum relative humidity observed was 33 on the 14th.

Fog on 1 day.

Hail on 1 day.

Lunar halos observed on 2 nights

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

¶ 33 years means.

§ 27 years means.

A Y, 1914.

Meteorological C McLEOD, *Superintendent.*

DAYS.	THERM(		of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
	† Mean.	Max.					
SUNDAY........1	19.3	25.1	51	...	0.7	.06	1.....SUNDAY
2	17.9	23.1	91	...	T	T	2
3	26.5	39.8	9	...	1.0	.08	3
4	29.4	37.0	64	.07	T	.07	4
5	8.1	13.6	74	...	...	...	5
6	7.4	19.6	77	...	4.2	.47	6
7	22.3	35.0	14	.01	2.2	.35	7
SUNDAY........8	3.7	12.9	82	...	T	T	8.....SUNDAY
9	8.1	15.0	81	...	0.2	.02	9
10	-0.7	9.8	89	...	...	...	10
11	-19.8	-12.3	89	...	...	...	11
12	-18.6	-12.0	90	...	...	...	12
13	-8.5	-4.2	30	...	...	...	13
14	1.7	12.3	0	...	3.5	.35	14
SUNDAY.......15	-2.8	6.1	88	...	...	...	15.....SUNDAY
16	-4.2	0.0	63	...	T	T	16
17	2.6	5.9	97	...	...	...	17
18	6.5	11.1	69	...	T	T	18
19	7.0	14.9	51	...	...	...	19
20	-0.8	8.8	88	...	...	...	20
21	-1.9	3.2	88	...	...	...	21
SUNDAY.......22	10.8	24.6	51	...	2.8	.20	22.....SUNDAY
23	-4.4	1.4	97	...	...	...	23
24	-2.8	2.3	94	...	T	T	24
25	10.6	21.6	48	...	T	T	25
26	24.4	30.8	16	...	0.1	.01	26
27	31.6	36.3	40	...	0.2	.02	27
28	33.8	40.6	79	...	...	...	28
Means......	7.41	15.1	4.57	.08	14.9	1.65	......Sums
40 Years means for and including this month.	14.690	22.652	0.40¶	7.61	25.11	3.248	40 Years means for and including this month.

ANALYSI

Direction	N	N.E.	E
Miles..............	489	1097	4
Duration in hours...	50	97	3
Mean Velocity......	9.8	11.3	11

The greatest mileage in one hour was 44 o
The greatest velocity in gusts was 70 on t
Resultant mileage, 6023.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

¶ 33 years means.

§ 27 years means.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER				*BAROMETER				‡ Mean relative humidity.	WIND		Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour					
SUNDAY........1	19.3	25.1	12.7	12.4	29.68	30.01	29.42	.59	74	NW	25.1	51	...	0.7	.06	1.....SUNDAY
2	17.9	23.1	11.5	11.6	30.44	30.61	30.07	.54	59	NW	14.7	91	...	T	T	2
3	26.5	39.8	7.2	32.6	30.12	30.46	30.04	.42	74	SW	13.2	9	...	1.0	.08	3
4	29.4	37.0	13.6	23.4	29.93	30.17	29.75	.42	66	NW	18.3	64	.07	T	.07	4
5	8.1	13.6	3.7	9.9	30.28	30.44	30.17	.27	61	NW	9.9	74	...	...	...	5
6	7.4	19.6	-3.3	22.9	30.30	30.52	29.87	.65	71	E	14.0	77	...	4.2	.47	6
7	22.3	35.0	12.9	22.1	29.33	29.75	29.14	.61	74	SW	23.8	14	.01	2.2	.35	7
SUNDAY........8	3.7	12.9	-1.3	14.2	29.83	29.97	29.54	.43	56	W	21.0	82	...	T	T	8.....SUNDAY
9	8.1	15.0	0.7	14.3	30.14	30.24	30.03	.21	61	W	16.0	81	...	0.2	.02	9
10	-0.7	9.8	-12.3	22.1	30.30	30.42	30.09	.33	49	NW	14.9	89	...	...	...	10
11	-19.8	-12.3	-26.9	14.6	30.42	30.46	30.36	.10	49	NE	14.0	89	...	...	...	11
12	-18.6	-12.0	-25.5	13.5	30.58	30.73	30.45	.28	56	NW	22.0	90	...	...	...	12
13	-8.5	-4.2	-15.7	11.5	30.66	30.81	30.33	.48	64	E	8.6	30	...	...	...	13
14	1.7	12.3	-8.0	20.3	29.92	30.29	29.62	.67	63	NE	12.7	0	...	3.5	.35	14
SUNDAY.......15	-2.6	0.1	-7.0	13.1	29.99	30.07	29.83	.24	55	W	17.4	83	...	...	...	15.....SUNDAY
16	-4.2	0.0	-10.0	10.0	29.91	30.04	29.84	.20	66	NE	9.9	63	...	T	T	16
17	2.0	5.9	-4.3	10.2	29.96	30.02	29.88	.14	61	W	14.6	97	...	...	...	17
18	6.5	11.1	-0.2	11.3	30.10	30.18	30.03	.15	65	SW	6.0	69	...	T	T	18
19	7.0	14.9	-2.0	16.9	30.04	30.12	29.98	.14	59	NE	10.8	51	...	...	...	19
20	-0.8	8.8	-5.5	14.3	30.35	30.45	30.24	.21	49	NE	11.6	88	...	...	...	20
21	-1.9	3.2	-7.7	10.9	30.20	30.30	29.92	.38	56	NE	10.4	88	...	...	...	21
SUNDAY.......22	10.8	24.6	0.0	24.6	29.82	30.14	29.59	.55	61	W	18.4	51	...	2.8	.20	22.....SUNDAY
23	-4.4	1.4	-9.9	11.3	30.37	30.44	30.23	.21	49	NW	14.7	97	...	...	...	23
24	-2.8	2.3	-9.5	11.8	30.51	30.56	30.48	.08	52	W	15.4	94	...	T	T	24
25	10.6	21.0	-3.9	25.5	30.39	30.53	30.22	.31	64	W	23.0	48	...	T	T	25
26	24.4	30.8	18.0	12.8	30.13	30.21	30.03	.18	64	W	17.5	16	...	0.1	.01	26
27	31.0	36.3	27.6	8.7	30.01	30.05	29.98	.07	68	W	20.8	40	...	0.2	.02	27
28	33.8	40.6	24.5	16.1	29.83	29.97	29.63	.34	62	SW	17.4	79	...	...	...	28
Means......	7.41	15.1	-0.7	15.8	30.127	30.284	29.956	.329	61.04		15.76	64.57	.08	14.9	1.65	......Sums
40 Years means for and including this month.	14.000	22.052	6.730	15.717	30.021	.....	.....	.317	79.26		17.35§	40.40¶	7.61	25.11	3.248	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction..........	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles..............	480	1097	453	183	276	1004	4305	2784	
Duration in hours...	50	97	39	21	22	59	235	148	1
Mean Velocity......	9.8	11.3	11.6	8.7	12.6	17.0	18.3	18.8	

The greatest mileage in one hour was 44 on the 7th.
The greatest velocity in gusts was 70 on the 7th. Total mileage, 10591. Resultant direction, N69°21'W.
Resultant mileage, 6023.

The greatest heat was 40.6° above zero on the 28th. The greatest cold was 26.9° below zero on the 11th, giving a range of 67.5°.

The warmest day was the 28th. The coldest day was the 11th.

The highest barometer reading was 30.81 on the 13th. The lowest barometer reading was 29.14 on the 27th, giving a range of 1.67 inches.

The minimum relative humidity observed was 41 on the 10th.

Fog on 2 days.

Lunar halos on 1 night.

Earthquake lasting about 1 minute at 1.30 p.m., on the 10th.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

¶ 33 years means.

§ 27 years means.

, 1914.

Meteorological . McLEOD, *Superintendent.*

DAYS.	THERM		Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
	† Mean.	Max.					
SUNDAY........1	33.4	35.4	0	.10	3.4	.64	1.....SUNDAY
2	34.6	36.3	0	.20	1.4	.44	2
3	37.0	44.9	60	.04	...	.04	3
4	25.6	31.4	1	...	1.3	.06	4
5	23.4	29.0	96	...	0.1	.01	5
6	26.1	35.0	32	...	1.2	.12	6
7	28.4	31.0	0	...	3.7	.39	7
SUNDAY........8	24.7	30.0	38	...	0.7	.06	8.....SUNDAY
9	16.9	21.2	48	...	.03	.03	9
10	15.0	19.6	64	...	...	...	10
11	16.7	20.6	80	...	...	...	11
12	16.3	21.3	87	...	...	...	12
13	22.1	29.9	83	...	...	...	13
14	26.1	33.0	0	...	2.6	.32	14
SUNDAY.......15	32.2	38.0	80	T	T	.01	15.....SUNDAY
16	38.4	43.6	1	.01	...	.01	16
17	37.5	41.5	73	...	...	...	17
18	33.6	40.3	0	...	5.7	.54	18
19	18.1	32.2	30	...	1.2	.12	19
20	7.5	12.1	97	...	...	...	20
21	16.2	24.3	93	...	...	...	21
SUNDAY.......22	25.7	31.6	63	...	0.2	.01	22.....SUNDAY
23	20.0	24.1	44	...	T	T	23
24	26.6	32.1	68	...	...	...	24
25	34.2	42.9	76	T	...	T	25
26	44.0	49.8	76	.02	...	.02	26
27	39.8	43.9	0	.02	...	.02	27
28	31.4	36.9	81	...	...	...	28
SUNDAY........29	32.3	37.7	0	...	...	...	29......SUNDAY
30	33.9	37.1	0	.05	1.2	.26	30
31	33.6	38.6	95	...	...	...	31
Means......	27.46	33.07	47.5	.44	23.0	3.10	......Sums
40 Years means for and including this month.	25.24	32.15	44.3¶	1.47	21.4	3.77	40 Years means for and including this month.

ANALYSI

Direction	N	N.E.	
Miles.............	545	2928	
Duration in hours...	36	155	
Mean Velocity......	15.1	18.9	1

The greatest mileage in one hour was 45
The greatest velocity in gusts was 66 on
Resultant mileage, 4972.

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

† Mean of bi-hourly readings taken from self-recording instruments.

Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

¶ 33 years means.

§ 28 years means.

ABSTRACT FOR THE MONTH OF MARCH, 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER				*BAROMETER				‡ Mean relative humidity.	WIND		Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour					
SUNDAY........1	33.4	35.4	32.3	3.1	29.37	29.59	29.02	.57	73	NE	21.5	0	.10	3.4	.64	1.....SUNDAY
2	34.0	36.3	31.6	4.7	29.28	29.47	29.02	.45	83	NE	31.6	0	.20	1.4	.44	2
3	37.0	44.9	31.4	13.5	29.57	29.63	29.52	.11	66	N	17.2	60	.04	...	.04	3
4	25.6	31.4	22.1	9.3	29.72	29.81	29.65	.16	74	W	19.1	1	...	1.3	.06	4
5	23.4	29.0	17.5	11.5	30.04	30.15	29.86	.29	68	W	12.9	96	...	0.1	.01	5
6	26.1	35.0	15.9	19.1	30.02	30.11	29.88	.23	74	NE	16.3	32	...	1.2	.12	6
7	28.4	31.0	26.9	4.1	29.63	29.80	29.57	.23	83	E	12.4	0	...	3.7	.39	7
SUNDAY........8	24.7	30.0	17.5	12.5	29.59	29.70	29.54	.16	77	W	18.0	38	...	0.7	.06	8.....SUNDAY
9	16.9	21.2	12.5	8.7	29.75	29.88	29.69	.19	70	W	16.0	48	...	.03	.03	9
10	15.0	19.6	10.2	9.4	30.00	30.08	29.90	.18	61	W	17.8	64	...	...	...	10
11	16.7	20.6	12.2	8.4	30.14	30.19	30.08	.11	59	NW	17.8	80	...	...	...	11
12	16.3	21.3	7.3	14.0	30.15	30.22	30.06	.16	49	W	14.4	87	...	...	...	12
13	22.1	29.9	12.8	17.1	30.11	30.21	30.01	.20	33	W	14.6	83	...	...	...	13
14	26.1	33.0	16.7	16.3	30.00	30.19	29.82	.37	75	SW	18.8	0	...	2.6	.32	14
SUNDAY.......15	32.2	38.0	27.7	10.3	30.07	30.18	29.86	.32	68	NE	8.9	80	T	T	.01	15.....SUNDAY
16	38.4	43.6	28.4	15.2	29.91	30.11	20.71	.40	67	SW	21.7	1	.01	...	.01	16
17	37.5	41.5	32.3	9.2	29.93	29.94	29.89	.05	61	W	18.8	73	...	...	...	17
18	33.6	40.3	31.1	9.2	29.70	29.87	29.49	.38	72	SE	17.4	0	...	5.7	.54	18
19	18.1	32.2	12.1	20.1	29.76	30.02	29.49	.53	73	NW	32.2	30	...	1.2	.12	19
20	7.5	12.1	1.9	10.2	30.15	30.26	30.03	.23	52	W	23.0	97	...	...	...	20
21	16.2	24.3	7.2	17.1	30.29	30.37	30.21	.16	51	W	20.0	93	...	...	...	21
SUNDAY.......22	25.7	31.6	19.7	11.9	29.98	30.17	29.82	.35	65	W	12.7	63	...	0.2	.01	22.....SUNDAY
23	20.0	24.1	14.3	9.8	29.96	30.09	29.85	.24	60	NE	7.7	44	...	T	T	23
24	26.0	32.1	18.1	14.0	30.27	30.41	30.13	.28	45	W	8.6	68	...	...	...	24
25	34.2	42.9	22.0	20.9	30.34	30.49	30.14	.35	62	S	16.0	76	T	...	T	25
26	44.0	49.8	38.3	11.5	30.10	30.15	30.03	.12	70	W	21.4	76	.02	...	.02	26
27	39.8	43.9	36.9	7.0	30.16	30.30	30.01	.29	73	NE	11.3	0	.02	...	.02	27
28	31.4	36.9	26.0	10.9	30.36	30.40	30.31	.09	58	NE	23.2	81	...	...	...	28
SUNDAY.......29	32.3	37.7	25.6	12.1	30.38	30.44	30.29	.15	66	NE	9.1	0	...	...	...	29.....SUNDAY
30	33.9	37.1	32.0	5.1	30.15	30.25	30.06	.19	63	NE	15.4	0	.05	1.2	.26	30
31	33.6	38.6	29.1	9.5	30.43	30.51	30.26	.25	58	W	11.7	95	...	...	...	31
Means......	27.40	33.07	21.60	11.47	29.979	30.096	29.845	.251	67.01		17.02	47.5	.44	23.0	3.10	......Sums
40 Years means for and including this month.	25.21	32.15	17.90	14.25	29.986	.....	.....	.287	76.70		17.031§	44.3¶	1.47	21.4	3.77	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction..........	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles..............	545	2928	304	183	773	1260	4759	1910	
Duration in hours...	36	155	25	17	53	69	281	98	7
Mean Velocity......	15.1	18.9	10.9	10.8	14.6	18.3	16.9	19.5	

The greatest mileage in one hour was 45 on the 19th.
The greatest velocity in gusts was 60 on the 19th. Total mileage, 12362. Resultant direction, N63°W.
Resultant mileage, 4072.

The greatest heat was 49.8° above zero on the 26th. The greatest cold was 1.9° below zero on the 20th, giving a range of 47.9°.

The warmest day was the 26th. The coldest day was the 20th.

The highest barometer reading was 30.51 on the 31st. The lowest barometer reading was 29.02 on the 1st, giving a range of 1.49 inches.

The minimum relative humidity observed was 38 on the 31st.

Fog on 4 days.

Hail on 1 day.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

¶ 33 years means.

§ 28 years means.

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THE

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OF SCIENCE

VOL. IX. JANUARY, 1915 NO. 7

DR. DAVID PEARCE PENHALLOW.

Macdonald Professor of Botany, McGill University, Montreal.

A strong son of the resolute makers of New England, Dr. Penhallow possessed the tireless energy, the ceaseless industry, the love of enterprise, and the public spirit which made members of his family honored citizens in Portsmouth, N.H., for two hundred years. He was born on the opposite shore of the Piscataqua River, at Kittery Point, Me., on May 25th, 1854. Throughout twenty-seven years of loyal service to Canada, to Montreal, and to McGill University, he maintained his allegiance to his native land and cherished the traditions of his early home.

When only nineteen, Dr. Penhallow graduated from the Massachusetts State University, at Amherst. Later, he obtained the degree of B.Sc. from Boston University and that of D.Sc. from McGill University.

In 1876 he was appointed Professor of Botany and Chemistry in the Imperial College of Agriculture at Sapporo, Japan. There he remained until 1880, acting as President during the final year of his stay. Like other young Americans to whom Japan turned for a knowledge of western thought and methods, he learned to love the country and its people. After returning to

America, he kept in close touch with Japanese friends and pupils, some of whom became well-known scientists. Members of the Montreal Folklore Society, of which Dr. Penhallow was President for several years, will recall his symathetic presentation of charming Japanese proverbs and folk-tales and his interesting accounts of the Ainos, the remnant of an ancient Aryan race which has maintained its purity in Japan. After a few months at Harvard and two years at the Houghton Farm Experimental Station, Dr. Penhallow became Professor of Botany at McGill University, in 1883. His predecessors had been Dr. Holmes, whose collection of Canadian plants grew under Dr. Penhallow's care into the present large herbarium; Dr. Barnston, an able pupil of Balfour of Edinburgh; and Sir William Dawson, who was not only Principal of the University, but had been Professor of all the Natural Sciences. After Dr. Penhallow's arrival, practical courses were begun in the Redpath Museum. In 1890 the largest of the present laboratories was fitted up for ten students. So great a step forward did this seem that a detailed description of "The New Botanical Laboratory" was published in the *Canadian Record of Science.* Year by year, the courses were multiplied and made more comprehensive, until the amount of work done, in the shabby old rooms at the top of the Arts Building, bore comparison with that conducted in any good modern laboratory by a large staff of instructors.

Sir William Dawson's interest in fossil plants soon turned Dr. Penhallow's attention towards palæobotany. Papers published by the two collaborators were succeeded by a long series of notes, articles, and monographs prepared by Dr. Penhallow alone. In addition, he gave much time to the examination of fossils and the preparation of reports for the Geological Surveys of Canada and of the United States. General recognition as an authority, especially upon the Cretaceous and Tertiary floras of Canada, followed.

In determining the species of fossil plants, reliance must be placed largely upon the structure of the wood and comparisons with the stems of modern types must be instituted. Dr. Penhallow, therefore, spent several years in a study of the conifers. The results are embodied in a book entitled "North American Gymnosperms." The first part consists of a discussion of the minute anatomy of the stem and of the probable origin of the constituent elements. The second part is a manual by means of which a species may be determined through the microscopic examination of its wood. This useful work was to have been followed by a similar study of the Angiosperms, but only a paper upon the willows was completed.

History, whether written upon the rocks or in forgotten volumes, was particularly attractive to Dr. Penhallow. His gleanings in the latter field are gathered in several articles. The most interesting and valuable comprise a complete "Review of Canadian Botany," from the time of the first settlement in New France until 1895.

Dr. Penhallow's power of administration was utilized not only within but without the University. The last years of his life were largely devoted to the organization of the new Marine Biological Station at St. Andrew's, New Brunswick. He was a trustee of the Marine Biological Laboratory, Wood's Holl, Mass.; Chairman of the American Biological Research Stations; Chairman, from 1902 to 1904, of the British Association's Committee on the Ethnological Survey of Canada; President of the Society of Plant Morphology and Physiology in 1899; Vice-President of the section of Botany at the meeting of the British Association in 1897; Fellow of the Royal Society of Canada and President of Section IV from 1896 to 1897; and President for several years of the Montreal Natural History Society. In addition, he was a member of many other organizations, including the Royal Microscopical Society of London, the Botanical Society of America, and the American Society of Naturalists.

From 1888 to 1890 he edited the *Canadian Record of Science;* from 1897 to 1907 he was associate editor of the *American Naturalist;* and from 1902 to 1907 he was editor of Palæobotany for the Botanisches Centralblatt.

With an exceptional interest in research, Dr. Penhallow combined the teacher's desire of extending to others the knowledge which he enjoyed, and of giving new views of life to people more limited by circumstance. A few of the manifestations of this spirit were: repeated attempts, in the face of strong opposition, to obtain Botanic Gardens for the free use of the general public; long-continued efforts to extend the work of the Natural History Society and to found a great museum for the use primarily of working-people; and the enthusiastic leadership of organizations like the dead Folklore Society, where such contributions as Beaugrand's "La Chasse Galerie" and Drummond's "Habitant" were enjoyed before being given to the public.

The limits set upon this sketch prevent further notice of Dr. Penhallow's many activities. An unexpected break in his laborious life came in December, 1909. A prolonged rest encouraged his friends to hope that another year would see him in his wonted place. But, when on his way to England with Mrs. Penhallow, his sudden death took place, on October 20th, 1910. The news of this peculiarly sad event called forth expressions of deep regret and heartfelt sympathy with his wife and his only son. Dr. Penhallow's name was known and honoured by the general public, his work was respected and his friendship valued by his colleagues and his pupils. But compartively few, until his life-work is adequately reviewed, will realize how varied were his interests, how wide his influence, and how valuable his work.

CARRIE M. DERICK.

McGill University, November 10th, 1914.

*FRESH-WATER ALGÆ OCCURRING IN THE VICINITY OF THE ISLAND OF MONTREAL.

By Clare Rothwell Miller, M.A., (Mrs. Hardolph Wasteneys).

INTRODUCTION.

In order to secure data in regard to the algal flora of Montreal Island, collections of material were made, during the autumn of 1911, from pools, ponds and streams in different localities and a number of aquaria containing the algæ were maintained in the Botanical Laboratory of McGill University, during the winter. Records were kept of the progress of the different cultures, the forms which had been collected were studied and classified, and a number of experiments were made with nutrient media.

The results of these observations are given in the following pages, with as full notes as possible in regard to the habits, associations and relative abundance of the forms described. The importance of such ecological data has been strongly emphasized by Fritsch[1] in his work upon the Algal Flora of the Tropics. The relation of certain of my results to the work of Benecke,[2] Danford,[3] Copeland,[4] and Fritsch and Rich[6] has been considered. Some observations of rhizoid formation in Spirogyra are given. A systematic list of the various species of the fresh-water algæ collected completes the account. The determination of the species in the systematic list has been based on standard taxonomic works and has been corroborated by Professor Derick, under whom the work has been done. I have been greatly aided in these studies by the advice and criticism of Professor Derick,

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*Read before the Natural History Society of Montreal, April 29th, 1912.

who suggested the problem, and my thanks are also due to Mr. Ardley of the Museum staff, who gave me very valuable assistance in collecting material.

As far as algal literature is concerned, Canada appears to be an unknown land. No references occur even in the latest works to the distribution of any of the forms in Canada, and Mr. Collins in the preface to "The Green Algæ of North America"[7] laments that apparently no data are to be had on the subject. With the exception of a list of forms recorded by Mr. A. B. Klugh from the Bruce Peninsula, in the *Ottawa Naturalist*[3] for September, 1911, I believe this is the first attempt at a systematic study of any Canadian fresh water algæ.

Occurrence and Distribution of Fresh-water Algæ.

No moist situation is without some type of alga. While quiet lakes, pools and ponds form the most congenial home for the larger forms, algæ are also to be found in great abundance in water-falls, and all sorts of swift-running streams, and, indeed, there is no tree-trunk, wet rock, water trough, damp wall or decaying fence-post but forms the habitat of some member of the group.

In quiet pools the large filamentous forms frequently occur, attached as epiphytes to rocks or to other aquatic plants, and stream up towards the surface in great felt-like masses. Some forms are found floating on the surface of ponds and lakes as conspicuous slimy green masses; while others occur, especially on rocks over which water is constantly dripping, in thin gelatinous films, exhibiting a variety of color. These are usually forms belonging to the Cyanophyceæ, or blue-green algæ, and are some of the most beautiful and interesting of all the species.

Some algæ have acquired a symbyotic relationship with other plants and even with animals. Examples are a species of Anabæna which lives symbiotically with the Hepatic, *Blasia,* and a Nostoc which is similarly connected with *Anthoceros.* Both of these forms occur on the Island of Montreal. Then, there are several species of Chlorella which are associated symbiotically with Hydra viridis.

Many of the most beautiful Algæ are very small and grow in gelatinous films on the leaves and stems of submerged plants. Other minute forms, together with an abundance of Peridinieæ and Copepoda, abound in the surface waters of lakes and rivers, and constitute a great part of the fresh-water plankton which forms the food of most of the smaller aquatic animals, which, in turn, serve as the food of the lake and river fishes.

Algæ exist under very diverse conditions of temperature. Many forms survive freezing. Filaments of Spirogyra and Vaucheria, which I have melted out of the ice, appear to suffer in no way from the low temperature. Species of the Cyanophyceæ and Bacillariaceæ are found in the Arctic regions and on mountain tops, forming the principal parts of the snow-flora and passing their entire existence on snow or ice. Other members of the same groups flourish in the waters of hot springs, where the temperature reaches 85°C.

The comparative richness of any district in freshwater algæ depends largely on its physical and geological features. West, in his "British Fresh-water Algæ,"[9] states that a mountainous region may be expected to show more forms than a flat district. The latter will contain the larger filamentous algæ, and an abundance of unicellular forms. On the other hand, a mountainous region will show forms belonging chiefly to the Cyanophyceæ and Conjugatæ, especially numerous species of Mougeotia and Desmids. Moreover, he says, "If the mountains consist of the older Palæozoic rocks or the Pre-Cambrian rocks, there is a surprising numerical increase not merely of species but also of individuals, and in comparison a mountainous region of carboniferous limestone or other formations is distinctly poor." Accordingly, it will be of interest to notice briefly the chief physical features of the Island of Montreal where the material for this study has been collected.

The Island of Montreal contains about two hundred and six square miles and is a rough isosceles triangle in shape. The long side is bounded by the Lake of Two Mountains and the Rivière des Prairies, and the other two sides by Lake St. Louis and the St. Lawrence River, respectively.

The island itself is a part of a great palæozoic plain, which extends up the Laurentian plateau on the north, southward into the United States, and from the Notre Dame Mountains in Quebec to Lake Huron on the west. The plain is flat, and the average elevation in the vicinity of Montreal is about a hundred feet above the sea level. The whole area is covered with drift and forms excellent farming lands. On the Island, the continuity of the plain is broken by Mount Royal, an igneous mass rising behind the city and occupying an area of about one and a half miles. This is the most westerly of a line of old volcanoes and laccolites, known as the Monteregian Hills. About the base of Mount Royal, the strata of the lower Silurian are represented by the Trenton Group, which covers the greater part of the island,—with Calciferous limestone at the western extremity, Chazy at Point Claire and at Cartierville, and Utica Shale along the river front at Verdun and Bout de l'Ile.

The upper part of the Palæozoic and the whole of the Mesozoic and Tertiary are unrepresented, but the Pleistocene has left its record in a drift of Leda clay and Saxicava sand and in a series of terraces between Mount Royal and the harbor, marking the gradual retreat of the Pleistocene Sea.

Collection of Algæ.

Throughout the month of October I collected material for study and classification from a variety of situations and from as widely separated parts of the island as possible, including:—

(1) The shore of the St. Lawrence at Verdun.

(2) The quarries at Amherst Park.

(3) The ponds and streams on Mount Royal.

(4) The Back River and brooklets emptying into it at Sault au Recollet.

(5) The shores of the St. Lawrence at Rivière des Prairies at Bout de l'Ile.

(1) Verdun:

Here, just opposite Nun's Island, the river is very shallow near the shore and abounds with small islands among which it runs slowly, forming a low, swampy tract of land. Reeds, rushes and sand-bar willows (Salix longifolia, Mühl) line the water edge, and a great variety of water weeds, such as Nymphaæ, Utricularia, Elodea and Myriophyllum, grow partly submerged in the shallow water. Entangled with these and also floating freely in the water, I found a great number of species of Zygnema and Spirogyra, also a very little Oscillatoria, some Nostoc, Pediastrum and quantities of Desmids. Some Diatoms were secured attached to filaments of Cladophora, which was found in abundance growing fastened to stones. A pool inside of the old river dyke contained an enormous amount of Lemna; and, in March, Chætophora was found growing in a thin film on the sides of the aquaria in which some of this Lemna had been placed. Leaves of Nymphæa, tufts of Elodea canadensis and other water weeds were collected and washed, to secure forms attached to them. When this locality was visited, on the 30th of September, the water was quite warm and abounded in animal life. I noted that, although there were many species of algæ present, there were comparatively few individuals. Ulothrix occurred in tufts, unmingled with other forms, but Spirogyra and Zygnema were always associated with each other. No

Spirogyra but only one Zygnema was found in a fruiting condition.

(2) Amherst Park:

This is a section of land at the north-east of the mountain, which is now beginning to be built up. There is a thin layer of sandy soil over the surface of the Trenton limestone, which is well developed here. This has been and is still being extensively quarried. Many abandoned workings exist, which have nearly all become filled with water, forming ponds of some size and great depth. The limestone is cut at intervals by dykes from the fourth period of Mount Royal's activity, and these, not having the commercial value of the limestone, have been left intact and serve to divide some of the quarries into ponds.

In two of the largest quarries, *Anabena inequalis,* (Kütz) Born. & Flah., was found covering the whole surface like a thin creamy-yellow film. Associated with this was a very little Oscillatorio. Very few water weeds were to be seen in any of these artificial ponds, save here and there a few tufts of Elodea, probably because the sides were too steep and sheer to afford any convenient place for it to take root. It was noticeable that each quarry invariably had a dominant form. The shallower pools contained the filamentous forms, some presenting a very beautiful appearance because of the long graceful strands of filaments which streamed up from the bottom. These pools were supplied with water both by drainage from the surrounding plain and from tiny springs.

This was by far the richest region discovered, both in the number of species and also in the quantity of individuals. More than twenty of these ponds, large and small, were visited upon several occasions and a great deal of material was collected. The ponds which contained the most refuse—these abandoned quarries are evidently largely used as dumping grounds for rubbish—i.e. those which contained the most nitrogenous material, were very much the richest in algæ. One pool in particular, which contained a great quantity of garbage, tin cans, old boots, etc., was evidently an ideal location for the Scenodesmaceæ. All the weeds in the pool and all the marginal plants which hung into it were coated with a thick gelatinous film composed of Desmids and Protococcaceæ.

As far as the sources of the flora of these quarry holes are concerned, there is little possibility of the dissemination of spores by water currents, as the various excavations are unconnected, and there is but one small stream in the whole region. On the other hand, dissemination may occasionally take place by currents of air bearing spores for short distances. Probably the chief means of transportation are insects, birds and other animals. Frogs, in going from one pond to another, would readily convey spores or even filaments of algæ attached to their bodies, and it has been observed by Mr. C. H. Thompson[11] in a study of the "Dissemination of Lemna," that Belostoma americana, commonly found flying about electric globes on the street, carries Lemna attached to its body. This insect stays in the water all day and flies about at night, possibly distributing algæ which grow in the same habitats as Lemna.

(3) Mount Royal:

The ponds and streams on the Mountain were by no means such favourable situations for algæ as the abandoned quarries at Amherst Park. But the fact that the summer of 1911 had been very long and very hot was, no doubt, partly the cause of this apparent scarcity; most of the small streams being dried up and the ponds low. A large artificial pond in the Roman Catholic cemetery, at the back of Mount Royal, was found to contain a very large quantity of Microspora entangled with Myriophyllum. A small streamlet of water which flowed down a steep bank into this pond was filled with almost a pure mass of Ulothrix. On the brick flags of the floor of the conservatory, I noticed a thin blackish green scum which proved to be a mixture of Calothrix, Tolypothrix, Scenodesmus and Lyngbya. The metal horse-trough on the driveway contained Ulothrix, some filaments of Spirogyra and Zygnema, and a good many Palmellaceæ.

(4) Back River:

The Rivière des Prairies, which is also known as Back River, is very shallow in some places, especially at Sault au Recollet. Here, along the edge of the water, Elodea was very plentiful. Entangled with this was a great deal of Hydrodictyon, Spirogyra and Zygnema. Later on, in the winter, Mougeotia developed in the aquaria in which these collections were placed. Cladophora also occurred here, showing its preference for running water. A small brook emptying into the river contained an enormous amount of Spirogyra, Vaucheria, Œdogonium and Zygnema growing together attached to stones on the bottom. The Spirogyra was very luxuriant and dark green in color.

(5) Bout de l'Ile:

This is the extreme eastern end of the island, where the Rivière des Prairies and the St. Lawrence join. Both rivers are very deep at this point and flow swiftly, consequently algal growth is scanty. Along the edge of the Rivière des Prairies, Stigeoclonium was abundant on the Leda clay, which always appears to be a favourable substratum for it. All along the edge of the St. Lawrence great mats of Vaucheria and Microspora were found having evidently been brought down by the current and caught in tufts of Elodea. Nearly all were covered by a thin layer of ice, for by this time it was the end of October. The Elodea appeared to have been killed by the low tempepratura, but the algæ were unhurt. Quantities of Spirogyra and Œdogonium were found in the swamp near the street-car tracks. Cladophora, as usual, occurred along the edges of the river, this alga showing a preference for well-aerated waters. In general there was a constant association of Elodea and filamentous forms.

Preservation of Algæ.

While the majority of algæ can be cultivated, or at least kept alive in fresh water under suitable conditions of light and temperature, some forms disintegrate and disappear within a short time after being brought into the laboratory. In order to secure those which might otherwise have disappeared before they could be identified, I preserved a sample of the freshly gathered contents of each aquarium. For this purpose I used a two per cent. solution of potassium acetate, containing just enough acetate of copper to make it faintly blue. This solution which is much more satisfactory than formalin as a preservative for algæ, gave the most excellent results with nearly every form. Vaucheria was slightly plasmolysed by it. This may be avoided by a method suggested by Mr J. H. Nieuland[12]. The plant should be killed rapidly with three or four per cent. formalin, which must be quickly and completely removed by repeatedly washing the plant in water, after which it should be put into glycerine to which a little thymol has been added. Thus it will retain its color perfectly.

Anabæna was also very difficult to preserve in this solution, the filaments rapidly becoming disorganized and breaking down. This was probably due to the copper having been too strong. As Moore[13] has shown in his experiments with copper as an algicide and disinfectant of water supplies, one part of copper to ten million parts of water is sufficient to destroy Anabæna in ponds and in reservoirs, while Oscillatoria requires one part of copper in every five million parts of water, and forms like Eudorina and Pandorina require one part of copper in every one hundred thousand parts of water.

The chief advantage of the potassium-copper-acetate solution, which serves at once as a killing, fixing and preserving solution, is the way in which it preserves the delicate shades of the green algæ. Material preserved in this way may be mounted satisfactorily in glycerine-jelly. I found the solution remarkably successful for Desmids and the various species of Spirogyra.

As well as securing forms for later identification, the sample from each aquarium served as a valuable check or control in studying the persistence or disappearance of various forms, the normal habit, the periodicity, and the appearance and development of those, whose spores only had been gathered.

Algæ under Artificial Environment.

On the field trips a number of small collecting bottles were carried and each sample of algæ secured from pool, pond or wet bank was placed by itself in one. If several samples were taken from the same large pond, they were all put into separate bottles. On being brought into the laboratory, the contents of each was placed in a separate aquarium which was then filled up with water. Stones and tufts of water-weed with algæ attached were collected and treated in the same way. By the end of October some sixty-five aquaria, ranging in size from one to ten liters, were set up, the majority having a capacity of about three liters. In every case the water used was the ordinary tap-water. The reports of various botanists who have cultivated algæ in water and in nutrient solutions show that the results of tap-water cultures have been distinctly variable. The variation naturally depends largely on the chemical qualities of the water. The good results from cultures in Montreal water were marked. It was learned from the City Analyst[14] that in connection with the filtration plant the Montreal Water-works regularly placed a definite quantity of hypochlorite of lime in the water supply as a disinfectant. Less than one part of the bleach to a million parts of water were used. While this amount destroys the deleterious bacteria, it was proved to have no ill effects upon higher organisms.

The following analysis obtained from the Chemical Department of McGill University, in addition, shows that the water contained the nutrient salts necessary for normal growth:

Total solids	11.13	parts per 100,000
Temporary hardness	7.39	
Permanent hardness	none	
Organic and volatile matter	1.92	
Free NH_3	0.0026	
Albuminoid NH_3	0.0154	
Nitrogen as nitrate	0.65	
Nitrogen as nitrite	none	
Oxygen as used in KNO_4 test	0.45	
Chlorine	0.6	
Silica	0.24	
Lime	2.5	
Magnesia	3.2	
Iron oxide and alumina	0.76	

In the Botanical Laboratories, where these experiments with algæ under artificial conditions were conducted, the windows facing the north were used during the early part of the winter for the aquaria. Towards spring, when experiments were made with nutritive solutions, parallel cultures were placed in both north and south windows, but no difference in effect could be observed. Toward the latter part of March, when the sunlight was much stronger than it had been during the winter, it was noticed that in such aquaria as had a coating of Oscillatoria, Stigeoclonium, Chætophora or Ulothrix about the sides, growth was much more successful than in those where the filaments were exposed to the direct sunlight.

The beneficial effect of a comparatively low temperature was also apparent. The most favourable range was from 5° to 15° C. Under this temperature, Spirogyra, Vaucheria and Cladophora lived most successfully, whereas they appeared less healthy and were shorter-lived when the temperature of the culture was raised above 20°C. Mougeotia, Ulothrix, Stigeoclonium and the Desmids seem to require a slightly higher temperature than other forms, usually appearing in aquaria where the temperature had been raised. Oscillatoria also showed in a marked degre the effect of a higher temperature, the blue-green tufts of this form always appearing in a culture within a day or two after the temperature had been allowed to rise to 25° or 30°C.

In the case of the filamentous forms like Cladophora and Vaucheria, the lower temperature probably proved favourable to growth because of the increased amount of oxygen and carbon dioxide, which would be dissolved in the water at the lower temperature. The same consideration would also apply to the Spirogyras, though as a rule they can grow in less aerated water than Vaucheria and Cladophora, probably because they possess thinner cell walls and numerous chloroplasts which permit an easy diffusion of gases.[1]

Mougeotia, Ulothrix, Stigeoclonium, Oscillatoria and the Desmids, on the other hand, were probably collected in the form of spores, and an increase of temperature, in the cultures in which they happened to be, induced germination.

It was found impossible to keep Anabæna alive in the laboratory for more than a week or two after collection. Generally, after a few days, the filaments had begun to disintegrate. Zygnema was also difficult to cultivate. Although in some of the aquaria it continued to live for a couple of months, it had disappeared from the majority after about a month. But both Anabæna and Zygnema began to appear in some of the aquaria in March, noticeably in those which contained a number of other types.

No Mougeotia was observed in the material first collected. But in December, when the temperature of many of the aquaria was allowed to rise considerably, it developed in great quantities in a large number. Ulothrix was noticed early in February in many of the aquaria where it had not been previously observed. *Cladophora glomerata* (L.) Kütz, which was growing attached to a stone, lived in a uniformly healthy condition all winter. So did *Microsporia crassior* (Hansg.) Hazen, which seemed to be especially hardy and flourished under every condition of light and temperature.

One aquarium contained a lump of clay on which a quantity of Stigeoclonium was growing. This began to die down in December and by the beginning of January none was to be found· The lump of clay was then placed in a two per cent. Knop's solution. In four weeks it was covered with a most luxuriant growth of Stigeoclonium. Cladophora also responded promptly to the nutritive effects of Knop's solution.

Some twenty of the aquaria contained Spirogyra, generally associated with several other genera, but usually forming the bulk of the material in each. When collected, Zygnema andŒdogonium were usually present with Spirogyra, but they soon died out. Spirogyra continued to live for three or four months in a comparatively healthy condition, but after this it showed signs of degeneration, the filaments became etiolated, the cytoplasm broke up into bodies somewhat resembling cysts. These were, however, very small and never secreted a wall and this stage was immediately followed by the disintegration of the whole filament. It was remarkable that in the large amount of Spirogyra collected during October none was found in a fruiting condition, nor were any spores observed. This material was watched carefully throughout the winter in the hope that conjugation might take place later on. By placing filaments in various culture media, attempts were made to induce conjugation by artificial means, but none gave the slightest success. Distilled water proved distinctly toxic, causing plasmolysis and death. Neither a two nor a four per cent. Knop's solution had any effect. Both a five per cent. and a one per cent. solution of ammonium nitrate were tried, and appeared only to accelerate the death of the filaments. In a culture of Desmids, on the contrary, the five per cent. solution caused luxuriant growth. In the majority of those cultures which contained nothing but Spirogyra, the plants had died by the end of March. On the other hand, in aquaria where there was a large number of forms associated, growth at this time was becoming more and more luxuriant. Quantities of Œdogonium, Chætophora and Stigeoclonium, some Anabæna and a little Spirogyra began to appear towards the end of this month. Vaucheria resisted comparatively well the disadvantages of growth under artificial conditions, and was found throughout the winter in various stages of development. Desmids and members of the Protococcaceæ occurred in all the aquaria, the varieties of Scenodesmus being especially plentiful. A number of Diatoms were found either floating in chains or attached to filaments of Cladophora and Vaucheria. They were most abundant at a low temperature.

An aquarium containing a number of Cyanophyceæ collected from the floor of the Conservatory at Mount Royal Cemetery, showed an interesting development.

When the film was scraped off the damp tiles, it presented the appearance of a blackish green scum. This was found to be composed of Calothrix, Tolypothrix, Oscillatoria, Lyngbya, Desmids and various other unicellular forms. During the winter, the aquarium containing them was not kept under the same conditions of light and warmth as had obtained in the conservatory. Although it was maintained at a higher temperature than the others, a marked difference in the color and relative numbers of the algal constituents had taken place. The contents of the culture were now a much lighter green, and while formerly the majority of the individuals had been blue-green, now the green unicellular forms predomniated and many of the blue-greens had entirely disappeared. This is an excellent illustration, on a small scale, of the dominance of the Cyanophyceæ under tropical conditions, and the greater adaptation of the Chlorophyceæ to conditions of less light and lower temperature which Dr. Fritsch has pointed out in his study of the Tropical Algæ.[1]

A good deal of animal life existed in the aquaria throughout the winter. In October, several small crayfish were noticed and removed, as well as innumerable tiny snails, which were feeding upon the unicellular algæ. Vorticella was found in practically every culture, especially in connection with Vaucheria and Ulothrix. Paramœcia were also frequently noticed, often containing unicellular forms of algæ which they had engulfed. Amœboæ were not so plentiful and no Hydra were observed in any of the cultures, although a special search was made for them. Daphnia, Crypris and Cyclops were quite plentiful in aquaria which contained a quantity of water-weed. It was interesting to observe that apparently Oscillatoria was not used by any of these forms as food, and that in several small aquaria where it appeared in large quantities the animal life disappeared shortly after the unicellular green algæ had been exhausted. This may be due to the toxic qualities of the Oscillatoria which are suggested by the disagreeable gas that it gives off.

Periodicity in Spirogyra.

A brief consideration of the theories advanced by several botanists who have studied the question of periodicity in the occurrence and sexual reproduction of Spirogyra may serve to summarize and explain some of the results which have been noted in the foregoing pages.

Benecke[2] has advanced the theory that conjugation in Spirogyra is due to the failure of ammonium salts, supposed to be removed from the the water by angiosperms which increase in size and abundance as the season advances. He placed *Spirogyra communis* (Hass.) Kütz, in various media, in bright light, with temperatures from 12°—20° C., and found that in nitrogen-free solutions conjugation took place at once or in a short time. If parallel cultures were run, in which NH_4 or NO_3 had been added in appropriate amounts (.05%) to any of the above media or substituted for one of the constituent salts, no conjugation took place, but good vegetative growth ensued generally.

Danforth[3] repeated these experiments, using other species. Of the five species investigated, three failed entirely to give the same results as had been obtained in Benecke's work, the fourth failed in every case but one, and the remaining species, *S. Grevilleana* (Hass.) Kütz seemed to agree more closely with S. *communis,* but even here the agreement was not complete. Apparently, Benecke did not find any specific stimulus which would induce conjugation unless the absence of ammonium salts be taken as such. Danforth also found that some species of Spirogyra did not respond by vegetative growth as did others when NH_4NO_3 (Ammonium nitrate) was added to the media. *Spirogyra stetiformis*

(Roth) Kütz was killed when placed in cultures of tap water and distilled water containing NH_4NO_3, even when a trace of this salt was added to a nutrient culture of five months' standing. His experiments seem to show clearly that in many cases at least the absence of ammonium salts is not enough to bring about conjugation. These results show considerable similarity to those which were given by my cultures, both in the deleterious effect of NH_4NO_3 on *S. setiformis* (Roth) Kütz, and the failure of all artificial methods to induce conjugation.

Copeland's work consisted in a study of Spirogyra both under natural and artificial environment. In the laboratory, he found that very satisfactory cultures could be made with tap-water, and even a .04 per cent. Knop's solution gave favourable results. But no particular advantage was observed from the use of nutrient solutions. It was noticed that it was a decided advantage to shade the aquaria with dark paper when first started. The good effect was especially noticeable in the south-east windows, where the light was strongest. The proximity of Œdogonium and Chara proved beneficial to Spirogyra, Œdogonium being invariably present and often the predominating form in the aquaria where Spirogyra lived for several months or a year. Oak leaves and charcoal also appeared to be beneficial factors.

In field work he collected thirteen species of Spirogyra, of which twelve fruited abundantly. Ten of these passed their period of maximum abundance in May, one in August and one in October. One reliable example of a second fruiting was *S. dubia*, which fruited in May and again in July. The period of maximum abundance was proved in every case to correspond with the period of maximum conjugation. After conjugation, the fruiting filaments and the vegetative forms disappeared at the same time. One species was observed during several years, but never found in fruiting condition. Copeland concludes, from notes taken in the field and supplemented by work in the laboratory, that conjugation results not so much from external as internal conditions. He, therefore, concludes that Spirogyra has definite periods of growth and activity.

In regard to the possibility of satisfactory cultures in tap-water, the advantage of a certain amount of shade and the beneficial effects of an association with other forms, especially Œdogonium, my results agree fully with those of Copeland.

Fritsch and Rich, in their "Preliminary Observations on Spirogyra," base their theories on observation of this genus under a natural environment.

Of the species examined, some appeared to be purely vernal or else to exhibit both a vernal and an autumnal phase with an intervening period of scarcity or complete disappearance. The factors for the disappearance of Spirogyra after the vernal phase are enumerated as follows:

(a) The increase in the intensity and duration of the light.
(b) The increase in the temperature of the water and the consequent diminution of the amount of dissolved gases in the water.
(c) The gradual concentration of the salts dissolved in the water owing to the heat and the the lack of rain-fall in a normal summer.
(d) The increase in the amount of higher vegetation present.

The autumnal appearance of certain species of Spirogyra may be due, they think, to the influence of certain combinations of external factors causing a small number of zygospores to germinate. In the absence of these conditions there may be no autumnal phase. Abnormal meteorological conditions may bring about abnormal absence or occurrence of Spirogyra.

Reproduction takes place ordinarily in the vernal phase. They consider it to be the result of certain periodically recurring combinations of factors which vary for different species. The nature of the stimulus causing reproduction is, therefore, an intensification of these conditions which is liable to occur in spring. Such intensification taking place at other times in the year would lead to exceptional cases of reproduction.

In a study of this nature, it is out of the question to attempt to confirm either the theory of Copeland that conjugation results from internal rather than from external conditions, or that of Fritsch that conjugation results from a periodically recurring combination of external factors. However, the appearance of numerous species of Spirogyra in October, and the entire absence of any fruiting material at that time, as well as my failure to obtain any conjunction in the laboratory during the winter, incline me to believe that while certain conditions of light, temperature and density of water, as Fritsch suggests, probably induce the second appearance of Spirogyra in the fall, conjugation results from certain periodically recurring internal conditions.

The Formation of Rhizoids in Spirogyra.

An interesting development was observed in an aquarium containing *Spirogyra fluviatilis* Hilse, collected from one of the quarry holes in Amherst Park. This vessel contained a large amount of the alga and, in examining some of the filaments in January, it was observed that at the end of many there was an abnormal growth. The end cell seemed to have lost most of its chlorophyll, the characteristic spiral chromatophore was broken up, and the cell had branched into two or more narrow root-like prolongations. Further search revealed filaments in all stages, from an almost imperceptible beginning of the forking to long colorless processes which were always found in contact with other filaments or with masses of slime. An examination of a large number of specimens showed that only the end cell was thus affected, though the cell next to it might lose some of its chlorophyll. These root-like processes were continuous with the end cell, they appeared to have a slightly laminated cell-wall, and usually showed a sort of mucilaginous excretion with which bacteria were frequently associated.

An examination of material preserved from the same aquarium in October showed that a few of the filaments had possessed these branches when collected, although in a less developed stage. Several other cultures of Spirogyra from different localities showed the same phenomenon, but it appeared in every case to be the same species, other species in the same aquaria showing no trace of the rhizoid-forming tendency.

From these observations, and after a number of experiments with various culture media which apparently did not effect the form in any definite way, I concluded that this tendenccy to form root-like projections must be a specific response to some physiological stimulus which occurs in nature as well as under artificial conditions. In Borge's "Uber die Rhizoidenbildung"[15] it is stated that rhizoids can be produced in Spirogyra filaments by the action of certain culture media. After citing various instances where the phenomenon of rhizoid formation has been observed in certain members of the Chlorophyceæ, which are ordinarily not supposed to possess these organs, Borge describes a large number of experiments which he made in order to study the cause of its occurrence. He found that, when grown in a number of culture media, such as cane-sugar, asparagin, agar-agar and glycerine solutions, *Spirogyra fluviatilis* could be induced to form rhizoids, while in pure water cultures it did not. This species, as well as two others, which were unnamed for lack of fruiting material but which greatly resembled it, were found in different places growing fastened to stones in the water. Experiments were made next with *S. inflata* Vauch, *S. orthospira* Naeg. and two unnamed species, all of which were found free-swimming in nature. None of these were apparently grown in culture media, but all were used in contact cultures. While neither the attached nor the free-swimming forms produced rhizoids when grown in ordinary water cultures, it was found that all could be induced to form these organs in a few days by growing them in contact with some object like a microscope-slide or cover-glass, in a drop-culture.

To complicate matters, however, it was found that several other species failed entirely to respond to the contact treatment. These were *S. Weberi, S. varians* and several unnamed forms, all of which were found free-swimming in nature. Although all of these were grown in contact cultures for over a month none showed any sign of rhizoid formation.

Spirogyra fluviatilis appeared to be the most highly sensitive of all the forms examined, and readily formed strong rhizoids. Other forms produced rhizoids more or less freely in contact culture, *S. orthospira* showing the least response to treatment. It was on this account, as the author explains, that *S. fluviatilis* was used for the majority of the experiments with culture media. In no case could he discover the cause of this phenomenon. In the rest of the paper, he discusses this rhizoid-forming tendency in other genera, such as Mougeotia, Ulothrix and Vaucheria, which show similar differences to those observed in various species of Spirogyra.

A consideration of all the evidence, both in this work and that furnished by my own observations of the rhizoid-forming power of Spirogyra, leads me to conclude that, in the first place, this phenomenon is due to a certain specific sensitiveness rather than to the nature of the stimulus. That there must be a stimulus of some sort is evident, but it seems to be rather the sensitiveness of the organism than the nature of the stimulus which determines the degree of the response.

The stimulus, both in Borge's culture media and in drop-cultures, was very probably the same, namely, a certain amount of irritation due to contact. In my cultures, the stimulus was apparently due to irritation caused by contact with other forms in a crowded aquarium, this being sufficient to produce marked rhizoid formation in the highly sensitive *S. fluviatilis.* In the second place, it may be suggested that this sensitiveness among certain species of algæ, which expresses itself in a more or less strongly marked tendency to form rhizoids, may have some connection with the thigmatropism shown by some of the higher plants.

This view is in harmony with the results of Prof. Derick's study of the early development of many of the red algæ [5]. In them the stimulus determining the point of origin of holdfasts and rhizoids seemed to her to be undoubtedly that supplied by contact irritation.

Systematic List.

I. Chlorophyceæ.

Order I. Conjugatæ.

Family 1. Desmidiaceæ.

Closterium Jenneri, Ralfs.

Crescent shaped, small, slightly tapering, six to eight times longer than broad, ends obtusely rounded, vacuole large, containing many active granules, cell wall colorless, smooth· Diam. about 14 micr.

Verdun, Bout de l'Ile, Amherst Park.

Cosmarium Botrytis, Menegh.

Cells nearly twice as long as broad, sinus narrowly linear, semi-cells with nearly straight base inclining to reniform, sides converging from inferior rounded angles to truncate end. Cell-wall granular. Diam. 35-36 micr.

Verdun, Amherst Park.

Micrasterias americana, (Ehrenb.) Ralfs.

Semicells three-lobed, lateral lobes broad margins, incised serrate, subdivisions narrow and dentate at extremities. Diam. 100-115 microns. Length one-third greater.

Verdun, Amherst Park.

Family 2. Zygnemaceæ.

Zygnema Vaucherii, Ag.

Cella 10-22 micr. 2½ or 3 to 5 times as long as broad.

Zygospores subglobose or broadly elliptical.

Verdun.

*Zygnema insigne, Kütz.

No fruiting material. Vegetative cells 26-30 micr. diam. Length equal or up to 2 diam.

Verdun.

*Spirogyra fluviatilis, Hilse.

Filaments 36 micr. diam. cells 5-6 diam. long.

Chromatophores, slender, very pale green, making 1½-2½ turns in the cells. No fruiting material; found sterile attached to stones; formed rhizoids when cultivated in water, in laboratory.

Amherst Park, Back River.

*Spirogyra setiformis, Kütz, of Collins or
Spirogyra orbicularis of Cooke.

Cells 110-140 micr. diam. about as long as broad, 4 rather broad chromatophores, with many large pyrenoids, making ½-1 turn in the cell. No fruiting material.

Mount Royal.

Family 3. Mesocarpaceæ.

*Mougeotia nummuloides, Hass.

No fruiting material, vegetative cells 16 micr. diam. 102 micr. long.

Verdun, Mount Royal, Back River, Amherst Park, etc.

*Several forms of Zygnema and Mougeotia and a great many of Spirogyra were collected, but as no fruiting material was obtained, save in the case of one Zygnema, it was found impossible to decide with certainty to which species they belonged. Only a few forms are, therefore, named, the structure of which appeared to be sufficiently characteristic to admit of listing them as accurately determined species.

Order II. Volvocales.

Family 1. Chlamydomonadaceæ.

Chlamydomonas sp?

Verdun.

Family 2. Volvocaceæ.

Pandorina morum, Müll.

Colony globose to ellipsoid, up to 220 micr. broad, 16 cells, rarely more or less, cells 9-15 micr. diam.

Amherst Park, Verdun, etc.

Eudorina elegans, Ehrenberg.

Colonies 50-200 micr. diam. usually 32 arranged in 3 parallel circles of 8 each with four at each pole, cells 12-24 micr. diam.

Amherst Park.

Family 3. Tetrasporaceæ.

Tetraspora lubrica. Roth.

Frond at first attached, soon splitting and forming irregular expansions, often with many rounded openings up to 20 cm. long and wide. Very gelatinous, usually yellowish in color, cells 7-11 micr. diam. Generally in fours.

Mount Royal, Amherst Park, Verdun.

Order III. Protococcales.

Family 1. Protococcaceæ.

Characium Sieboldii, A. Braun in Kützing.

Cells 15-25 x 4-9 micr. erect, lanceolate when young, when adult short and broad. Stripe short, without basal disk. On Vaucheria.

Bout de l'Ile.

Family 2, Scenodesmaceæ.

Raphidium falcatum, Corda.

Cells bright yellowish-green, slender, fusiform, ends acute. 1.5-3.5 micr. diam. 15-25 diam. long, usually 2-32 united in a bundle.

R. falcatun var. aciculare, A. Br.

Very slender, 1.5-3 micr. diam., 15-20 diam. long, acicular, straight or slightly curved. usually solitary.

Very plentiful in every locality.

Scenodesmus bijuga, Turp.

Colonies of 4-8 cells oblong-ellipsoidal, with rounded ends 7-18 x 4-7 micr., arranged in a single or double row.

Every locality.

S. bijuga var. alternans, Reinsch.

Cells broader than in the type, in two rows alternately placed.

Every locality.

Scenedesmus obliquus, Turp.
Colonies of 4-8 cells, cells fusiform with acute ends, usually in a single series. 5-27 x 3-9 micr.
Every locality.

S. denticulatus, Lagerheim.
Colonies, 4-8 cells, in a nearly straight line. 4-5 micr. wide, to 15 micr. long, each end with two minute teeth.
Every locality.

S. quadricauda, Turp.
Colonies of 2-8 cells, oblong-cylindric with rounded ends, 9-33 x 3-12 micr. arranged in a single series, end cells with long filiform projections.
Every locality.

Crucigenia rectangularis, A. Br.
Cells 4-6 x 5-7 micr. 4-8-16-32 in a colony 13 to 35 micr. square with rounded angles, always in groups of 4, cells oval or oblong, touching near the outer end.
Amherst Park, Back River.

Selenastrum minutum, Näg.
Cells crescent shaped, usually uniformly curved. 7-9 micr. from tip to tip, 2-3 micr. wide at middle, cells usually free.
Back River, Amherst Park.

Kirchneriella lunaris, Kirchner.
Cells crescent shaped with rounded ends. 3-5 micr. diam. at middle, 6-10 micr. long.
Mount Royal, Amherst Park.

Family 3. Hydrodictyaceæ.
Hydrodictyon reticulatum (L.).
Cells usually several diameters long, length up to

1 cm. 100-200 micr. wide; families 1 to 2 dm. long.
Back River, Verdun, Bout de l'Ile.

Pediastrum Boryanum, Turp.
Cells 4-64, 10-20 micr. wide, forming a continuous circular disk, disk-cells 4-6 angled, marginal cells bi-lobed, each lobe ending in a short obtuse projection.
Verdun, Mount Royal.

P. constrictum, Hass.
Cells of periphery irregularly 2-lobed, sinus narrow, lobes unequal produced into an obtuse horn; central cells, polygonal. 16-32 cells.
Verdun, Amherst Park.

P. Ehrenhergii, Braun.
Coenobium orbicular, composed of 8-16 cells or quadrate of 4 wedge-shape cells, cells of periphery cuneate, truncate at base, deeply bilobate, lobes obliquely truncate, central cells polygonal, yellow green.
Verdun.

Order IV. Ulothricaceæ.

Family 1, Ulothricaceæ.

Ulothrix variabilis, Kützing.
Filaments 5-6 micr. diam. cells cylindrical, ½-1½ diam. long wall, thin, delicate, pyrenoid, single, small.
Mount Royal, Bout de l'Ile.

U. aequalis, Kützing.
Filaments 13-16 micr. diam. cylindrical cells 1-2 diam. long.
Mount Royal, Verdun.

U. tenerrima, Kützing.

Filaments 7-9 micr. diam., cells cylindrical, chromatophore contracted to one side of cell, pyrenoid, single. In light green, silky masses.

Mount Royal, Amherst Park.

Microspora crassior, Hansg.

Filaments long, dark green, nearly cylindrical. 28-33 micr. diam. cells 1-16 diam. long, with wall 2.5-3 micr., thick, chromatophore dense, covering whole cell wall.

Bout de l'Ile, Mount Royal.

Family 2. Œdogoniaceæ.

Œdogonium sp?
Bout de l'Ile, Back River.

Family 3. Chaetophoraceæ.

Chaetophora incrassata (Huds.) Hazen.

Thalli irregularly extended, branched, closely packed, main filaments elongate, secund branches, setiferous ramuli, cells of main filaments 8-16 micr. diam. 2-6 diam. long, ramuli 6-11 micr. diam. cells 1-2 diam. long.

Verdun.

Stigeoclonium tenue (Ag.) Kütz.

Tufts up to 1 cm. high, bright green, filaments slender, 7-10 micr. diam. below, 5-6 micr. in ramuli, cells cylindrical 1-3 diam. long, about equal in ramuli, main branches opposite, ramuli numerous, tapering to slender seta.

Bout de l'Ile

S. æstivale, Hazen.

Light green, palmelloid base, branching alternate, main filaments 7-9 micr. diam. cells 2-6 diam. long below, equal in ramuli, thin walled, somewhat swollen, ramuli near summit few.
Verdun.

Gleocystis gigas, Kütz.

Cells globose, 9-12 micr. diam. solitary, membrane thick and lamellate, contents green.

From floor of conservatory, Mount Royal.

Family 4. Coleochaetaceæ.

Coleochæte sp?
Verdun.

Order V. Siphonocladiales.

Family 1. Cladophoraceæ.

Cladophora glomerata (L), Kütz.

Fronds up to 30 cm. high, branches more and more frequent towards the top, filaments cylindrical, 75-100 micr. diam. below, 6-7 diam. long. 35-50 micr. in ramuli, 3-6 diam. long, ramuli not tapering, tips rounded. (An extremely variable species—Collins).
Verdun, Back River, Bout de l'Ile.

C. Kuetzingiana, Grunow in Rabenhorst.

Soft, loose, feathery tufts, up to 30 cm. high, filaments 45-85 micr. diam. below, ramuli 25-35 micr. diameter, cells cylindrical, slightly swollen ramuli, 6-10 diam. long below, 2-4 diam. long in ramuli, branching erect, opposite, or alternate below, ramuli with acute tips.
Bout de l'Ile, Back River.

Order VI. Siphonales.

Family 1. Vaucheriaceæ.

Vaucheria sessilis, Vauch.

Filaments 50-85 micr. diam. oogonia usually two, sessile ovoid, 70-85 x 75-100 micr. more or less oblique. Short beak, antheridium between the oogonia on short pedicel, circinate, ripe oospore with triple membrane, filling the oogonium.
Back River, Amherst Park, Bout de l'Ile.

V. geminata (Vauch.) var. racemosa.

Filaments 50-90 x 60-75 micr. or smaller, corymbosely arranged about antheridium, which is hooked.
Bout de l'Ile.

II. Diatomaceæ.

Found with Vaucheria and Cladophora from all the localities.

Order Pennatæ.

Family 1. Tabellariaceæ.

Tabellaria flocculosa (Roth) Kütz.

Family 2. Fragilariaceæ.

Fragillaria capucina.

Length of valves 30-60 micr.

Synedra ulva, Nitzsch·

Length of valves 150-250 micr.

Family 3. Naviculaceæ.

Navicula sp?

Family 4. Gomphonemaceæ.

Gomphonema geminatum.
On filaments of Mougeotia.

G. constrictum.
On filaments of Mougeotia.

III. Cyanophyceæ.

Order I. Hormogoneales.

Family 1. Scytonemaceæ.

Tolypothrix trunciola, Rab.

Diam. of filaments 11-14 micr.

Dull æruginous, articulatious ⅓ as long as broad. Heterocysts subsperical, singly at the base of the branches, making a velvety black, fuscous surface.
Mount Royal.

Family 2. Nostocaceæ.

Nostoc Sp?
Verdun.

Anabæna oscillarioides, Bory.

Forming bluish-green stratum. Trichomes elongated, joints sub-quadrate, distinct, heterocysts barrel shaped. Cells 4-5 x 4-6 micr. Heterocysts 6-8 x 7-9 micr. Spores 7-8 x 8-12 microns.
Bout de l'Ile.

A. inaequalis, Kütz.

Trichomes vary in thickness, about 4 microns in diam.

Amherst Park.

Family 3. Oscillatoriaceæ.

Lynghya æstuarii, Lieb.
(Oscillatoria insignis, Cooke.)
Thickness of trichomes 24 microns.

Bout de l'Ile.

Oscillatoria tenuis, Ag.

Trichomes straight, active, motile, joints half as long as broad, apex obtuse, cell contents pale blue, forming dark blue green stratum. Filaments 3 microns diam.

Bout de l'Ile, Back River, Amherst Park.

O. leptotricha var. splendida, Kütz.

Trichomes 2 micr. diam. indistinctly articulate, joints twice as long as broad, minutely punctate at periphery, cell-contents pale bluish-green.

Verdun.

Family 4, Rivulariaceæ.

Calothrx confervicola, Ag.
Tufts fasciculate, filaments dark bluish purple, attenuated, 18 microns in diam. heterocysts all basal, generally few in number.

Mount Royal.

Rivularia haematites ,Ag.).

Heterosysta basal, extremities of filament piliferous, no spores. Globose thallus attached to stones in streams and to Myriophyllum·

Amherst Park.

Order II. Coccogoneales.

Family 1. Chamaesiphoniaceæ.

Chamæsiphon incrustans, Grun.
Diam. of cells 3.5-4.8 micr.
On filaments of Vaucheria from Bout de l'Ile.

Chroococcus turgidus, Kütz.
Diam. cells 13-25 microns.
Mount Royal.

Merismopedia glauca, Ehring.
Diam. of cells 3.3-3.8 microns.
Mount Royal.

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McGILL UNIVERSITY, APRIL, 1912.

NOTE.

By periodically renewing the water in Miss Miller's aquaria, so as to prevent the undue concentration of the mineral contents and by guarding against excessive exposure to strong light, many of the cultures were kept in good condition, during the summer of 1912, and furnished excellent material for class-work throughout the following winter. Towards the spring of 1913, hardy forms like Scenodesmus crowded out less resistive genera and the cultures were allowed to die during the summer.

Similar cultures started in October, 1913, were comparatively unsuccessful, the summer having been unfavorable to the majority of the groups. Spirogyra, Zygnema, Mougeotia, Œdogoniums and several of the Protococcaceæ began to grow after a few weeks. In December, practically all were attacked by disease, bacilli, vibrios, spirilla and water moulds abounding in the aquaria. These conditions were probably due in part to the high temperature which was maintained in the laboratories, in 1913-14, possibly in part to a less rigorous use of hypochlorite of lime in connection with the water-works of the city.

Miss Miller's results show that where water-supplies are freed from deleterious bacteria, a luxuriant development of algae will cause pollution unless preventive measures, such as treatment with copper sulphate, are taken.

C. M. D.

January, 1915.

THOUGHTS AND FACTS ON RIGHT AND LEFT-HANDEDNESS AND AN ATTEMPT TO EXPLAIN WHY THE MAJORITY OF MEN ARE RIGHT-HANDED.

*By G. Prout Girdwood, M.D., M.R.C.S. (Eng.), F.C.S., F.I.C., F.R.C.S., Emeritus Professor in Chemistry Medical Faculty of McGill University, late Assistant Surgeon Grenadier Guards.

That the average man is right-handed is so well known, that it would appear hardly worth noting the fact, but left-handed men are so common that the question why are all men not right-handed must frequently have been asked, and up to the present date diligent search and enquiry by the writer has not resulted in finding that anyone has published a satisfactory reply; this is the excuse for bringing the subject before you again.

In the proceedings of this society are two able and exhaustive articles upon right-handedness, by the late Sir Daniel Wilson.

In Section II, paper VII, page 119, Vol. No. 3, 1885, Sir Daniel writes on "Paleolithic Dexterity." In this beautiful and interesting article, he goes over all the evidence of the stone implements of the paleolithic age and of the stone arrow heads and tools, knives and daggers, and the articles he has been able to obtain or reach an account of, and although finding some places where there seems to have been a larger number of left-

* Read before the Royal Society of Canada, May 26th 1908, and now reprinted by permission in the "Record cf Science."

handed workmen, he still comes to the conclusion that in those localities men at that period were as a rule right-handed, some were ambidextrous, and others were left-handed; as Sir Daniel himself was naturally left-handed, his opinion on the effect of education as a reason for right-handedness is especially valuable, and he says that "my own experience as one originally left-handed is "that in spite of very persistent efforts on the part of "teachers to suppress all use of the left hand, I am "now thoroughly ambidextrous, though still with the "left the more dextrous hand."

On page 130, Sir Daniel says, "But the entire num-"ber of left-handed warriors of the tribe appears to have "barely amounted to 2.7 per cent. Out of 26,000 "Benjamites, as we are told, all warriors, there were "700 chosen men of the tribe, every one of whom was "left-handed and could sling a stone at a hair's breadth "and not miss. The instinctively left-handed is more "dextrous in the true sense of that term. He is not "only an exception to many right-handed men, he is "still more an exception to the large majority in whom "the bias is so slight and the dexterity so partial that "their practice is little more than a compliance with "the usage of the majority."

Still more, the fact of the difficulty of overcoming by education the natural predilection of some individuals to use the left hand instead of the right, so far goes to destroy the theory that education is the reason why men are mostly right-handed, and points out that there is some other reason why there is a natural inclination to use the right hand in preference to the left.

Sir Daniel Wilson also quotes from Froude's Thos. Carlyle, whose "sad misfortune it was to lose the use "of his right hand when he had reached the advanced "age of 75. The period of life was all too late to turn "with any hope of success to the unaccustomed and "untrained left hand, and in his journal more than one "entry refers to the irreparable loss." But one curious

embodiment of the reflections suggested by this privation is thus recorded in his journal upwards of a year after experience had familiarized him with all that the loss involved: "Curious to consider the institution of the
" right hand among universal mankind; probably the
" very oldest human institution that exists, indispensable
" to all human co-operation whatsoever. He that has
" seen three mowers, one of whom is lelt-handed, trying
" to mow together and how impossible it is, has witnessed
" the simplest form of an impossibility, which but for
" the distinction of a right hand could have pervaded
" all human things. Have often thought of all that,
" never saw so clearly as this morning, while out walking,
" unslept and dreary enough, in the windy sunshine.
" How old? old! I wonder if there is any people bar-
" barous enough not to have this distinction of hands;
" no human cosmos possible to be even begun without it.
"Oldest Hebrews, etc., writing from right to left, are as
" familiar with the world-old institution as we, why that
" particular hand was chosen is a question not to be
" settled, not worth asking except as a kind of riddle;
" probably arose in fighting; most important to protect
" your heart and its adjacencies and to carry the shield
" on that hand."

It has been suggested that right-handedness is hereditary and so it certainly is, so also is left-handedness which runs in families[1]

The world is made up of right-handed men the majority, left-handed men the minority, but between the two there are probably many who use either hand indiscriminately. These would soon become right-handed by example and education and so throw their weight with the right-handed number.

It is also suggested that the lower animals, the apes and quadrupeds, do not exhibit any peculiarity of right and left-handedness; this statement is perhaps due to

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[1] Judges, 20 Chap., 16 verse.

want of closer observation of the habits of the lower animals. The monkeys are quadrumanous animals, using their fore hands as feet as well as prehensible organs, and indifferently right or left as occasion may require. So quadrupeds use all four feet as medium of support and progression and there is apparently no reason why they should make use of one side more than the other. Yet as we shall see there are reasons why there is a possible difference of the two sides with them also.

In man, in very early childhood, the mother carries her infant on her left arm and thus the child's right arm is compressed against the mother's breast; this would leave the child's left hand and arm free to move and would give the child the earliest tendency to use its left hand most.

This habit pervades most civilized races who are more right-handed than the more uncivilized, the females of which latter races carry their babies slung over the shoulders in some way; and hence there is no special inducement for the child to use either hand more than the other.

It is the late Dr. Gilbert Finlay Girdwood, of London, the writer's father, to whom the writer is indebted for many suggestions and thoughts on the habits and instincts of the lower animals, and to whom the writer now desires to give all credit for whatever of value may be in these thoughts and facts on this subject, and whose death in 1870 prevented his carrying out what he doubtless would have done far better than his son.

Amongst other things he observed was the fact that in horses where there is one white leg it will probably be the near hind-leg, if two, these will likely be the two hind-legs, and if three, the two hind and near fore-leg; this observation has been extended and an official list of 3,000 horses is examined which was obtained by writing to all the veterinary offices in the United States Army in cavalry regiments and horse artillery and to the veterinary officers of the Northwest Mounted Police, to all of whom the writer's indebtedness is here acknowledged and thanks returned, as well as to Dr. Higgins, Bacteriologist to the Veterinary Department at Ottawa.

The numbers obtained from this list, although only just 3,000 horses, are a sufficient average to call for further attention. These numbers were obtained by direct application to the different veterinary officers in charge, and their personal examination and answers. It is a pity more answers were not forth-coming. A similar application to the forces in England and to the Royal College of Veterinary Surgeons received for answers, no records of the kind were obtainable. It may be asked what has this observation to do with right and left-handedness in man; to those who would ask, the answer is, that as man gets older and the vital forces are lessened, the man becomes gray haired, and if his life be continued he at last becomes quite white and the powers of life have become much weaker.

This is apparently the case, not only in animal, but in vegetable life. The fact that absence of pigment in life where pigment usually is seen is evidence of weakness.

There is a common saying about white-footed horses:

> One white leg buy him,
> Two white legs try him,
> Three white legs deny him,
> Four white legs, throw him to the dogs.

As the hind-legs are those most commonly white the weakness is more observable in the fore-legs than in the hind and the remarks made by the different veterinarians go to show that a tendency to navicular disease is common in the white fore-legged horses—that the white-legged horses are generally washy — that the roan-coloured horses and the buff are constitutionally the strongest, with brown next.

Report comes this spring from the west communicated by Dr. McEachran, from which the following is quoted:

"In the car this morning, I met Mr. D. N. Campbell, "live stock agent, who asked me if I had noticed last "winter and spring whether or not the greatest mor-"tality among our range cattle was in the light-coloured "ones. He said, George Lane, of Gordon & Ironsides' "U ranch, told him that with them 90 per cent of the "dead cattle from the severity of the winter were white "and light roan in colour."

Absence of pigment where pigment is usually found is an evidence of lessened vitality.

Potato shoots grown in the dark are thin, long and white, easily destroyed.

All plants grown in the dark are weakly and are deprived more or less of chlorophyl.

What are called variegated varieties in plants have less vitality than normal plants.

One variety of the Coleus is cultivated for the variety of colour in its leaves, and for the white patches on its leaves; a whole branch will be spotted more or less with white, brown, red and green, and by making cuttings from the variegated branch, where white predominates, for all branches are not equally coloured, the variety may be made constant and this is carried out to obtain more white, till at last the leaves become almost white and the stem pink, then the plant will gradually fade away and die.

It is impossible to obtain a specimen of this plant just now, but a dried specimen of the Phyllanthus Nivosus, a Euphorbiacious plant, shows the tendency to grow white leaves is a strongly marked characteristic. The leaves are alternate and at the base of the stalk are green and of full size. They show their tendency to become white, increasing as they get nearer the end of the stalk, till they become nearly or quite white and suddenly drop in size. In this specimen the leaves become smaller as the white increases, and at last, when quite white, they are much smaller and die early and drop off. Here are two leaves which have dropped. In the branch on which the leaves become white, the stem at the same time assumes a pink colour.

As people get older, there is usually a decreasing amount of pigment in the hair, and the older the whiter the hair becomes. The whitening may be the result of some sudden stay in vitality from shock, when the vitality is greatly suspended, so that whiteness, where pigment should be, may be accepted as evidence of slightly lessened vitality.

Information received from a lady who is a cat-fancier is to the effect that white Persian cats are more or less deaf and that the lighter coloured breeds are less healthy than pigmented varieties, the hardiest being the black.

If, then, white hair may be taken as an index of weakness, and it would appear that it is so, it would imply that the side on which white hair is most frequent would be the weaker and the figures quoted above would show a preponderance of strength on the right side.

In man it has been observed that deformities and arrest of development occur more frequently on the left side.

Notably, hare lip most frequently on the left side. Here is a set of skiagraphs showing deformity in both arms and legs. The young lad from whose hands these two were made is a Russian Jew. On the left arm there are only two middle fingers which are complete to the base of the metacarpal bones, the unciform bone is present and what appears to be the cuneiform bone. There is but one bone to represent radius and ulnar and that is united to the humerus without any elbow joint, and there is a long, extended internal condyle to the humerus.

On the right arm the same arrangement for humerus, radius and ulnar is present, but the one bone representing radius and ulnar is somewhat longer than the left. There is a rudimentary scaphoid, a trapezoid, os magnum and unciform and a cuneiform, but the other carpal bones are absent. There are three metacarpal bones; to the one is attached a double phalanx made by the union of the proximal phalanx of thumb and index-finger, and then there are thumb, index, middle and ring-fingers but no little finger and no metacarpal bone of the thumb. In this case the greater deformity is on the left side.

Here is a similar deformity in a man of 55 years of age. On the left side he has both radius and ulna with an apparent tendency to fusion of humerus and ulna with lengthening of the internal condyle of humerus. At the wrist joint, there is a scaphoid bone and rudimentary trapezium; there is apparently an os magnum and unciform, the other bones of carpus rudimentary, three metacarpal bones for fore-finger, middle and ring-finger, none for thumb or little finger and the same arrangement as in the boy's fingers of right hand. In the man's right hand the radius and ulna are nearly perfect. There is a scaphoid, semi-lunar and cuneiform blended, a pisiform but no trapezium, there is a trepezoid os magnum and unciform, there is present a complete index, middle and ring-finger with a rudimentary thumb, and the metacarpal bone of the right finger.

The next is a club-foot on the left side and not on the right.

The next is a deformity of the left leg, the tibia and fibula end in expanded bony growths, and the bones of the foot are represented by rudimentary points of ossification, and here is a case of congenital absence of the left fibula.

Here is a picture of another abnormal left arm recorded by Dr. Jubb,[1] Glasgow Royal Infirmary. In this case the deformity is absence of radius in its greater extent and of the carpal and metacarpal bones of the thumb. This deformity is again on the left side.

When a student, in 1853, the writer had the opportunity of seeing a specimen of hermaphrodite organs as a preparation now in the museum of St. Mary's,

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[1] Copied from the archives of the Roentgen Ray of London, Rebman & Co.

London, in which there was a penis, a vagina and uterus, with a testicle in the right vulvum and an ovary on the left side. Again showing the left the weaker side.

These cases are too few in number to make any very strong statement as to the difference of frequency of deformity on the left side as against the right, but they do tend to show a leaning to deformities more frequent on the left side and to a greater extent on the left side than the right.

Paralysis or hemiplegia is more frequent on the right side than on the left, and in this case the injury to the brain is on the left side, while the effect is on the right side, due to the decussation of the fibres.

All these observations tend to the idea that the right side is a little stronger than the left, and hence the use of the right hand more than the left.

The carpenter and stonemason and blacksmith, like the majority, are mostly right-handed men and they hold their chisels when they want to direct the cut, in the left hand, and strike with the heavy mallet with the right hand.

In his second article on this subject, Sir Daniel Wilson says, page 3, section 2, papers for 1886: "The "phenomenon to be explained is not merely why each "individual uses one hand rather than another. Ex- "perience abundantly accounts for this. But if, as "seems to be the case, all nations, civilized and savage, "appear from remotest times to have used the same "hand, it is in vain to look for the origin of this as an "acquired habit. Only referring it to some anatomical "cause can its general prevalence among all races and "in every age be satisfactorily accounted for. Never- "theless, this simple phenomenon cognisant to the ex- "perience of all and brought under constant notice in "our daily intercourse with others, seems to baffle the "physiologist in his search for any entirely satisfactory "explanation."

He goes further into the habits of man in different countries and into the various reasons assigned for the predominant condition of right-handedness, by physicians, anatomists and physiologists, some giving an opinion as Sir C. Bell, that not only is man right-handed, but also right-footed, and that the right side is stronger than the left physically, others stating that the blood supply is better to the right side than the left, again that it is due to the difference in the blood supply to the brain, and even to the difference in size of the two sides of the brain.

If the course of the blood be, starting from the apex of the left ventricle through the ventricle into the aorta, and then a line be drawn as it were through the left ventricle and the course of the ascending aorta, through the arch of the aorta, and down to the promentary of the sacrum, it will be found to be represented thus, and if a plan were made looking down from above, it would be represented as a circle drawn from left to right, passing upwards and to the right in a curved manner, then still upwards and back at the same time passing gradually to the left side of the vertebral column, then down the left side of vertebral column, gradually passing to the centre thereof opposite the promontory of the sacrum, where it divides into two common iliac arteries.

In this course the aorta gives off the two small branches to supply the heart, the coronaries, then it passes on and where it begins to turn back and to the right side it gives off the large arteria innominata which divides into the right common carotid and subclavian, the carotid supplying the right side of the head and brain and the subclavian the right upper extremity. Passing on the arch of the aorta gives off from the upper side of the arch the left common carotid and the subclavian, the carotid supplying the right side of the head and brain and the subclavian the right upper extremity. Passing on the arch of the aorta gives off from the upper side of the arch the left common carotid and a little further on the left subclavian, and then passing down the left side of the vertebral column gradually coming forwards from the left side of the column to the centre of the front of the column where it divides into the right and left common iliacs to supply the lower limbs, the trunk and internal organs being supplied by other branches on its way down. Now in this course it does seem that the blood supply to the right side through the larger conjoined vessel the arteria innominata does receive a more direct current and the two vessels being united and a little better positioned to receive the more direct current, than on the left side where the two vessels common carotid and subclavian are separate in their origin, and given off at an angle not quite so favourable to the supply in directness.

In the supply to the lower extremities by the two common iliac vessels, the right iliac seems to get a little more direct supply than the left, not from difference in blood pressure in either case; for it has been found that there is no difference in the pressure on the two sides, as indeed, the physical law that liquids press equally in all directions would preclude a difference in pressure, but simply in direction, and the difference in direction being more easy for the current is the only difference, but with the multiplication of 120 beats a minute, the rate of pulse of the newly born and before birth, would make a multiplication of the slight difference of

120	per minute.
60	
7,200	per hour.
24	
28800	
14400	
172,800	per 24 hours.

and that continued for a few years would easily establish

[1] Dr. Janeway, Blood Pressure.

a little stronger vitality on the right side over the left, and would fully account for the difference previously noted.

The hindlegs in the horse which are so commonly white as compared with the number of fore-legs white may be due to the greater distance from the heart, the centre of force of the supply.

The conclusion the writer comes to from the observations recorded are that the right side of the bodies of man and the quadrupeds are a trifle stronger than the left, that this difference is caused by the little difference in the directness of the blood supply.

And that this difference accounts for the preponderance of right-handed men over left-handed.

And that the habit once established by natural causes has been increased in man by heredity and education.

But the cause of this determination of a slightly increased supply of blood is still unexplained.

Still the question, Why? remains.

Reference and illustration has been made to plants and a weakness shown to exist there when the normal colour is absent. If now we go further, we find the snail shell all rotating in the direction of the hands of a watch, that is, from left to right, but if the snail be watched in its egg during development it will be found to slowly rotate in the opposite direction, the direction from right to left; the writer has often watched them under the microscope for hours before they passed from the shell.

If now we take a hyacinth or an onion and strip off the leaves, we find the scars left on the flattened disk arranged so as to produce an appearance like the back of an engine turned watch with curves proceeding from the outside to the centre in the direction of the hands of a watch. The same appearance is found in the sunflower disk (Helianthus annuus) when the flowers are fallen, and the seeds are ripened they will be found to be arranged in similar lines. In these cases the axis of growth instead of being elongated, is flattened down into a disk, with the leaves in their normal places and with the buds in the axils of the leaves; in the sunflower the seeds are largest at the outside of the circle and get smaller as they go up to the top of the stem represented by the centre of the disk further away from source of supply.

If the fine point of a young pine or larch tree be looked at from the upper end towards the root, the branches or leaves will be seen to have a similar spiral arrangement.

In the Bryophyllum Peltatum the leaves are thick and fleshy and are deeply crenated on the edge and stay hanging on the plant till they are quite old and then fall off. If the leaf happens to fall on a damp place and is allowed to lie there, in a short time a root will be protruded from the angle of each of the deep crenations, and shortly a second and a third root find their way into the moisture and a bud will be protruded on the upper side which will grow up to become a new plant, hence the common name for this plant is the life plant. This same characteristic to a less degree is enjoyed by the begonia, the coleus and others.

In seed-bearing plants, a flower is produced. The various parts or envelopes of the flower consist only of modified leaves, and it may be expected that they occasionally take on other functions than the simple flower duties. And flowers or clusters of flowers are seen, especially in the primulaceæ, in which the flower is converted into a new branch, hence the common appearance known as the hen and chickens; in this case, the leaves which began as flower leaves have returned to their duties as ordinary leaves, but when the flower goes on to maturity we find the calyx or outside covering, comes a whorl or more of stamens; all these parts are the corolla, more or less gaudy, to attract insects, then leaves modified to perform their functions; lastly, in the centre, is the carpel or fruit or seed vessel; also a leaf, the fleshy part of which constitutes the fruit; this leaf is called the carpellary leaf or carpel, which has its midrib prolonged to form what is called the style, and terminated by the stigma. There may be one or more carpellary leaves constituting the fruit; in the plum one leaf only constitutes the fruit, and the inner surface of the plum stone represents the upper surface of the leaf, the outer skin of the plum represents the under surface, and the flesh of the plum, the cellular matter between the two layers of the leaf, upper and lower, the thin line down the one side of the plum represnts the part where the edges of the carpellary leaf are joined, and inside the cavity is the seed or kernel.

In the apple there are usually five such carpellary leaves united to form the fruit and again the inside of the five cavities seen when the apple is cut across, looking somewhat like a five-pointed star, are the representatives of the upper surface of these five carpellary leaves,—the outside being the representative of the under surface of the leaves, and the outside points represent the mid-ribs of these five leaves, and the five inner points will be observed to be double and represent the edges of neighbouring carpellary leaves joined together on the edges of which little seeds begin to grow. These are only like the buds on the Bryophyllum leaf, but in this modified form they require impregnation; if that operation takes place they grow to be perfect seeds, but if not they waste away and dry up.

In (100) one hundred apples of the northern spy variety examined, there were five carpellary leaves in each apple, and on the margin of each leaf there were either one or two, occasionally three, matured pips; but on each side of each leaf were little brown tubercules in number sufficient to make up (4) four pips in each cell, two on either side counting mature seeds or rudimentary immature seeds.

One hundred apples with five carpels to each would give (500) five hundred cells or carpellary leaves, and each leaf having four seeds or pip, mature or immature, would give a total of 2,000 pips that would be the proper full number of seeds; but the results of the examination gave only 972 mature seeds, of which number (556) five hundred and fifty-six were on the right side of the leaf, and 416 on the left, or 48.6 per cent. of the total number grew to full maturity as seeds; of these 556—57.09 per cent.—were grown on the right side of the leaf, 42.8 per cent. nearly on the left.

These numbers are all too small to make a general average of so large a subject, but they are so striking as to call attention to the subject and induce further observations in the same direction.

Now, if these pips be examined in the apple more closely, they will be found attached: first, the lowest, on the right side of the carpellary leaf, next a little higher on the left side, the third a little higher on the right side, and last, for there are seldom more than four, on the left side and a little higher, as the numbers that come to maturity.

From these observations, it seems then that there is something apparently determining the why these happenings are as they are, and it is the business of science to find out the why and wherefore for everything.

In the present instance there is no apparent reason why one side should have the preference over the other, but if the cause be hidden the more reason to search for it.

Suggestions or hypotheses might be made: there are so many notes or arrangement, and motion, in the direction of the hands of a clock that thoughts are directed to some cosmic influence which appears to dominate both animal and vegetable growth, and possibly also mineral growth amongst crystalline substances.

Amongst such forces as appear on the surface the rotation of the earth itself, its alteration of heat and cold every (24) twenty-four hours by exposure to and absence of the heat of the sun's rays, the magnetization of the atmospheric oxygen thereby producing a diurnal variation of the needle. There is the negative condition of the earth and the positive condition electrically speaking of the upper atmosphere keeping up a constant current of different electrical conditions, and the effect of a sudden thunder storm destroying a whole sitting of eggs shows the influence of electrical phenomena on early life, and then there is the constant radiation from the earth's surface of radium, any of which might be sufficient cause. Or must we still go back to protoplasmic memory.

If the averages noted in these thoughts and observations are borne out and verified by other observers, the natural result would be to breed out white-legged horses, and in the meantime for governments to refuse to purchase them. In the selection of seeds for the propagation of plants, seek out those that have been grown earliest and on the right side of carpellary leaf.

The first evidence which may solve the riddle found in Crystalline bodies—it is well known that the asymmetric carbon atom in organic compounds determines whether the plane of polarized light be rotated to the right or to the left, or whether the amount of asymmetric right and left-handed rotation be equal we have an inactive compound which does not affect the plane of polarized light.

Starch and sugar are most plentifully present in the vegetable kingdom.

Starch has the formula, $C_6H_{10}O_5$
in endless varieties of plants.
Dextrin in varieties of plants, $C_6H_{10}O_5$
Inuline, Dahlias and Artichokes, $C_6H_{10}O_5$
Moss starch.
Inuline, Dahlias and Artichokes, $C_6H_{10}O_5$
Glycogen animal starch, $C_6H_{10}O_5$
Glycogen, being found in the mollusca—in the surroundings of the infant in embryo—and is leave notary.

Both converted into grape sugar by the action of acids, and as sugar turns the ray of polarized light to the left or right, according as it is dextrose or levulose, here is a connecting link between the animal and the vegetable, and from its action, as rotating the plane of polarized light, it might be the means of determining the growth to one side or the other. These are only hints, not even hypotheses.

REPORT OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

Session 1907-1908.

Presented by Dr. Robert Bell, F.R.S.

In last year's report to the Royal Society of Canada, it was stated that the Natural History Society of Montreal, having sold its old building, had been obliged to store its library, collections and other effects and get along as best it could in the two old dwelling houses on its new lot on Drummond Street, but that it was hoped that its new building would very soon be under course of construction. Owing to the recent financial depression, however, no work has as yet been done on the new structure, and the society is still in the same uncomfortable situation with respect to an abiding place as it was a year ago. But the funds necessary for the construction of the basement and ground floor of its new home, with temporary roof and permanent heating system, etc., are now in hand, and the building committee has been instructed to start operations as soon as possible, and it is confidently hoped that the additional funds for the completion of the building will be forthcoming in time to prevent any pause in the work.

Meanwhile, the society has been by no means idle. The regular monthly meetings were held as usual during the winter at the temporary quarters of the society, the attendance and interest being gratifying. The following papers were presented:—

Oct. 26th.—"The New Permanent Biological Station at St. Andrews, N. B.," by Dr. D. P. Penhallow.

Jan. 27th.—"The Collection and Rearing of Dragon Flies, at the Marine Biological Station, Georgian Bay," by Dr. E. M. Walker.

Feb. 24th.—"Quebec and the Rock Slides from Cape Diamond," by Professor Carrie M. Derick, M.A.

Mar. 31st.—"History of the Natural History Society of Montreal, With a Description of the Proposed New Building," by Dr. D. P. Penhallow.

Apl. 27th.—"The New North West of Canada," by Fred. G. Lawrence, F.R.G.S.

In accordance with its usual custom, the society arranged for six Somerville Lectures and six Saturday Half-hour Talks to Children, and in addition a joint committee of the Natural History Society and the Local Council of Women planned thirty-four free illustrated lectures, delivered at various points in the city and suburbs, in the carrying out of which they were assisted by the Arts and Handicrafts Guild, The Cooking School of the Y.W.C.A., Ecole Menagere, The Pure Milk League, The Tuberculosis League, The Victorian Order of Nurses. At all these lectures and demonstrations, the attendance was very satisfactory, and the interest elicited of such a nature as to thoroughly justify the society in continuing the work next year. The programme of these lectures is here appended.

Somerville Lectures, delivered in the Lecture Hall of the Y.M.C.A., Dominion Square.

"Coal Mining," by J. Bonsall Porter, Ph.D.

"Education for the Improvement of Rural Conditions," by J. W. Robertson, L.L.D., C.M.G.

"A Botanist's Rambles in Spain," by Thep. L. Wardleworth, F.L.S.

"British Columbia and Its Possibilities," by Harry Bragg, Esq.

"Forestry," by Dr. B. E. Fernow (Dean of the Forestry School, University of Toronto).

"The Fiords of British Columbia," by J. Austen Bancroft, M.A.

Saturday Half-hour Talks to Children.

Delivered in the Lecture Hall of St. Andrew's Church, Beaver Hall Hill:—

"How Plants Get Their Food," by Prof. Carrie M. Derick, M.A.

"Just a Piece of Coal," by J. Austen Bancroft, M.A.

"Air," by J. S. Buchan, K.C.

"The Life of a Frog," S. Kirsch, M.A.

"Rubbers," by W. G. MacNaughton, B.A., B.Sc.

"Books and Their Bindings," by C. E. H. Phillips, Esq.

TECHNICAL LECTURE.

"Chemistry of Iron and Steel Manufacture," by Prof. Nevil Norton Evans, in the Chemistry Building, McGill University (two lectures).

"Principle of the Electric Motor and of the Electric Dynamo," by Prof. John Cox, Physics Building, McGill University (two lectures).

ARTS AND HANDICRAFTS.

"Our Canadian Handicrafts," by Prof. Henry Armstrong, in St. George's School House, 15 Stanley Street.

"House Furnishing and Decoration," by Prof. Henry Armstrong, in Victoria Hall, Westmount.

"Beauty of the Home," by Cecil E. Burgess, A.R.I.B.A., in Chalmers Church, Cor. St. Lawrence and Prince Arthur Streets.

"Art in Our Households," by Cecil E. Burgess, A.R.I.B.A., in the Grand Trunk Literary Institute, Point St. Charles.

"The Furnishing of a Modest Home," by Prof. Henry Armstrong, in Taylor Church, Papineau Avenue.

PURE MILK.

"Pure Milk," by Dr. F. M. Fry, at St. Lambert, Que.

"Pure Milk," by Dr. F. M. Fry, in St. Mary's Church, Cor. Prefontaine and Rouville Streets.

BREAD.

"Ancient Bread Making," by Dr. D. P. Penhallow, in the Grand Trunk Literary Institute, Point St. Charles.

"Modern Bread Making," by Dr. D. P. Penhallow, in the Grand Trunk Literary Institute, Point St. Charles.

"Ancient Bread Making," by Dr. D. P. Penhallow, in Taylor Church, Papineau Avenue.

"Modern Bread Making," by Dr. D. P. Penhallow, in Taylor Church, Papineau Avenue.

COOKING.

"Substitutes for Meat and Fish," by Miss McLennan (Y.W.C.A.), in St. George's School House. 15 Stanley Street.

Ecole Menagere (in French), Montcalm Street, DeMontigny Street (two lectures).

"A Well Balanced Dinner," by Miss McLennan (Y.W.C.A.), in Chalmers Church, Cor. St. Lawrence and Prince Arthur Streets.

TUBERCULOSIS.

"Tuberculosis," by Dr. C. N. Valin (in French), in Montcalm School, DeMontigny Street; Dr. J. G. Adami, in Victoria Hall, Westmount, Dr. T. A. Starkey, in Old Brewery Mission, Craig Street; by Dr. J. E. Laberge, in St. George's School House, 15 Stanley Street; by Dr. T. A. Starkey, Victoria Hall, Westmount.

VICTORIAN ORDER-NURSING.

Grace Church, Point St. Charles; Victoria Hall, Westmount; "Care of Sick at Home" (in French), by Dr. Eug. St. Jacques; in Montcalm School, DeMontigny Street; Taylor Church, Papineau Avenue; Chalmers Church, Cor. St. Lawrence and Prince Arthur Streets; St. George's School House, 15 Stanley Street.

The annual field day was held on Saturday, 8th June, at Isle aux Noix, on the Richelieu River, near St. John's, and was a pronounced success.

The officers of the Society are:—

Patron—His Excellency the Governor General of Canada.

Hon. President—Lord Strathcona and Mount Royal.

President—D. P. Penhallow, D.Sc., F.R.C.S.

Vice-Presidents—Frank D. Adams, Ph.D., F.R.C.S., J. S. Buchan, K.C., B.C.L.; Rev R. Campbell, M.A., D.D.; Carrie M. Derick, M.A; E. W. MacBride, M.A., Sc.D.; Wesley Mills, M.A., M.D.; C. S. J. Phillips; Major G. W. Stephens, M.L.A.; Miss Van Horne.

Hon. Recording Secretary—Prof. N. N. Evans.

Hon. Corresponding Secretary—F. W. Richards.

Hon. Treasurer—Jas. W. Pyke.

Hon. Curator—A. E. Norris.

Members of Council—John Harper, Chairman; J. A. U. Beaudry, C.E.; Prof. Jos. Bemrose, F.I.C., F.C.S.; Henry Birks, Joseph Fortier, A. Holden, E. P. Lachapelle, M.D.; James Morgan, Alex. Robertson, B.A.

Superintendent—Alfred Griffin.

REPORT OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

1908-1909.

Presented by Alfred Griffin.

On behalf of the Natural History Society of Montreal, the following report is submitted for the consideration of the Royal Society of Canada.

It was earnestly hoped that the society would have been in its new quarters as announced in our report of last year, but owing to the commercial depression that has prevailed for some time, the necessary funds have not been forthcoming to warrant us in commencing building operations. However, our work, though somewhat hampered by the cramped quarters we at present occupy, has been attended with a greater measure of success, than far several years past. The subjects treated at the Monthly Meetings were, as usual, original communications, and the attendance on several occasions was such that many were turned away. This, though very gratifying as showing an increased interest in the study of Natural Science, is a condition of things much to be deplored, and, it is hoped, remedied in the very near future. The following is a list of the papers read at the Monthly Meetings:—

Monday, Nov. 2nd, 1908—The Possibilities of Oyster Culture in the Maritime Provinces of Canada— E. W. MacBride, M.A., D.Sc.

Monday, Nov. 30th, 1908—Man as an Animal—Dr. F. Slater Jackson.

Monday, Jan. 25th, 1909—The Scot in Canada and an Old Time New Year—J. S. Buchan, K.C.

Monday, Feb. 22nd, 1909—A vain quest in Zoology—Rev. I. J. Kavanagh, S.J.; Some aspects of the Forestry Problem—Dr. D. P. Penhallow.

Monday, Mar. 29th, 1909—The possibilities of the

Cobalt and the Montreal River District—Dr. Alfred Barlow.

Monday, Apl. 26th, 1909—The Natural History of the Canadian Oyster, Dr. J. Stafford, B.A., M.A.

The Lectures of the Somerville Course were delivered in the lecture hall of the Young Men's Christian Association. The subjects dealt with were of unusual interest and great value to Canada from an economic point of view, dealing as they did with matters of live importance of today with immense possibilities for the future.

The following is the list:—

Thursday, Jan. 21st.—The Introduction of Reindeer into Canada for Domestic Purposes—F. S. Lawrence, F.R.G.S.

Thursday, Jan. 28th.—Matter and Ether—Professor John Cox, M.A., LL.D. This lecture was given in the Physics Building, McGill College.

Thursday, Feb. 4th—Early History of Man as determined by Biology—Dr. E. W. MacBride.

Thursday, Feb. 11th.—Food, Body, Heat and Animal Calorimetry—Prof. J. H. Snell, Ph.D.

Thursday, Feb. 18th.—Radium—Howard L. Bronson, Ph.D.

Thursday, Feb. 25th.—Science and Education—Prof. J. A. Dale, M.A.

The Saturday Half Hour Talks to Children were also given in the Lecture Hall of the Y.M.C.A., every seat being occupied on each occasion.

A glance at the following list will give some idea of the subjects dealt with, and it was generally conceded that it was one of the best courses that had ever been given since these lectures were instituted.

Saturday, Jan. 23rd.—Some Common Birds—I. Gammell, M.A.

Saturday, Jan. 30th.—The Flame of a Candle—Prof. Nevil Norton Evans.

Saturday, Feb. 6th.—The Story of a Lobster—S. Kirsch, M.A.

Saturday, Feb. 13th.—The Story of a Coal Mine—Dr. J. Bonsall Porter.

Saturday, Feb. 20th.—The Story of a Dew Drop—Mrs. McIntosh, M.Sc.

Saturday, Feb. 27th.—The Story of a Pine Tree—Prof. Carrie M. Derick, M.A.

The usual donations to the library have been received in the shape of exchanges from kindred societies, but the need of our Library becomes more acute as time goes on. Many enquiries are made, references are sought, and a great deal of labor is involved in supplying the information owing to the Library being inaccessible.

Many valuable donations are promised as soon as we have a fitting home to receive them . A valuable collection of Shells, Minerals, Fossils, etc., has been received from Mrs. J. H. R. Molson, being specimens gathered together by the late J. H. R. Molson during his lifetime. These will be specially valuable in filling the blanks in our collection.

The Annual Field Day was held on Saturday, the 13th of June, a visit being made to Oka. A party of about 200 enjoyed the hospitality of the polite and gentlemanly monks of La Trappe, the return trip through the Lachine Rapids bringing a pleasant and most enjoyable day to a close.

Fourteen new members have been added to the roll during the year, but death has removed the following:—James Coristine, F. S. Lyman, James Williamson, Angus W. Hooper, Miss Catherine N. Macfarlan.

The Society has every reason to feel satisfied with the result of its crusade against the Tussock Moth, both as regards the abatement of the pest, and the consequent danger to our trees, also the awakened interest on the part of the civic authorities, and the public generally.

In reviewing the work done during the last twenty-one years that I have been connected with the Society, I cannot help thinking that considering the limited means at our disposal, we have no reason to be discouraged, and that a new era of increased usefulness will be opened up just as soon as our new building is erected, one that shall be worthy of the past traditions of the Society, and of the City of Montreal.

I cannot close this report without a tribute of thanks to our good friends of McGill University, who are ever ready to give us a helping hand, particularly as regards the Somerville Course of Lectures and Saturday Half-Hour Talks to Children; also to the press of Montreal who gratuitously notice our lectures from time to time.

The list of officers for the Session of 1908-9 is as follows:—

Patron—His Excellency, the Governor General of Canada.

Hon. President—Lord Strathcona and Mount Royal.

President—Dr. D. P. Penhallow.

Hon. Vice-President—Hon. J. K. Ward.

Vice-Presidents—Frank D. Adams, Ph.D., F.R.C.S.; J. S. Buchan, K.C., B.C.L.; Rev. Robert Campbell, M.A., D.D.; Miss Carrie Derick, M.A.; E. W. MacBride, M.A., D.Sc.; Wesley Mills, M.A., M.D.; C. S. J. Phillips, Major G. W. Stephens, Miss Van Horne.

Hon. Recording Secretary—Albert Holden.

Hon. Corresponding Secretary—F. W. Richards.

Hon. Treasurer—Jas. W. Pyke.

Hon. Curator—A. E. Norris.

Members of Council—John Harper, Chairman; J. A. U. Beaudry, C.E.; S. W. Ewing, Joseph Fortier, Dr. Milton L. Hersey, Albert Holden, H. Lampard, Alex. Robertson, B.A., Farquhar Robertson.

Superintendent—Alfred Griffin.

REPORT OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

1909-1910.

Presented to the Royal Society of Canada by Harry Bragg, M.J.I., Honorary Librarian.
September, 1910.

Mr. President and Gentlemen:—

Herewith I have the honour to present to you the Annual Report of the Natural History Society of Montreal, which is now in the eighty-fourth year of its age.

It is very pleasant to be able to state that the work of the Society during the year, so far as the regular courses of Free Public Lectures is concerned, has been carried on very energetically and successfully, and that the larger attendance of the public has continued to show increasing interest in the questions chosen for these lectures. The Saturday Afternoon Lectures for Children were so popular that a larger room had to be secured to accommodate the audience, while the larger Hall of the Y.M.C.A. Building was crowded at several of the Somerville Course.

The Programmes of the three Courses given by the Society were as follows:—

REGULAR MONTHLY MEETINGS OF THE SOCIETY.

"The work of the St. Andrew's Biological Station," Dr. D. P. Penhallow.

"Animal and Plant Life in the Mackenzie Basin," Fred. S. Lawrence, F.R.G.S.

"The Natural History of Death," Prof. J. C. Simpson.

"The Mineral Resources of Northern Ontario and Quebec," Dr. Alfred E. Barlow.

SOMERVILLE LECTURES.

"Halley's Comet," Rev. I. J. Kavanagh, S.J., M.A.

"The Ice Problem of the St. Lawrence," Dr. Howard T. Barnes, F.R.C.S.

"The Nature and Origin of Ore Deposits," Dr. Frank D. Adams, Ph.D., F.R.C.S.

"The Quebec Bridge," Henry Holgate, C.E.

"Eight Months in the Swamps of West Africa," Hilder Daw, C.E.

"Heredity and Environment," Prof. Carrie M. Derick, M.A.

"Darwin's Centennial," Rev. Robert Campbell, D.D.

Owing to the sudden illness of Prof. Derick, a blank evening would have occurred, but one of the lectures of the Saturday Afternoon Course was given, so as to provide a lecture for the expectant audience, and Miss Derick gave her promised one at a later date.

SATURDAY HALF-HOUR TALKS TO CHILDREN.

"The Story of a Dandelion," Prof. Carrie M. Derick.

"The Story of a Glacier," J. O'Neill, Esq.

"The Ferns of Montreal," Rev. Robert Campbell, M.A., D.D.

"Mushrooms and Toadstools," Mrs. F. H. Pitcher.

"The Story of the Coral Builders," Harry Bragg, M.J.I.

"Some Birds of the Sea," I. Gammell, B.A.

The Annual Picnic of the Society was held at Grand Mere, and a very pleasant feature of the day was the presentation of a Silver Medal to Mr. Alfred Griffin, the only permanent official, in consideration of his completion of twenty-one years' service for the Society, as a small recognition of his zealous and devoted work.

The Society has made another very important move by purchasing the lot of land immediately behind its new property, the lot facing on Drummond Street. So that the Society now owns about twenty thousand square feet, with frontage on both Mountain and Drummond Streets, midway between St. Catherine and Sherbrooke Streets. This property is most desirable for the purpose for which it has been secured, and is centrally situated, with a good car service near to it, yet not so near as to be an annoyance.

What is lacking now is a suitable building, where the splendid collection of specimens could be seen free of cost, every day in the year; where the fine library of books could be available to the student, and where the courses of free lectures could be delivered in properly designed halls, all the property of the Society.

This is a consummation devoutly to be wished, for the Commercial Capital of the Dominion is incomplete as a great city without a Free Natural History Museum, and the Society the oldest in Canada, and the parent of the Geological Survey, as well as of the kindred societies, should be housed in a home suitable to its history and traditions.

The Directors live in hopes that sufficient public spirit may be found to secure this desirable object, within a short time.

It would be very pleasant if this could be accomplished while His Excellency, Lord Grey, continues to grace the position of Governor General, so that as he and Lady Grey honoured the last function in the old building, they could also lend their presence at the opening of the New Museum.

Before concluding with the list of Officers, it is satisfactory to note that our Ex-President, Dr. D. P. Penhallow, has returned from a long absence, greatly improved in health, and that we can still count him among our active members.

THE OFFICERS FOR THE YEAR ARE AS FOLLOWS:

Honorary Patron—His Excellency, Lord Grey, the Governor General.

Honorary President—The Rt. Hon. Lord Strathcona and Mount Royal.

President—Milton L. Hersey, M.Sc., LL.D.

Hon. Vice-President—Hon. J. K. Ward.

Vice-Presidents—Frank D. Adams, Ph.D., F.R.S.C., J. A. U. Beaudry, C.E.; J. S. Buchan, K.C., B.C.L.; Rev. Robert Campbell, M.A., D.D.; Miss Carrie M. Derick, M.A.; John Harper, C. S. J. Phillips, Major G. W. Stephens, Miss Van Horne.

Secretary—Albert Griffin.

Hon. Corresponding Secretary—F. W. Richards.

Hon. Treasurer—Jas. W. Pyke.

Hon. Librarian—Harry Bragg, M.J.I.

Hon. Curator—A. E. Norris.

Members of Council—Chas. S. M. Brown, S. W. Ewing, H. Lampard, Hilder Daw, C. E., Joseph Fortier, Alex. Robertson, B.A.; Prof. Nevil Norton Evans, Albert Holden, Farquhar Robertson.

Superintendent—Alfred Griffin.

ERRATA

in Vol. IX No. 6

p. 327 (10 lines from top) for "trafficing" read "trafficking."
p. 336 (17 lines from bottom) for "escutenta" read "esculenta."
p. 343 (designation of plate) for "cemetry" read "cemetery."
p. 244 (10 lines from the top) insert of before "which."
p. 347 (near middle of page) for "pre-natal of the beaver" read "pre-natal life of the beaver."
p. 348 (10 lines from top) for "J. B. Tyrell" read "J. B. Tyrrell."
p. 351 (4 lines from top) for "benedicta fibri sars" read "benedicta fibri caro."
p. 351 (6 lines from bottom) for "principle as to preservation" read "principle as the preservation."
p. 352 (5 lines from top) for "tail is not the external" read "tail is not the only external."
p. 353 (10 lines from top) for "Chilion" read "Chilian."
p. 354 (6 lines from top) for "wind" read "wing."
p. 354 (3 lines from bottom) for "or" read "of."
p. 355 (5 lines from bottom) omit one "the."
p. 356 (16 lines from top) for "re" read "he" and for "ris" read "his."

914.

Meteoro McLEOD, *Superintendent.*

DAYS.	† Mean.	of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
1	36.8	35	.14	...	.14	1
2	33.3	17	.03	T	.03	2
3	24.7	83	...	...	...	3
4	28.6	91	...	T	T	4
SUNDAY........5	31.3	74	...	0.3	.02	5.....SUNDAY
6	29.7	7	...	T	T	6
7	32.9	38	...	...	...	7
8	32.5	0	.42	2.6	.69	8
9	30.2	50	.01	0.3	.02	9
10	34.5	98	...	...	...	10
11	37.4	0	T	...	T	11
SUNDAY.......12	30.6	48	...	0.7	.06	12.....SUNDAY
13	22.2	96	...	...	...	13
14	31.5	7	...	...	...	14
15	34.6	85	...	...	...	15
16	35.3	0	.04	...	0.4	16
17	46.4	90	...	...	...	17
18	53.2	49	.01	...	0.1	18
SUNDAY.......19	60.1	22	.11	...	.11	19.....SUNDAY
20	38.5	0	.03	0.6	.08	20
21	37.2	42	...	...	...	21
22	42.0	76	...	...	...	22
23	36.4	94	...	...	...	23
24	44.1	92	...	...	...	24
25	45.8	21	...	...	...	25
SUNDAY.......26	40.5	0	.15	...	.15	26.....SUNDAY
27	50.7	57	T	...	T	27
28	52.7	2	.11	...	.11	28
29	38.6	0	.07	...	.07	29
30	42.9	80	...	...	...	30
31						31
Means......	37.83	04	1.12	4.5	1.53	......Sums
40 Years means for and including this month.	40.70	04¶	1.78	5.35	2.35	40 Years means for and including this month.

AN

Direction..........	N	N
Miles..............	533	25
Duration in hours...	46	1
Mean Velocity......	11.6	18

The greatest mileage in one hour
The greatest velocity in gusts wa
Resultant mileage, 3303.

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

Mean of bi-hourly readings taken from self-recording instruments.

Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

¶ 33 years means.

§ 28 years means.

ABSTRACT FOR THE MONTH OF APRIL, 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER				*BAROMETER				‡ Mean relative humidity.	WIND		Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour					
1	36.8	45.6	28.3	17.3	30.01	30.35	29.61	.74	67	SW	13.1	35	.14	...	.14	1
2	33.3	37.2	28.6	8.6	29.60	29.74	29.48	.26	58	NE	14.5	17	.03	T	.03	2
3	24.7	30.6	18.1	12.5	29.90	30.02	29.78	.24	44	NW	17.2	83	...	...	...	3
4	28.6	35.0	21.4	13.6	30.09	30.15	30.04	.11	53	W	15.3	91	...	T	T	4
SUNDAY.......5	31.3	37.0	27.9	9.1	30.09	30.16	30.04	.12	61	W	15.0	74	...	0.3	.02	5.....SUNDAY
6	29.7	34.0	26.6	7.4	30.14	30.16	30.10	.06	63	W	14.4	7	...	T	T	6
7	32.9	38.1	24.2	13.9	30.08	30.15	29.98	.17	65	SE	10.7	38	...	...	...	7
8	32.5	34.9	31.2	3.7	29.77	29.91	29.68	.23	87	NE	17.0	0	.42	2.6	.69	8
9	30.2	33.6	25.0	8.6	29.73	29.76	29.70	.06	69	W	19.4	50	.01	0.3	.02	9
10	34.5	42.2	25.0	17.2	29.90	29.99	29.78	.21	57	W	25.5	98	...	...	...	10
11	37.4	43.5	32.0	11.5	29.80	30.00	29.71	.29	62	SW	24.2	0	T	...	T	11
SUNDAY.......12	30.6	40.0	19.9	20.1	29.79	30.11	29.51	.60	56	NW	21.8	48	...	0.7	.06	12.....SUNDAY
13	22.2	28.0	13.9	14.1	30.30	30.36	30.17	.19	46	NW	10.4	96	...	...	...	13
14	31.5	38.0	24.4	13.6	30.19	30.25	30.13	.12	59	W	8.4	7	...	...	...	14
15	34.6	43.4	28.7	14.7	30.22	30.35	30.07	.28	59	NE	15.2	85	...	...	...	15
16	35.3	40.2	30.6	9.6	29.88	30.05	29.79	.26	71	NE	13.5	0	.04	...	0.4	16
17	46.4	56.7	34.8	21.9	29.95	30.05	29.84	.21	47	NW	11.0	90	...	...	...	17
18	53.2	62.8	43.9	18.9	29.97	30.09	29.78	.31	60	W	17.9	49	.01	...	0.1	18
SUNDAY.......19	60.1	74.2	50.5	23.7	29.64	29.76	29.56	.20	66	W	21.2	22	.11	...	.11	19.....SUNDAY
20	38.5	55.9	29.8	26.1	29.74	29.87	29.57	.30	84	NE	23.0	0	.03	0.6	.08	20
21	37.2	46.1	29.1	17.0	30.01	30.07	29.87	.20	64	W	12.2	42	...	...	...	21
22	42.0	54.6	30.6	24.0	29.98	30.25	29.85	.40	49	NW	24.8	76	...	...	...	22
23	36.4	46.5	25.9	20.6	30.35	30.41	30.27	.14	36	NW	17.6	94	...	...	...	23
24	44.1	52.2	35.3	16.9	30.36	30.42	30.27	.15	31	N	8.1	92	...	...	...	24
25	45.8	54.4	33.5	20.9	30.23	30.33	30.14	.19	44	SE	14.4	21	...	...	...	25
SUNDAY.......26	40.5	44.2	39.3	4.9	30.02	30.07	29.99	.08	81	S	17.6	0	.15	...	.15	26.....SUNDAY
27	50.7	60.5	38.8	21.7	30.14	30.19	30.06	.13	67	SE	8.5	57	T	...	T	27
28	52.7	62.2	44.0	18.2	30.10	30.15	30.03	.12	74	SW	13.2	2	.11	...	.11	28
29	38.6	44.0	35.1	8.9	30.13	30.17	30.11	.06	63	NE	18.1	0	.07	...	.07	29
30	42.9	51.7	36.3	15.4	30.13	30.16	30.09	.07	37	NE	16.8	80	...	...	...	30
31																31
Means......	37.83	45.58	30.42	15.15	30.009	30.120	29.900	.220	59.34		16.00	45.04	1.12	4.5	1.53	......Sums
40 Years means for and including this month.	40.70	48.95	33.04	15.91	29.956	.....	.....	.212	66.37		15.93§	49.04¶	1.78	5 35	2.35	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction..........	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles..............	533	2588	385	628	747	1522	3327	1789	
Duration in hours...	46	143	34	55	53	87	189	111	2
Mean Velocity......	11.6	18.1	11.3	11.4	14.1	17.5	17.6	16.1	

The greatest mileage in one hour was 40 on the 12th.
The greatest velocity in gusts was 48 on the 12th. Total mileage, 11519. Resultant direction, N66°W.
Resultant mileage, 3303.

The greatest heat was 74.2° above zero on the 19th. The greatest cold was 13.9° above zero on the 13th, giving a range of 60.3°.

The warmest day was the 19th. The coldest day was the 13th.

The highest barometer reading was 30.42 on the 24th. The lowest barometer reading was 29.48 on the 2nd, giving a range of .94 inches.

The minimum relative humidity observed was 20 on the 30th.

Thunderstorms on 2 days. Fog on 1 day.

Hail on 2 days. Lunar halos on 1 night.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

¶ 33 years means.

§ 28 years means.

1914.

Meteoro[C. H. McLEOD, *Superintendent.*

DAYS.	† Mean.	Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
1	40.0	95	...	...	...	1
2	50.9	95	...	...	...	2
SUNDAY........3	57.6	79	...	...	...	3.....SUNDAY
4	58.9	6	T	...	T	4
5	54.7	6	.06	...	.06	5
6	55.5	85	...	...	...	6
7	54.4	36	...	...	...	7
8	59.7	94	...	...	...	8
9	57.1	86	...	...	...	9
SUNDAY.......10	57.6	61	...	...	...	10.....SUNDAY
11	50.3	51	...	...	...	11
12	48.3	1	...	...	...	12
13	48.0	44	.06	...	.06	13
14	51.6	44	.02	...	.02	14
15	48.3	82	...	...	...	15
16	53.5	85	...	...	...	16
SUNDAY.......17	58.0	80	...	...	...	17.....SUNDAY
18	63.6	73	...	...	...	18
19	65.6	73	...	...	...	19
20	67.0	69	...	...	...	20
21	69.5	35	...	...	...	21
22	71.4	68	.10	...	.10	22
23	55.3	7	.10	...	.10	23
SUNDAY.......24	58.6	94	...	...	...	24.....SUNDAY
25	60.7	9	.01	...	.01	25
26	73.3	55	...	...	...	26
27	72.6	67	...	...	...	27
28	65.0	93	...	...	...	28
29	64.2	76	...	...	...	29
30	66.3	61	.19	...	.19	30
SUNDAY..........31	63.6	70	.88	...	.88	31......SUNDAY
Means......	58.75	60 38	1.42	...	1 42	......Sums
40 Years means for and including this month.	54.93	50.46¶	3.079	...	3.087	40 Years means for and including this month.

AN

Direction..........	N	N
Miles..............	1495	6
Duration in hours...	132	
Mean Velocity......	11.3	10

The greatest mileage in one hour
The greatest velocity in gusts wa
Resultant direction, N74°W.

the zero

day

the 29.60

was

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

¶ 33 years means.

§ 27 years means.

ABSTRACT FOR THE MONTH OF MAY, 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER				*BAROMETER				‡ Mean relative humidity.	WIND		Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour					
1	40.0	49.0	31.9	17.1	30.04	30.13	29.93	.20	29	N	16.1	95	...	...	...	1
2	50.9	64.5	37.0	27.5	29.94	30.00	29.87	.13	35	N	13.4	95	...	...	...	2
SUNDAY.........3	57.6	68.2	45.5	22.7	30.02	30.08	29.98	.10	40	W	10.8	79	...	...	...	3.....SUNDAY
4	58.9	68.7	49.3	19.4	29.88	29.98	29.76	.22	46	S	9.4	6	T	...	T	4
5	54.7	62.3	47.7	14.6	29.67	29.73	29.61	.12	75	NE	10.6	6	.06	...	.06	5
6	55.5	65.5	45.6	19.9	29.74	29.78	29.69	.09	53	NE	9.1	85	...	...	...	6
7	54.4	63.0	45.0	18.0	29.83	29.86	29.78	.08	50	NE	10.2	36	...	...	...	7
8	59.7	69.2	49.9	19.3	29.85	29.91	29.77	.14	48	NE	9.9	94	...	...	...	8
9	57.1	66.0	46.0	20.0	29.73	29.77	29.68	.09	62	NE	10.1	86	...	...	...	9
SUNDAY.......10	57.6	70.2	45.4	24.8	29.75	29.83	29.70	.13	53	W	10.8	61	...	...	...	10.....SUNDAY
11	50.3	56.6	41.0	15.6	30.04	30.12	29.87	.25	48	N	8.7	51	...	...	...	11
12	48.3	54.0	42.0	12.0	30.14	30.17	30.11	.06	39	N	9.5	1	...	...	...	12
13	48.0	57.4	40.4	17.0	30.12	30.18	30.05	.13	65	S	10.5	44	.06	...	.06	13
14	51.6	63.4	42.6	20.8	29.99	30.04	29.92	.12	62	W	10.7	44	.02	...	.02	14
15	48.3	55.2	39.4	15.8	30.11	30.16	30.08	.08	40	W	13.0	82	...	...	...	15
16	53.5	63.0	43.5	19.5	30.14	30.19	30.08	.11	46	W	12.2	85	...	...	...	16
SUNDAY.......17	58.0	69.7	42.6	27.1	30.28	30.32	30.21	.11	47	W	11.8	80	...	...	...	17.....SUNDAY
18	63.6	74.1	53.3	20.8	30.33	30.38	30.29	.09	46	W	20.5	73	...	...	...	18
19	65.6	76.0	55.7	20.3	30.36	30.41	30.31	.10	49	W	19.3	73	...	...	...	19
20	67.0	77.0	57.6	19.4	30.26	30.33	30.19	.14	50	W	17.6	69	...	...	...	20
21	69.5	80.0	61.3	18.7	30.06	30.16	29.94	.22	49	W	15.8	35	...	...	...	21
22	71.4	83.8	61.5	22.3	29.76	29.91	29.62	.29	53	W	18.1	68	.10	...	.10	22
23	55.3	61.9	47.5	14.4	29.75	29.94	29.60	.34	67	W	14.6	7	.10	...	.10	23
SUNDAY.......24	58.6	70.4	46.0	24.4	30.13	30.19	29.98	.21	46	W	15.6	94	...	...	...	24.....SUNDAY
25	60.7	71.3	51.4	19.9	30.04	30.18	29.93	.25	65	W	13.5	9	.01	...	.01	25
26	73.3	81.8	61.2	20.6	29.84	29.89	29.78	.11	65	W	19.6	55	...	...	...	26
27	72.6	87.2	61.8	25.4	29.87	29.96	29.74	.22	59	W	13.7	67	...	...	...	27
28	65.0	70.0	58.7	11.3	30.13	30.31	39.83	.48	48	N	9.8	93	...	...	...	28
29	64.2	75.0	51.9	23.1	30.23	30.36	30.04	.32	52	E	7.4	76	...	...	...	29
30	66.3	75.7	58.6	17.1	29.95	29.99	29.90	.09	51	NW	12.0	61	.19	...	.19	30
SUNDAY ..31	63.6	77.8	53.7	24.1	29.85	29.96	29.71	.25	59	W	11.5	70	.88	...	.88	31......SUNDAY
Means......	58.75	68.64	48.87	19.74	29.994	30.072	29.902	.170	51.71		12.78	60 38	1.42	...	1 42	......Sums
40 Years means for and including this month.	51.93	64.13	46.07	18.05	29.933	.....	.....	.176	65.40		13.56§	50.46¶	3.079	...	3.087	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction..........	N	N E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles..............	1495	649	229	39	400	706	5172	819	
Duration in hours...	132	60	36	6	43	61	336	70	0
Mean Velocity......	11.3	10.8	6.4	6.5	9.3	11.6	15.4	11.7	

The greatest mileage in one hour was 29 on the 17th, 18th and 19th.
The greatest velocity in gusts was 40 on the 16th and 31st. Total mileage, 9509.
Resultant direction, N74°W. Resultant mileage, 5755.

The greatest heat was 87.2° above zero on the 27th. The greatest cold was 31.9° above zero on the 1st, giving a range of 55.3°.

The warmest day was the 26th. The coldest day was the 1st.

The highest barometer reading was 30.41 on the 19th. The lowest barometer reading was 29.60 on the 23rd, giving a range of 0.81 inches.

The minimum relative humidity observed was 17 on the 2nd.

Thunderstorms on 1 day. Fog on 2 days.

Hail on 1 day.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

¶ 33 years means.

§ 27 years means.

914.

Meteorolo . McLEOD, *Superintendent.*

DAYS.	TI Mean.†	M	of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted	DAYS.
1	57.5	6	60	.13	...	.13	1
2	49.6	5	74	.01	...	.01	2
3	54.0	6	21	T	...	T	3
4	50.9	5	0	.13	...	.13	4
5	55.6	6	94	.01	...	.01	5
6	61.0	7	84	...	...	...	6
SUNDAY........7	64.2	7	30	T	...	T	7.....SUNDAY
8	63.9	6	39	T	...	T	8
9	65.3	7	10	T	...	T	9
10	74.6	8	92	...	...	...	10
11	73.1	8	85	...	...	...	11
12	69.2	78	73	...	...	...	12
13	62.4	7	87	.01	...	.01	13
SUNDAY.......14	56.8	67	93	...	...	...	14.....SUNDAY
15	60.7	71	89	...	...	...	15
16	53.9	5	10	.29	...	.29	16
17	62.1	71	95	...	...	...	17
18	70.1	8	76	T	...	T	18
19	63.9	7	55	.56	...	.56	19
20	51.8	6	45	.02	...	.02	20
SUNDAY.......21	62.0	7	69	...	...	...	21.....SUNDAY
22	66.2	7	89	...	...	...	22
23	70.8	8	49	T	...	T	23
24	75.4	87	74	.23	...	.23	24
25	71.8	8	91	...	...	...	25
26	63.7	7	78	...	...	...	26
27	61.3	67	85	...	...	...	27
SUNDAY.......28	55.7	62	5	.50	...	.50	28.....SUNDAY
29	57.2	6	0	.84	...	.84	29
30	54.5	5	0	.17	...	.17	30
Means......	61.97	71	8 44	2.90	...	2.90	......Sums
40 Years means for and including this month.	64.49	73	4.70¶	3.425	...	3.425	40 Years means for and including this month.

ANA

Direction	N	N.E
Miles.............	766	105
Duration in hours...	69	108
Mean Velocity......	11.1	9.8

The greatest mileage in one hour w
The greatest velocity in gusts was
Resultant direction, N66°W.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

§ 26 years means.

¶ 33 years means.

ABSTRACT FOR THE MONTH OF JUNE, 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER † Mean.	THERMOMETER Max.	THERMOMETER Min.	THERMOMETER Range.	*BAROMETER † Mean.	*BAROMETER Max.	*BAROMETER Min.	*BAROMETER Range.	‡ Mean relative humidity.	WIND General direction.	WIND Mean velocity in miles per hour	Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted	DAYS.
1	57.5	68.0	51.1	16.9	29.89	29.98	29.83	.15	56	NW	9.7	60	.13	...	.13	1
2	49.6	58.8	39.9	18.9	30.06	30.16	29.93	.23	49	NE	9.4	74	.01	...	.01	2
3	51.0	60.2	49.0	11.2	30.04	30.09	29.92	.17	54	W	10.8	21	T	...	T	3
4	50.9	53.2	49.4	3.8	29.91	30.04	29.80	.24	83	NE	9.5	0	.13	...	.13	4
5	55.6	64.6	45.9	18.7	29.97	30.10	29.84	.26	42	N	12.8	94	.01	...	.01	5
6	61.0	71.0	51.3	19.7	30.14	30.21	30.09	.12	37	NW	11.1	84	...	...	...	6
SUNDAY.......7	64.2	76.8	51.5	25.3	30.00	30.13	29.90	.23	63	W	10.9	30	T	...	T	7.....SUNDAY
8	63.9	68.1	59.9	8.2	30.06	30.13	29.92	.21	68	NE	10.5	39	T	...	T	8
9	65.3	73.9	55.9	18.0	30.02	30.14	29.82	.32	61	S	11.6	10	T	...	T	9
10	74.6	86.2	62.0	24.2	29.71	29.77	29.67	.10	49	NW	12.8	92	...	...	...	10
11	73.1	85.8	63.5	22.3	29.73	29.77	29.70	.07	50	W	13.3	85	...	...	...	11
12	69.2	78.1	61.0	17.1	29.75	29.88	29.65	.23	53	W	11.7	73	...	...	...	12
13	62.4	73.1	50.5	22.6	29.93	30.04	29.88	.16	53	NW	10.8	87	.01	...	.01	13
SUNDAY.......14	56.8	67.3	45.5	21.8	30.00	30.10	29.87	.23	46	N	9.6	93	...	...	...	14.....SUNDAY
15	60.7	71.6	52.8	18.8	29.74	29.85	29.69	.16	51	NW	12.1	89	...	...	...	15
16	53.9	58.8	49.8	9.0	29.83	29.94	29.72	.22	66	NW	13.3	10	.29	...	.29	16
17	62.1	71.8	50.6	21.2	29.99	30.06	29.93	.13	45	W	13.1	95	...	...	...	17
18	70.1	81.6	60.1	21.5	29.91	30.02	29.78	.24	48	SW	12.0	76	T	...	T	18
19	63.9	79.4	44.4	35.0	29.67	29.79	29.50	.29	65	SW	12.8	55	.56	...	.56	19
20	51.8	63.2	42.0	21.2	29.86	29.95	29.76	.19	56	NW	14.7	45	.02	...	.02	20
SUNDAY......21	62.0	73.7	52.1	21.6	29.96	29.99	29.90	.09	53	W	14.2	69	...	...	...	21.....SUNDAY
22	66.2	76.7	55.1	21.6	29.97	30.02	29.94	.08	57	W	7.3	89	...	...	...	22
23	70.8	80.4	57.3	23.1	29.86	29.93	29.79	.14	64	SW	9.9	49	T	...	T	23
24	75.4	87.5	66.2	21.3	29.77	29.86	29.64	.22	64	W	12.6	74	.23	...	.23	24
25	71.8	81.2	61.3	19.9	29.79	29.99	29.64	.35	52	NW	15.7	91	...	...	...	25
26	63.7	72.5	52.8	19.7	30.03	30.11	29.95	.16	45	NW	10.0	78	...	...	...	26
27	61.3	67.4	54.3	13.1	30.03	30.08	29.98	.10	14	NE	8.5	85	...	...	...	27
SUNDAY.......28	55.7	62.2	51.2	11.0	29.94	30.02	29.84	.18	64	SE	12.2	5	.50	...	.50	28.....SUNDAY
29	57.2	65.2	53.1	12.1	29.73	29.79	29.69	.10	85	SE	8.9	0	.84	...	.84	29
30	54.5	55.7	52.8	2.9	29.98	30.16	29.80	.36	81	NE	11.7	0	.17	...	.17	30
Means......	61.97	71.13	53.08	18.06	29.909	30.003	29.812	.191	56.73		11.41	58.41	2.90	...	2.90	......Sums
40 Years means for and including this month.	61.49	73.27	56.00	17.25	29.907	.....	.....	.158	69.43		12.29§	54.70¶	3.125	...	3.425	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction..........	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles.............	766	1053	111	358	376	1148	2369	2057	
Duration in hours...	69	108	11	34	36	102	194	165	1
Mean Velocity......	11.1	9.8	10.3	10.5	10.5	11.2	12.2	12.5	

The greatest mileage in one hour was 24 on the 10th.
The greatest velocity in gusts was 40 on the 12th. Total mileage, 8241.
Resultant direction, N66°W. Resultant mileage, 3837.

The greatest heat was 87.5° above zero on the 24th. The greatest cold was 39.9° above zero on the 2nd, giving a range of 47.6°.

The warmest day was the 24th. The coldest day was the 2nd.

The highest barometer reading was 30.21 on the 6th. The lowest barometer reading was 29.50 on the 19th, giving a range of .71 inches.

The minimum relative humidity observed was 23 on the 5th.

Thunderstorms on 2 days.

Solar halos on 1 day.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

§ 26 years means.

¶ 33 years means.

914.

Meteorold . McLEOD, *Superintendent.*

DAYS.	† Mean.	T 1	Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
1	60.8	6	75	T	...	T	1
2	56.7	5	2	.24	...	.24	2
3	60.7	6	90	...	...	...	3
4	68.1	7	91	...	...	...	4
SUNDAY........5	68.5	7	38	.07	...	.07	5.....SUNDAY
6	71.7	8	89	...	...	...	6
7	68.6	7	6	.03	...	.03	7
8	71.3	8	48	T	...	T	8
9	69.3	7	94	...	...	...	9
10	71.2	8	94	...	...	...	10
11	71.6	8	34	.07	...	.07	11
SUNDAY.......12	73.2	8	94	...	...	...	12.....SUNDAY
13	73.2	8	94	...	...	...	13
14	74.9	8	94	...	...	...	14
15	77.8	8	92	...	...	...	15
16	78.9	8	59	.03	...	.03	16
17	78.5	9	51	.02	...	.02	17
18	69.6	7	86	...	...	...	18
SUNDAY.......19	59.1	6	47	...	...	...	19.....SUNDAY
20	65.9	7	77	T	...	T	20
21	65.2	7	76	...	...	...	21
22	66.5	7	80	...	...	...	22
23	61.8	6	0	.35	...	.35	23
24	68.4	7	64	...	...	...	24
25	72.2	8	74	.15	...	.15	25
SUNDAY.......26	67.9	7	86	...	...	...	26.....SUNDAY
27	64.3	7	79	...	...	...	27
28	63.4	7	48	...	...	...	28
29	62.0	6	53	T	...	T	29
30	64.5	7	75	...	...	...	30
31	68.5	8	77	T		T	31
Means......	68.20	7	8.21	0.96	...	0 96	......Sums
40 Years means for and including this month.	69.02	7	9.52¶	3.834	...	3.834	40 Years means for and including this month.

AN

Direction..........	N	N
Miles.............	174	16
Duration in hours...	26	1
Mean Velocity......	6.8	9

The greatest mileage in one hour
Total mileage, 6609.
Resultant direction, N50°W.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

§ 26 years means.

¶ 33 years means.

ABSTRACT FOR THE MONTH OF JULY, 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER				*BAROMETER				‡ Mean relative humidity.	WIND		Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour					
1	60.8	69.6	49.5	20.1	30.11	30.20	29.99	.21	63	SE	8.1	75	T	...	T	1
2	56.7	58.2	55.4	2.8	29.95	30.04	29.91	.13	79	NE	10.7	2	.24	...	.24	2
3	60.7	69.8	50.9	18.9	30.11	30.13	30.07	.06	64	NE	6.7	90	...	...	...	3
4	68.1	79.2	54.8	24.4	30.06	30.12	30.01	.11	59	SW	9.9	91	...	...	...	4
SUNDAY........5	68.5	77.1	63.0	14.1	30.06	30.12	30.01	.11	69	W	8.2	38	.07	...	.07	5.....SUNDAY
6	71.7	82.0	60.0	22.0	30.11	30.20	30.03	.17	63	E	4.9	89	...	...	...	6
7	68.6	73.0	63.6	9.4	29.87	29.98	29.77	.21	74	NE	9.4	6	.03	...	.03	7
8	71.3	81.2	63.2	18.0	29.96	30.11	29.84	.27	70	NW	11.0	48	T	...	T	8
9	69.3	77.2	60.1	17.1	30.11	30.18	30.02	.16	59	NE	8.8	94	...	...	...	9
10	71.2	82.4	57.2	25.2	29.95	30.02	29.85	.17	62	NE	7.1	94	...	...	...	10
11	71.6	83.7	66.2	17.5	29.88	29.92	29.84	.08	73	SW	7.7	34	.07	...	.07	11
SUNDAY.......12	73.2	84.0	63.3	20.7	29.89	29.97	29.87	.10	48	NE	8.0	94	...	...	...	12.....SUNDAY
13	73.2	81.5	63.1	18.4	29.92	29.97	29.87	.10	49	NE	7.6	94	...	...	...	13
14	74.9	88.7	61.0	27.7	29.91	29.97	29.87	.10	53	S	6.8	94	...	...	...	14
15	77.8	87.7	65.8	21.9	29.87	29.94	29.81	.13	56	S	7.6	92	...	...	...	15
16	78.9	88.6	69.7	18.9	29.78	29.86	29.70	.16	69	SW	8.4	59	.03	...	.03	16
17	78.5	91.0	72.3	18.7	29.61	29.66	29.51	.15	72	SW	10.4	51	.02	...	.02	17
18	69.6	78.2	62.6	15.6	29.72	29.86	29.61	.25	56	NW	10.7	86	...	...	...	18
SUNDAY.......19	59.1	68.9	52.6	16 3	29.91	29.97	29.88	.09	53	NW	9.6	47	...	...	...	19.....SUNDAY
20	65.9	75.9	52.6	23.3	29.92	30.00	29.82	.18	47	NW	11.3	77	T	...	T	20
21	65.2	75.0	55.0	20.0	29.87	30.07	29.79	.28	51	NW	13.1	76	...	...	...	21
22	66.5	79.4	52.0	27.4	30.11	30.17	30.08	.09	48	NW	11.6	80	...	...	...	22
23	61.8	68.9	57.0	11.9	30.02	30.10	29.96	.14	75	SW	6.8	0	.35	...	.35	23
24	68.4	78.1	57.6	20.5	29.95	30.01	29.87	.14	66	W	6.7	64	...	...	...	24
25	72.2	85.0	64.9	20.1	29.78	29.86	29.68	.18	66	SW	12.6	74	.15	...	.15	25
SUNDAY.......26	67.9	78.8	58.0	20.8	29.92	30.01	29.86	.15	52	NW	10.4	86	...	...	...	26.....SUNDAY
27	64.3	72.0	54.4	17.6	29.98	30 04	29.92	.12	53	NE	6.8	79	...	...	...	27
28	63.4	72.5	55.3	17.2	30.01	30.03	29.98	.05	55	NE	10.0	48	...	...	...	28
29	62.0	67.9	55.0	12.9	30.11	30.20	30.01	.19	63	NE	11.5	53	T	...	T	29
30	64.5	74.0	52.8	21.2	30.22	30.30	30.17	.13	56	NE	6.4	75	...	...	...	30
31	68.5	80.0	55.3	24.7	30.09	30.16	29.97	.19	54	W	6.5	77	T		T	31
Means......	68.20	77.73	58.85	18.88	29.961	30.038	29.889	.149	60.55		8.88	68.21	0.96	...	0 96	......Sums
40 Years means for and including this month.	69.02	77.47	60.98	16.49	29.898	.....	.....	.145	71.08		12.37§	59.52¶	3.831	...	3.834	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.........	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles..............	174	1644	266	243	355	1376	672	1879	
Duration in hours...	26	183	47	32	54	144	81	177	0
Mean Velocity......	6.8	9.0	5.7	7.6	6.6	9.6	8.3	10.6	

The greatest mileage in one hour was 19 on the 21st and 25th.
Total mileage, 6609
Resultant direction, N50°W. Resultant mileage, 1803.

The greatest heat was 91.0° above zero on the 17th. The greatest cold was 49.5° above zero on the 1st, giving a range of 41.5°.

The warmest day was the 16th. The coldest day was the 2nd.

The highest barometer reading was 30.30 on the 30th. The lowest barometer reading was 29.51 on the 17th, giving a range of .79 inches.

The minimum relative humidity observed was 23 on the 12th and 14th.

Thunderstorms on 4 days.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

§ 26 years means.

¶ 33 years means.

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DR. T. WESLEY MILLS.

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DR. T. WESLEY MILLS.

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

Dr. T. Wesley Mills was a native of the town of Brockville, Ontario, where he was born on 22nd February, 1847. He enjoyed the great advantage of a universiey course in Arts before entering upon the study of medicine, in that respect resembling some of the most eminent of the physicians of Montreal and of the professors of the Medical Faculty of McGill, Dr. G. W. Campbell, Dean of that Faculty, half a century ago, Dr. R. P. Howard, who succeeded him in that distinguished office, Dr. George Ross, also, his successor, were graduates in Arts as well as in Medicine, as was also Sir William Osler. The sharpening of the intellect, the acquisition of powers of observation, and of habits of close reasoning, the widening of view, the refinement of taste, all that is implied in culture and thoughtfulness, constitute a fine foundation for professional studies to rest on, and Dr. Wesley Mills acquired these qualifications in full measure by his Arts' course in Toronto University, in which he graduated B.A. in 1871, and M. A. in 1872. All the productions of his pen have a distinct literary flavour.

Making choice of the physician's profession, he took his course of training therefor in the Medical Faculty of McGill, which then, as to-day, was manned by a body of distinguished professors; and being naturally an ardent student, he drank in eagerly the instruction which they imparted and graduated with the highest honours, in 1878, receiving the degree of M.D.C.M. He became a Doctor of Veterinary Surgery in 1890. As he progressed in knowledge, gradually extending his reputation, honours came pouring in upon him, and when the Royal Society of Canada was founded by the Marquis of Lorne he was named a Fellow thereof. Other distinctions reached were membership in the British Medical Association, in the Canada Medical Association, the Natural History Society of Montreal, and in the American Physiological Society. He was chosen also a Vice-President of the Society of American Naturalists. He founded in this city a society for the study of Comparative Physiology about the year 1885. While still a student, he became greatly enamoured with the wonders of the human body, its structure and the laws governing it, and he acquired such a reputation for knowledge of this subject that, in 1882, he was appointed demonstrator in Physiology in the Medical Faculty of McGill. Whole-hearted enthusiasm in his work characterized his intercourse with the students while serving in this capacity, so that, in 1884, he was promoted by the Faculty to the position of Lecturer in the same subject. In 1886 he succeeded to the full dignity of Professor of Physiology. He continued in that office, which he filled with illustrious success, until the year 1910. His prelections were marked by great originality, as the result of profound and careful personal research. Obliged to resign on account of failing health he retired that year with the rank of Professor Emeritus.

Dr. Wesley Mills wielded a facile pen and was a prolific writer. No graduate of the Medical Faculty of McGill has so many publications to his credit as he. His first book, "Outlines of Lectures on Physiology," was issued in 1886. It was followed by a "Text Book in Animal Physiology," in 1889, and that by a "Text

Book on Comparative Physiology,'' in 1890. His next publication was on ''How to Keep a Dog in the City,'' in 1891, and this was succeeded by a volume on ''The Dog in Health and Sickness,'' in 1892. No one was ever a greater lover of dogs than he and no one ever got deeper into the secrets of the dog's nature. Indeed, he was known as the friend and champion protector of all animals. An ancient poet-philosopher took credit to himself that he counted nothing relating to man foreign to him. The range of Professor Mills' interest and sympathies was vastly more comprehensive: it embraced everything that had life. To him no bird or beast was an object of indifference. And this is a prime qualification in one who would interpret animal life. To understand the creatures about us we must love them, as love is the true organ of man's perception and of his interpretation of the entire field of his observations. Longfellow ascribes the remarkable skill in various kinds of woodcraft of his Indian hero, Hiawatha, to the tenderness of his sympathies with the tenants of the forest; in consequence they readily yielded up their secrets to him: He ''learned of every bird its language, where they built their nests in summer, where they hid themselves in winter.'' According to this law, while the knowledge of that most sagacious animal and companion of man, the dog, Dr. Wesley Mills made peculiarly his own, all animal nature was to him an open book.

When he entered upon the domain of Comparative Physiology, he extended the scope of his energies and thought, and the fruit of his new studies was given in his next publication, ''The Nature and Development of Animal Intelligence,'' a work of rare charm, issued in 1898. Speculation along the line of evolution was rife at this time, and Dr. Mills' work gave tokens that he had come largely under the fascinating spell of Darwin, Huxley, Spenser, and Hæckel. These great masters had an unquestioned influence upon his views. His studies were conducted under the same thorough fashion as theirs. The scientific spirit was pre-eminently his. How earnestly he planned and how patiently he waited and worked to get at the truth this volume makes clear. While accepting evolution as a working theory, he put fact above theory. Nothing was taken for granted, and no detail was deemed unimportant in his observations on the development of the intelligence of the animals under study. No portion of this delightful book more conspicuously displays his love of truth than the correspondence regarding "instinct" with which it concludes. He would not bind himself to any hard and fast theory which would not take in the facts which he had personally collected.

Having established that animals have mind, which usually goes by the name of instinct, he proceeds to show that their mental powers are capable of great expansion from the moment of the creature's birth until the time it has reached full growth and maturity. He concluded that individuals sometimes went beyond the stage of intelligence attained by the mass of the species. He thought this an important fact bearing upon the evolutionary theory. Henri Fabre, in his studies on insect life, pointed out similar instances of the acquisition of knowledge by individuals in advance of that reached by the species as a whole; but neither of them was able to assert that the offspring of these more intelligent individuals had any advantage over the offspring of the common herd. They all started with the same degree of intelligence. So that the link is wanting, postulated by the theory of evolution, that habits acquired by individuals in their passage through life are transmitted to their offspring, and become the basis for subsequent general advancement of the species. Proof is lacking that special acquirements of individuals are inherited by their descendants.

His last publication was on the somewhat curious subject of "Voice Production in Singing and Speaking on Scientific Principles." He would appear to have pursued the consideration of this practical question either as the result of his second marriage or as a step leading up to it. His first wife died at Leipsic in 1901, and in September, 1903, he married Kate Samuels, of Bendigo, Australia, a distinguished operatic singer, known on the stage as Madame Benda. His highly susceptible nature was attracted by her splendid musical qualities, and the double result followed: he married her and took up, with fresh eagerness, a line of study to which he had previously given some attention, and the outcome of his fuller and later researches on the subject we have in the volume mentioned.

Dr. Wesley Mills early connected himself with the Natural History Society, which was at the height of its prosperity and usefulness about the time he entered upon his public career. He contributed many valuable papers to its transactions, especially in the line of his professional studies; and the Society showed its appreciation of his scientific attainments, and of the obligations under which he had laid it by his demonstrated interest in its work, by his presence at its meetings and the numerous papers he had read before it, by raising him to the Presidency of the Society in May, 1893, and elected him again to the same office in May, 1894.

The Natural History Society has been largely beholden to McGill University, during the last sixty years, for its success as a scientific institution; and not the least of the members of the distinguished staff of the college who have afforded efficient help to it, was Dr. Wesley Mills. To the last he remained on the list of its Vice-Presidents, and continued to be interested in its work. It was with much regret that the members of the Society learned of the resignation of his professorship on the score of ill-health; although the hope was entertained that the enjoyment of leisure might help his recovery, and specially that receiving treatment from the most eminent skill which London could afford would result in the re-establishment of his impaired health.

They counted on seeing his genial presence among them after a short interval.

When he left the city, he looked forward with eagerness to taking up his abode in the great Metropolis, not only on account of the surgical aid he counted on, but also by reason of the numerous general advantages which the culture, art and science of the world's capital afforded. Among others residing therein whose society he specially valued was the friend and companion of his youth, Dr. Crozier, formerly of Galt, Ontario, the eminent philosophic-litterateur, and then his quondam colleague and distinguished friend, Sir William Osler, of Oxford, was within easy reach of London. In close intercourse with these and other men of learning, of artistic and of scientific eminence, he expected to spend many happy days; but it was not to be: he was cut off on the 15th day of February, 1915, within a week of the completion of his 68th year.

On March 6th, 1915, the Faculty of Medicine of McGill University, adopted the following resolution on the death of Prof. T. Wesley Mills:

"That the members of the Faculty of Medicine desire to place on record an expression of their sincere regret at the death of their former colleague, Professor J. Wesley Mills.

"Prof. Mills had been associated with the teaching staff of the Medical Faculty of McGill University for more than thirty years, first as Demonstrator in 1882, then as Lecturer, and from 1886 to 1910 as Professor of Physiology. From the time of his resignation he has been Professor Emeritus.

"He had taken part in the extraordinary development of the Faculty in all its branches and at a time when none of its members were active writers he had brought credit to the Faculty by his textbooks upon Animal Physiology and Comparative Physiology.

"It was hoped that with his liberation from the burden of routine professorial duties he would have regained his health and vigor after his prolonged illness and serious operation and that he would be spared for many years to continue his studies upon those special branches of physiology and medicine in which he was so much interested and which he had made so particularly his own.''

A LIST OF THE TYPE FOSSILS IN THE PETER REDPATH MUSEUM (McGILL UNIVERSITY).

By Edmond Ardley,

Assistant Curator of Peter Redpath Museum.

PART I.

Protozoa.

Cryptozoon occidentale, Dn.
Lower Cambrian.
Grand Canon, Arizona.
Collector—Dr. Charles D. Walcott.
Canadian Record of Science, Vol VII, 1889.

Cryptozoon lachutense, Dn.
Calciferous.
Lachute, Pro. Que.
Collector—Sir W. Dawson.
Canadian Record of Science, Vol. VII., 1889.

Cryptozoon boreale, Dn.
Siluro. Cambrian (Ordovician).
Lake St. John County.
Collector—E. T. Chambers.
Canadian Record of Science, Vol. VII., 1889.

Dentalina priscilla, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—C. F. Hartt.
Museum No. 3050, Acadian Geology, 1878, p. 285.

Megastroma laminosum, Dn.
L. Carboniferous.
Brookfield, N.S.

Collector—Sir W. Dawson.
Museum No. 3047.
Report on the Peter Redpath Museum, McGill University, No. II, p. 12, 1883.

PORIFERA.

Trachyum vetustum, Dn.
L. Cambrian.
Little Metis, Que.
Collector—Sir W. Dawson.
Mss. "The Fauna of the Lower Cambrian or Odenellus Zone," p. 598, by Charles D. Walcott.

Palæosaccus dawsoni, Hinde.
Quebec Group (Ordovician).
Little Metis, Que.
Collector—Sir W. Dawson.
Geological Magazine, Decade III, Vol. X., No. 344, p. 56, February, 1893.

Protospongia tetranema, Dn.
Quebec Group (Ordovician).
Little Metis, Pro. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. VII., Section IV., 1889.

Protospongia coronata, Dn.
Quebec Group (Ordovician).
Little Metis, Prov. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. VII., Section IV., 1889.

Protospongia mononema, Dawson.
Quebec Group (Ordovician).
Little Metis, Prov. Que.

Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol VII., Section IV., 1889.

Protospongia polynema, Dn.
Quebec Group (Ordovician).
Little Metis, Prov. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. VII., Section IV., 1889.

Protospongia cyathiformis, Dn.
Quebec Group (Ordovician).
Little Metis, Prov. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. VII., Section IV., 1889.

Protospongia delicatula, Dn.
Quebec Group (Ordovician).
Little Metis, Prov. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. VII., Section IV., 1889.

Cyathospongia (ryathophycus) quebecense, Dn.
Quebec Group (Ordovician).
Little Metis, Prov. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. VII., Section IV., 1889.

Acanthodictya hispida, Hinde.
Quebec Group (Ordovician).
Little Metis, Prov. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. VII., Section IV., 1889.

Hyalostelia metissica, Dn.
Quebec Group (Ordovician).
Little Metis, Prov. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. VII., Section IV., 1889.

Lasiothrix curvicostata, Hinde.
Quebec Group (Ordovician).
Little Metis, Prov. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. VII., Section IV., 1889.

Stephenella hindii, Dn.
Quebec Group (Ordovician).
Little Metis, Prov. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. II., Section IV., Second Series, 1896-97.

Halichondrites confusus, Dn.
Quebec Group (Ordovician).
Little Metis, Prov. Que.
Collector—Sir W. Dawson.
Trans. Royal Society of Canada, Vol. VII., Section IV., 1889.

Craniella (Tethea) logani, Dn.
Post Pliocene, Montreal, Que.
Collector—Sir W. Dawson.
Museum No. 6545, "Ice Age of Canada," p. 217.

COELENTERATA.

Graptolites.

Dictyonema websteri, Dn.
Upper Silunan.
New Canaan, Nova Scotia.

Collector—Dr. Webster.
Marked "A," Acadian Geology, 1868, 2nd ed., p. 563.

ACTINOZOA.

Tabulata.

Stenopora exilis, Dn.
L. Carboniferous.
Shubenacadie, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 3041.
Acadian Geology, 1878, p. 287.

RUGOSA.

Lithostrotion pictoense, Billings.
L. Carboniferous.
East River, Pictou, N.S.
Collector—Sir W. Dawson.
Museum No. 3034.
Acadian Geology, 1878, p. 285.

Cyathophyllum billingsi, Dn.
L. Carboniferous.
Stewiack, Nova Scotia.
Collector—C. F. Hartt.
Museum No. 3037.
Acadian Geology, 1878, p. 287.

Zaphrentis minas Dn.
L. Carboniferous.
Kennetcook, Nova Scotia.
Collector—Prof. How.
Museum No. 3042.
Acadian Geology, 1878, p. 286.

VERMES.

Sabellarites phosphaticus, Dn.
Quebec Group (Ordovician).
Kamouraska, Que.
Collector—Sir W. Dawson.
Museum No. 580.
Quart. Journal Geological Society, 1890, Vol. XLVI., p. 608.

Sabellarites trentonensis, Dn.
Black-river (Ordovician).
Point Claire, Que.
Collector—Sir W. Dawson.
Quart. Journal Geological Society, 1890, Vol. XLVI., p. 608.

Serpulies annulatus, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collectors—H. Poole and C. F. Hartt.
Museum No. 2711.
Acadian Geology, 1878, p. 312.

Serpulites hortonensis, Dn.
L. Carboniferous.
Half-way River, Nova Scotia.
Collector—Prof. How.
Museum No. 2720.
Acadian Geology, 1878, p. 312.

Serpulites murrayi, Dn.
L. Carboniferous.
Port-au-Port, Newfoundland
Collector—Dr. R. Bell.
Museum No 2719.
Report on the Peter Redpath Museum, McGill University, No. 11, p. 13, 1883.

Spirorbis carbonarius, Dn.

Carboniferous.
S. Joggins, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 3102.
Quart. Journal Geological Society, Vol. I., p. 326.
Acadian Geology, 1878, p. 205.

Spirorbis angulatus, Dn.

L. Carboniferous.
Windsor, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2717.
Acadian Geology, 1878, p. 312.

BRACHIOPODA.

Spirifer montrealensis, Williams.

Devonian.
St. Helen's Island, Montreal.
Collector—Ed. Ardley.
Number 252-1-17.
Trans. Royal Society of Canada, Third Series, Vol. III., section IV., 1909-10.

Spirifer montrealensis, Williams.

Devonian.
St. Helen's Island, Montreal.
Collector—Ed. Ardley.
Number 252.1-14, Card No. 5379.
Trans. Royal Society of Canada, Third Series, Vol. III., Section IV., 1909-10.

Spirifer concinnus, var Helenæ, Williams.

Devonian.
St. Helen's Island, Montreal.

Collector—Ed. Ardley.
Number 252-2-23, Card No. 5378.
Trans. Royal Society of Canada, Third Series, Vol. III., Section IV., 1909-10.

Rhynchonella dawsoniana, Davidson.
L. Carboniferous.
Windsor and Lennox Passage, C.B.
Collector—Sir W. Dawson.
Museum No. 2905.
Acadian Geology, 1878, p. 294.

Rhynchonella acadiensis, Davidson.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2908.
Acadian Geology, 1878, p. 295.

Echinodermata.

Palæaster parviusculus, Billings.
Upper Silurian.
Arisaig, Nova Scotia.
Collector—Dr. Honeyman.
Museum No. 1586.
Canadian Naturalist, Vol. V., p. 69; Acadian Geology, p. 594.

Mollusca.

Lamellibranchiata.

Actinopteria (Pterinea) fronsacia, Clarke.
Gaspé Sandstone (Devonian).
Gaspé Basin, Que.
Collector—Sir W. Dawson.
Museum No. 1942.
Memoir 9, Early Devonic History of New York and Eastern North America, by John M. Clarke.

Palæoncilo (cf. Maxima Clarke) helena, Williams.
Devonian.
St. Helen's Island, Montreal.
Collector—Ed. Ardley.
No. 2521, 1, 23, Card No. 5546.
Trans. Royal Society of Canada, Third Series, Vol. III., Section IV., 1909-10.

Modiomorpha helena, Williams (cf. concentrica).
Devonian.
St. Helen's Island, Montreal.
Collector—Ed. Ardley.
No. 2521, 1, 22, Card No. 5545.
Trans. Royal Society of Canada, Third Series, Vol. III., Section IV., 1909-10.

Naiadites carbonarius, Dn.
Carboniferous.
So. Joggins, Nova Scotia.
Collector—Sir W. Dawson.
Canadian Record of Science, Vol. VI., 1894.

Naiadites longus, Dn.
Carboniferous.
So. Joggins, Nova Scotia.
Collector—Sir W. Dawson.
Quart. Journal, Geological Society, 1894, Plate XX., Fig. 1.

Naiadites mytiloides, Dn.
Carboniferous.
Chimney Corner, Cape Breton.
Collector—Mr. Neighswander.
Canadian Record of Science, Vol. VI., 1894.

Anthracoyma clongata, Dn.
Middle carboniferous.
So. Joggins, Nova Scotia.

Collector—Sir. W. Dawson.
Canadian Record of Science, Vol. VI., 1894.

Anthracomya arenacea, Dn.
Upper carboniferous.
Pictou, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 3131.
Supplement to Acadian Geology, last edition, Canadian Record of Science, Vol. VI., 1894.

Anthracomya ovalis, Dn.
L. Carboniferous.
Parrsboro, Nova Scotia.
Collector—Sir W. Dawson.
Acadian Geology (second edition), p. 205, Canadian Record of Science, Vol. VI., 1894.

Anthracomya obtenta, Dn.
M. Carboniferous.
Mabou, Cape Breton.
Collector—Sir W. Dawson.
Acadian Geology, second edition, p. 205, Canadian Record of Science, Vol .VI., 1894.

Carbonicola (Naiadites) angulata, Dn.
L. Carboniferous.
Parrsboro, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 3132.
Acadian Geology, second edition, p. 205, Canadian Record of Science, Vol. VI., 1894.

Modiola polli, Dn.
L. Carboniferous.
Shubenacadie, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2811.
Acadian Geology, 1878, p. 301.

Modiola avonia, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—Prof. Hartt.
Museum No. 2801.
Acadian Geology, 1878, p. 301.

Macrodon hardingi, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2820.
Acadian Geology, 1878, p. 302.

Macrodon shubenacadiensis, Dn.
L. Carboniferous.
Shubenacadie, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2818.
Acadian Geology, 1878, p. 303.

Macrodon elegans, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2822.
Acadian Geology, 1878, p. 303.

Edmondia harttii, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—C. F. Hartt.
Museum No. 2815.
Acadian Geology, 1878, p. 303.

Cardinia sub-angulata, Dn.
L. Carboniferous.
Pugwash, Nova Scotia.

Collector—Sir W. Dawson.
Museum No. 2826.
Acadian Geology, 1878, p. 304.

Cardinia antigonesensis, Dn.
L. Carboniferous.
Antigonish, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2825.
Acadian Geology, 1878, p. 304.

Conocardium acadianum, Hartt.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—C. F. Hartt.
Museum No. 2812.
Acadian Geology, 1878, p. 305.

Anthracosia bradorica, Dn.
L. Carboniferous.
Baddeck, Cape Breton.
Collector—J. Barnes.
Museum No. 2834.
Acadian Geology, 1878, p. 314.

Aviculopecten lyelli, Dn.
L. Carboniferous.
Windsor—Nova Scotia.
Collector—Sir W. Dawson.
Museum 2831.
Acadian Geology, 1878, p. 305.

Aviculopecten reticulatus, Dn.
L. Carboniferous.
Gay's River, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2837.
Acadian Geology, 1878, p. 306.

Aviculopecten simplex, Dn.
L. Carboniferous.
Shubenacodie, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2832.
Acadian Geology, 1878, p. 306.

Aviculopeten cora, Dn.
L. Carboniferous.
Shubenacadie, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2833.
Acadian Geology, 1878, p. 307.

Aviculopecten debertianus, Dn.
L. Carboniferous.
De Bert River, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2842.
Acadian Geology, 1878, p. 307.

Cardimorpha vindobonensis, Hartt.
L. Carboniferous.
Nova Scotia.
Collector—C. F. Hartt.
Museum No. 2850.
Acadian Geology, 1878, p. 305.

Sanguinolitea brookfieldianus, Dn.
L. Carboniferous.
Brookfield and Windsor, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2830.
Report on the Peter Redpath Museum, McGill University, No. II., p. 11, 1883.

Tellina nanaimöensis, Whiteaves.
Upper Cretaceous.
Nanaimo, British Columbia.

Collector—Dr. F. D. Adams.
Mss.

Mollusca.

Gasteropods.

Platyceras dawsoni; Walcott.

Lower Cambrian.
St. Simon, Quebec.
Collector—Sir W. Dawson.
The Fauna of the Lower Cambrian or Olenellus Zone, p. 618, 1892, by Charles D. Walcott.

Strophites grandæva, Dn.

Devonian.
St. John, New Brunswick.
Collector—Dr. G. F. Matthew.
Museum No. 2384.
American Journal of Science, Vol. XX., p. 413.

Pupa vetusta, Dn.

Carboniferous.
So. Joggins, Nova Scotia.
Collector—Sir W. Dawson.
Sir C. Lyell and Dr. Dawson, Journal of Geological Society, Vol. IX., 1832; Acadian Geology, 1855, p 160; Air-breathers of the Coal Period, 1863; American Journal of Science, Vol. XX., p. 405.

Pupa bigsbii, Dn.

Carboniferous.
So. Joggins, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 3122.
American Journal of Science, Vol. XX., p. 401.

Zonites (conulus) priscus, Carpenter.
Carboniferous.
So. Joggins, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 3116.
Quart. Journal of Geological Society, Nov., 1867; Acadian Geology, 1868, p. 385; American Journal of Science, Vol. X., p. 411.

Pleurotomaria acadica, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—Prof. C. F. Hartt.
Report on the Peter Redpath Museum, McGill University, No. II, p. 11, 1883.

Pleurotomaria ignobilis, Dn.
L. Carboniferous.
Stewiacke, Nova Scotia.
Collector—C. F. Hartt.
Museum No. 2769.
Acadian Geology, 1878, p. 310.

Pleurotomaria dispersa, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—H. Poole.
Museum No. 2770.
Acadian Geology, 1878, p. 310.

Murchisonia gypsea, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—H. Poole.
Museum No. 2762.
Acadian Geology, 1878, p. 310.

Platyschisma dubia, Dn.
L. Carboniferous.

Windsor, Nova Scotia.
Collector—H. Poole.
Museum No. 2765.
Acadian Geology, 1878, p. 309.

Naticopsis dispassa, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2753.
Acadia Geology, 1878, p. 309.

Naticopsis howi, Dn.
L. Carboniferous.
Windsor, Nova Secotia.
Collector—Sir W. Dawson.
Museum No. 2752.
Acadian Geology, 1878, p. 309.

Euomphalus exortivus, Dn.
L. Carboniferous.
East River, Pictou, Nova Scotia.
Collector—D. Fraser.
Museum No. 2751.
Acadian Geology, 1878, p. 309.

Macrocheilus terranovicus, Dn.
L. Carboniferous.
St. George's Bay, Newfoundland.
Collector—Dr. R. Bell.
Museum No. 2763.
Report on the Peter Redpath Museum, McGill University, No. II, p. 14, 1883.

Macrocheilus acadicus, Dn.
L. Carboniferous.
Pugwash, Nova Scotia.

Collector—Sir W. Dawson.
Museum No. 2781.
Acadian Geology, 1878, p. 309.

Choristes elegans, Carpenter.
Pleistocene.
Montreal, Que.
Collector—Sir W. Dawson.
Museum No. 6240.
The Ice Age in Canada, p. 251.

MOLLUSCA.

Cephalopoda.

Piloceras amplum, Dn.
Calciferous.
Lachute, Prov. Que.
Collector—Mr. Macpherson.
Museum No. 438.
Canadian Naturalist, Vol. X., No. 1.

Actinoceras inops, Dn.
L. Carboniferous.
East River, Pictou, Nova Scotia.
Collector—D. Fraser.
Museum No. 2724.
Acadian Geology, 1878, p. 314.

Orthoceras perstrictum, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—C. F. Hartt.
Museum No. 2723.
Acadian Geology, 1878, p. 312.

Orthoceras laqueatum, Hartt.

L. Carboniferous.

Windsor, Nova Scotia.

Collector—C. F. Hartt.

Museum No. 2731.

Acadian Geology, 1878, p. 312.

Orthoceras vindobodonense, Dn.

L. Carboniferous.

Windsor, Nova Scotia.

Collector—Sir W. Dawson.

Museum No. 2730.

Acadian Geology, 1878, p. 311.

Discites (Gyroceras) harttii, Dn.

L. Carboniferous.

Brookfield, Nova Scotia.

Collector—Sir W. Dawson.

Museum No. 2742.

Acadian Geology, 1878, p. 311, Report on the Peter Redpath Museum, McGill University, No. 11, p. 10, 1883.

Pteropoda.

Tentaculites helena, Donald.

L. Helderberg.

St. Helen's Island, Montreal.

Collector—Sir W. Dawson.

Canadian Naturalist, 1880, Vol. IX., p. 302.

Conularia planicostata, Dn.

L. Carboniferous.

Irish Cove, Cape Breton.

Collector—Sir W. Dawson.

Museum No. 2749.

Acadian Geology, 1878, p. 307

Polyzoa.

Fenestella lyelli, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—Sir W. Dawson.
Museum No. 2974.
Acadian Geology, 1878, p. 288.

Berenicea insueta, Dn.
L. Carboniferous.
Windsor, Nova Scotia.
Collector—Prof. C. F. Hartt.
Report on the Peter Redpath Museum, McGill University, No. II, page 12, 1883.

THE EVENING GROSBEAK IN THE EAST.

The past winter has been a memorable one for our bird-lovers through the presence in large numbers of that rare visitant, the Evening Grosbeak (*Hesperiphona Vespertina*). This beautiful bird with its strikingly variegated costume of yellow, white, brown and black, attracted much attention in our streets. Comparatively few had ever seen or heard of such a bird. One listening to the comments from a group watching a flock feeding in the trees on the street, would hear references to "wild canaries," "winter goldfinches," "yellow robins," etc.

Like its relative, the Crossbill, the Evening Grosbeak is somewhat erratic in its movements. Nesting in the far Northwest, it usually migrates in Autumn to the plains of Manitoba, Saskatchewan, Alberta and of the states immediately to the south. Occasionally, however, it continues its way far down into the western Mississippi Valley, and at infrequent intervals extends its range as far east as the province of Quebec and the North Atlantic States.

The first great recorded migration into the east occurred in the winter of 1889-90. I remember counting at least forty on a bitterly cold winter morning, twittering contentedly in the trees just in front of the McGill Arts' Building. Since that date, I know of no record of its appearance here, although Dionne reports it in numbers at Quebec in the winter of 1903-4. It has been occasionally seen in Ottawa, at Guelph, Parry Sound, and at other points in Western Ontario. There was a visitation of the eastern states in 1910.11.

This year the Evening Grosbeaks appeared in numbers towards the end of February and were reported from time to time in almost every part of the city and its suburbs. They were seen in St. Lambert, Ste. Anne de Bellevue, Morin Heights, Ste. Agathe, Grand'Mere, and doubtless at many other points in the province. They remained here for nearly two months, being observed on

Esplanade Avenue in the city and at Ste. Anne de Bellevue about April 22nd.

In the April number of *Bird Lore,* the organ of the Audubon Society, are given reports on the visit of the Grosbeaks to various localities across the border, as Saratoga Springs, Poughkeepsie, Glen's Falls, Boston, Lexington, etc. The observer in the last mentioned place, Winsor M. Tyler, M.D., gives an account of its eating habits, which is of sufficient interest to quote:

"Having detached it (the seed) from the stem, (to do this the bird merely leans downward and pulls off the husk and its wing) the Grosbeak cuts through the husk as far as the kernel and allows the wing to drop to the ground; this it does with a fluttering motion suggestive of a small moth. The remainder, the whole kernel and perhaps two-thirds of the husk, the Grosbeak mumbles in his bill, and in an incredibly short time discards from the sides of his beak the more or less macerated remains of the husk. Some of these particles fall to the ground, some cling for a time to the beak. The bird swallows the kernel. Upon examining the wings which the birds have clipped off, it was apparent that the birds had bitten directly over the kernel itself at a point rather nearer the wing than the centre of the kernel. But, althought by this incision the kernel was exposed, it was never severed and allowed to fall with the wing, as would have been the case had the beak been closed and the bite completed. The cutting process was always arrested at the point after the casing had been divided, and before the meat had been severed. All this, although the process involved the nicest precision, was accomplished with great rapidity,—the wing fluttering to the ground within a second or two after the fruit was plucked from the stem."

The seeds referred to are of the Manitoba maple and are apparently the Grosbeak's first choice for food. Wherever this tree has been planted in our streets there the birds were first seen. They seldom left before the supply was fully exhausted, when they sought the ash, the locust or the rowan tree. Often the unusual carpeting of the husks of these seeds on the snowy street was the first indication to passersby of the presence of the birds in the trees above.

These birds are remarkably gentle and unobtrusive in their ways. They make little noise, whispering softly to each other, somewhat after the manner of cedar waxwings. When they first came, they appeared quite tame, and apparently were quite ignorant of any danger in the proximity of man.

Unfortunately, their confidence was frequently misplaced. Many were slaughtered in some parts of the city, apparently from the mere lust of killing. Others were captured and exposed in various bird shops for sale. Through the prompt efforts of the Women's Council and of the Society for the Prevention of Cruelty to Animals, however, the law protecting song birds was enforced, and the captives were freed.

I. GAMMELL.

The High School of Montreal.

SOME RECENT CHANGES IN THE FLORA OF MONTREAL AND ADDITIONS THERETO.

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

Ornithogalum umbellatum L.—Found in marshy little bay on north bank of St. Lawrence River, opposite Verdun Hospital; and also near the Victoria Bridge, on the St. Lambert side of the St. Lawrence. August.

Serapias Helleborine L. (*Epipactis Viridiflora Reichenb*), was first found by Dr. Herbert Cushing in Mount Royal Park, Montreal, in 1894, a few specimens confined to one spot. The writer discovered specimens in another part of the mountain the following year. Since then it has multiplied so rapidly that thousands of specimens of it are to be found on and around the mountain, the debris of the *banc rouge* composing the rocky framework of Mount Royal seeming to afford the plant suitable soil. July and August.

Aristolochia clematitis L.—A fairly large colony of this plant the writer discovered five years ago, near the Montreal Water Works Reservoir, Cote des Neiges Road. It is maintaining itself in competition with grass and other plants. May-July.

Amaranthus blitoides Wats.—This weed has been introduecd along the line of the Grand Trunk Railway, and seems to flourish among cinders. All summer.

Dianthus deltoides L.—A small colony of this European plant was found on the Cote des Neiges side of Mount Royal by Mr. Lachlan Gibb some years ago, and it persists. May-August.

Sisymbrium altissimum L.—This troublesome plant came originally from Europe, but it has reached Canada by way of British Columbia, travelling eastward by the Canadian Pacific Railway. The writer first found it at

Yale, B.C., nearly twenty years ago; but now, wherever the Canadian Pacific road goes, there it grows in thousands, and is carried by the wind "tumbling" and spreading its seeds. All summer.

Gymnocladus dioica (L.) Koch.—Only a few specimens of this tree, Kentucky Coffee Tree, used to be found on the Island of Montreal, but it has taken root in Mount Royal Cemetery and bears fruit so well in its large pods that it is multiplying rapidly. May-June.

Euphorbia hirsuta (Torr.) Wiegand.—This little prostrate spurge was somewhat rare in and around the city twenty years ago, but the railways have carried it far and near. Like the *Amaranthus blitoides* it flourishes where the ground is mixed with cinders. June-September.

Acer negundo L.—The Manitoba maple, as it is called, has made itself very much at home in the Montreal district, into which it was introduced about thirty years ago. It is a great fruit-bearer and requires no help to get itself distributed. It has the advantage of being a quick grower, and so it is useful in bare places in which trees are wanted soon, vying with the poplar in the rapidity of its growth. The grosbeak, which visited Montreal last winter, found in the fruit of this tree its chief sustenance although it did not disdain the barberry. April.

Ægopodium podagraria L.—This European umbel has established itself very thoroughly in the writer's back yard. It requires no nursing to get on. How it got there no one can tell. May-June.

Grindelia Squarrosa (Pursh) Durial.—This western (gum) plant owes its distribution also to the Canadian Pacific Railway. Only a single plant so far came under the eye of the writer, and it was found on a vacant lot in the heart of the city; but doubtless more have taken hold of the soil if one could only come across them. July-October.

Galinsoga parviflora Cav.—This Mexican plant was first reported in Canada by the writer, in 1893, a small colony of it being observed in September of that year, on McGill College Campus. Now it is in full possession of every uncared for space in front of people's houses, and can be counted by hundreds of thousands. August-October.

Artemisia biennis Willd.—This westerner has also found evidently a congenial home in Montreal, for it, too, numbers hundreds of thousands of specimens everywhere in waste ground about our streets and lanes, although it was rarely seen thirty years ago. August-October.

Ambrosia psilostachya D. C.—The railways are to be credited also with introducing this "ragweed." It is making its way rapidly near railway stations. August-October.

Echinops sphærocephalus L.—A colony of this plant has maintained itself for several years alongside the street railway track, near the junction of Westmount Boulevard with Cote des Neiges Road, and seems likely to extend itself, so large are its heads of achenes. July-September.

Cirsium horridulum Michaux.—This yellow thistle is not found in any portion of Eastern Canada besides the Island of Montreal and the district lying immediately around. Thirty years ago it was to be met with occasionally on the roads leading to St. Michael, and elsewhere, between the city and Riviere des Prairies; but to-day thousands of specimens may be seen wherever there are quarries, and it has made its way across the two rivers to Rosemere. August-October.

Cirsium Arvense (Scop.) setosum.—A small colony of this plant has been in existence for some years among shrubs in a vacant lot on St. Catherine Street, Westmount, not far from the M. A. A. grounds. It belongs to the Middle States of the Union, and has not been hitherto reported from Canada. July-September.

Sonchus arrensis L.—This worst of weeds, although of European origin, has, like one or two others mentioned above, invaded Eastern Canada by way of Manitoba and the Western Provinces, where it is a dreadful scourge, much of the land on the Red River being virtually valueless, it has so thoroughly taken possession of the soil. Being a great seeder it makes its way rapidly when care is not taken to destroy it before the seed is ripe. Farmers in the East must vigilantly combat it, if they would escape the endless trouble which it causes to their western contemporaries. July-October.

Latuca Scariola Var-integrata Gren. Godr.—This is also a Western invader that has taken firm hold in the district of Montreal; but it is not yet among us the terrible nuisance it is in Ottawa. In all the ruins left by the great fire near the Chaudiere in that city it fairly covers the ground.

Hieracium aurantiacum L.—The devil's paintbrush is better known and more dreaded in the Eastern Townships than in Montreal and vicinity, on which, however, it is gradually encroaching. It has an attractive blossom, but it should be pulled up wherever met with. Vast territories in the State of New York are rendered useless by it. August-October.

NOTE ON THE DISCOVERY OF A SKELETON OF BELUGA CATODON (WHITE WHALE) IN THE PLEISTOCENE (LEDA CLAY) AT THE TOWN OF MONTREAL EAST, QUEBEC.

By Edward Ardley, Peter Redpath Museum, McGill University.

During the present summer, while the Queen City Oil Company were making excavation for a drain in connection with their works at Montreal East, they laid bare a nearly perfect skeleton of a white whale. Before the attention of Mr. Forman, the Superintendent of the works, had been drawn to this interesting discovery the specimen had been somewhat broken by the workmen, but he at once recognizing its scientific value had the greater part of the skeleton carefully removed and a notification of the occurrence sent to the manager of the company.

The writer, at the request of Dr. Frank D. Adams, visited the locality and removed the skeleton to the Peter Redpath Museum, where it is now being set up, and he desires to extend his thanks to the authorities of the Queen City Oil Company for the facilities which they placed at his disposal, and the help which they extended to him in the recovery of this interesting skeleton. The clay in which the skeleton was found is a typical leda clay, bluish-grey in colour towards the bottom, changing to rusty grey or brown towards the top. It shows no evidence of stratification. When dry, it breaks into joint blocks. It contains a few small boulders of limestone. The excavation was 12 feet in width. The skeleton was 10½ feet in length. When found it was lying at right angles to the cut, with its head pointing towards the west, at a depth of 12 feet below the surface. The locality is approximately 15 feet above the St. Lawrence. Associated with the skeleton were shells of the Natica clausa, Leda glacialis, Macoma proxoma, Macoma graenlandica, also sepicules of a sponge, Tethea logani, and fragment of wood.

The following parts of the skeleton have been recovered:

Cranium and lower jaw.

Teeth—only three were found.

The Hyoid.

The vetrebral column—forty-two of the vertebræ were found.

Chevrons—only one.

The sternum.

The ribs—of these there are several pairs complete, the others are more or less broken.

The Scapula—the right complete; the left broken.

The Humerus—both right and left.

The Ulna—both right and left.

At the time this animal perished, and its remains were imbedded in the Leda clay, Mount Royal was a small rocky island in a wide inland sea, extending from the Laurentian Hills on the north to the higher ground of the Eastern Townships on the south; communicating with the Atlantic not only by the Gulf of St. Lawrence, but also by the strait between the hills of New England and the Adirondacks, and extending west ward at least as far as the Thousand Islands.

This arm of the sea was inhabited by a rich boreal fauna, consisting of species now found in the colder waters of the Gulf and Lower St. Lawrence, and in the Greenland Seas. Remains of these animals may be seen in the collection at the Peter Redpath Museum.

There was thus wide sea room and probably abundant food, on what is now the fertile plain of the Province of Quebec for the Belugu and for the Greenland Seal, whose bones are found associated with it in the Leda clay,

The following is a list of all the known specimens which have been found in North America, up to the present date:

1849—A nearly complete skeleton.
Charlotte, Vermont.
Z. Thompson.
In State Museum, Montpelier, Vermont.

1858—Twenty vertebræ, mostly caudal.
Sir J. W. Dawson.
Geological Survey Museum, Ottawa, Ont.

1864—A few detached bones.
Riviere de Loup, Que.
Sir J. W. Dawson.
Peter Redpath Museum, Montreal, Que.

1870—A nearly complete skeleton.
Cornwall, Ont.
Mr. E. Billings.
Geological Survey Museum, Ottawa, Ont.

1874—An imperfect skeleton.
Jacquet River, New Brunswick.
Provincial Museum, Halifax, N.S.

1883—A few vertebræ and fragment of a rib.
Smith's Falls, Ont.
Sir J. W. Dawson.
Peter Redpath Museum, Montreal, Que.

1891—A part of the lower jaw (11 feet) of a large whale.
Little Metis, Que.
Sir J. W. Dawson.
Peter Redpath Museum, Montreal, Que.

1895—A nearly complete skeleton.
Smith's Brickyard, Papineau Road, Montreal.
Sir J. W. Dawson.
Peter Redpath Museum, Montreal, Que.

1901—Ten vertebræ, ribs and part of cranium.
Smith's Brickyard, Papineau Road, Montreal.
Peter Redpath Museum, Montreal, Que.

1901—A few bones, hyoid, etc.
Wiliamstown, Ont.
Ed. Ardley.
Peter Redpath Museum, Montreal, Que.

1906—Most of the skull and several vertebræ.
Pakenham, Ont.
Dr. J. F. Whiteaves.

1916—A nearly complete skeleton.
Queen's City Oil Company, Montreal East.
Peter Redpath Museum, Montreal, Que.

Montreal, September, 1916.

HENRI FABRE.

There passed away a few months ago, at Orange, France, in his ninety-second year, one of the most remarkable scientific men that the world has ever seen, Henri Fabre. He remained almost unknown to the world until he was over 80 years old, when suddenly he became recognized as one of the greatest scientists of the times. He spent his long life exploring the insect world. "Entomology is not, I know, to the taste of everybody," he said, in speaking of his success. "To the terrible utilitarian, a bushel of peas preserved from the weevil is of more importance than a volume of observations which bring no profit. It is by the accumulation of ideas that humanity has done, and will continue to do, better to-day than yesterday, and better to-morrow than to-day."

Fabre's life was one of poverty, sacrifice, struggle and perseverance. He was born of humble and illiterate parents at Saint Leons, France, in 1823. His youth was a constant struggle for education. His first adventure into Nature's secrets began at his fifth year, when he sought to learn how the cricket produced its chirping sound. His interest in insects never flagged, although he started his career as teacher of mathematics in a school at Ajaccio. It was there he met the celebrated botanist, Moquin-Tandon, who gave him this advice: "Leave your mathematics and get to the beast." He followed the advice, but directing his attention to insects, and after years of study he wrote the "Life of the Spider," and other books on insects, some in as entrancing a vein as a novel.

Though Fabre veritably loved his insects, he realized and deplored their deeds of lust, cruelty and murder. "Crime is the 'note' of insect life," he once said. "Cannibalism is incidental in many instances. The story of that unspeakable hyprocrite, the praying-mantis, is one of cruelty, license and grotesque horror, such as human annals cannot match."

Speaking of his own life, the aged scientist said: "Because I have stirred a few grains of sand on the shore, am I in a position to know the depths of the ocean? Life has unfathomable secrets. Human knowledge will be erased from the archives of the world before we possess the last word that the gnat has to say to us. Scientifically, Nature is a riddle without a definite solution to satisfy man's curiosity. Hypothesis follows hypothesis; the theoretical rubbish heap accumulates, and truth ever eludes us. To know how not to know might well be the last word of wisdom."

Darwin, Mistral, Maeterlinck, all masters in their sciences, were his friends. Maeterlinck, in speaking of Fabre, declares him to be "one of the most profound scholars, the purest writer, and one of the finest poets of the century just past."

Although poverty and care had dogged Fabre's life, the last years of it were provided for by a pension from the French Government. It was Frederic Mistral, the great French poet, who urged this relief to the man "to whom France owes every assistance from every point of view." Before his death a monument had been erected in his honour in Avignon.

The following sketch of Fabre and his work is from the pen of a British Naturalist, who heads his article, "The Stupidity of Insects: Ingenuity Without Intelligence":

For over half a century Henri Fabre has been writing and publishing his epoch-making works. The ten volumes of the "Souvenirs Entomologiques" have not been written in vain, so far as English students are concerned, though we are at the tail of the vast procession which is wending its way to do homage to the sage of Serignan.

Years ago, in admiration of the then few papers published by Henri Fabre, Darwin had called this man "that inimitable observer." Henri Fabre has travelled far since then, and altogether out of the line of vision attributed to Darwin. As far back as 1881, we find the philosopher of Down writing anxiously to Romanes and asking him to discuss in a forthcoming work some of the astonishing experiments of Fabre. Unfortunately, he died before he could be initiated into the secrets Fabre was yearly solving, and all discussion of what views he would have taken are futile. But the work of Fabre went on, and to-day the world calls him "Master."

A Modest Genius.

"Unluckily for us and for himself Henri Fabre is possessed of such a modest and retiring character that his studies did not become known for many years. In the little villave of Serignan, in the South of France, he lived only to work. All he asked was leisure to fulfil his self-appointed task, profits and honours left him cold. And there he is to-day, as keen to work as ever, but the weight of his ninety-one years chains him to a couch in the dining-room of his little home.

"An example of his work and a brief summing up is all that I can gather within the compass of a short article. It only remains to say that each example is based on countless experiments. The following is from Vol. IV. of the "Souvenirs Entomologiques":—

The "Pelopæus" wasp, the "mud dauber" of warm climates, captures small spiders with which she provisions her cells of mud. After inserting the first spider, she lays an egg on it and proceeds to gather more spiders until the cell is full. It is then sealed up and another commenced, and so on until the ovaries of the wasp are exhausted.

Fabre took away the first spider with the egg attached and watched the wasp bring another. Without noticing the robbery, the wasp inserted a second spider and again set out for more. Fabre took the spiders away as fast as the wasp inserted them. At last, though there was not a single spider in the nest, the wasp sealed it up. Now, if she had any gleam of intelligence she must have noticed the cell was empty. How does it happen that she did not discover that her egg was missing? But there is more yet. Fabre took away the whole series of cells, which were attached to a wall. The Pelopæus has the habit of plastering her cells all over with a coating of mud when the series is complete. And on the bare wall, where once her cells had been, the wasp Fabre was examining proceeded to neatly plaster a covering which had no meaning or use.

Not an Exceptional Case.

"What kind of an intelligence is that? Is it an isolated case of aberration? By no means. Henri Febre proved by the closest of experiments that all insects act in the same way. Gladly would he have shown that such cases are caused by distractions, that they are only exceptional. But, alas! as he says, every species of insect tested by this method committed similar stupidities. The inexorable logic of the facts caused him to draw up the following conclusions:—

"The insect is neither free nor conscious in its industry. For it the external functions are regulated with almost as much rigour as the internal functions, like those of digestion, for example. It builds, it spins, it hunts, it stings, it paralyses just as it digests, just as it secretes the venom of its weapon or the silk of its cocoon —always without knowing anything about the means or the goal. It is as ignorant of its marvellous talents as the stomach is ignorant of its own chemistry. It can neither add nor subtract anything essential to its work any more than it can increase or diminish the pulsations of its dorsal vessel.

"Experience teaches it nothing. Time can never succeed in enlightening the obscurities of its unconsciousness. Its art, perfect in its speciality, but useless before novel difficulties, transmits itself unchangingly as the art of suckling is transmitted to the nursling. To expect the insect to modify the essential points of its industry is to hope that one day the nursling will change its way of suckling.

"The insect lacks any re-erecting powers. A blind impulse sends it from one act to another and yet to another until the work is finished, without any possibility of going back to an interrupted act if accidents happen. The cycle accomplished the work appears highly logical, but the work is done by a workman without logic.

The Pursuit of Pleasure.

"And the stimulus of this labour is the pursuit of pleasure, that main motive spring in the animal world. The mother insect has no foresight of the future larvæ. She does not hunt, nor build, nor provision with any conscious view of the family which will be raised. Her real goal is occult. For her what drives her on as sole guide is the pleasure derived accessory to the work. The Pelopæus wasp feels great satisfaction in filling her cell with spiders even when her egg has been extracted. Imperturbably she continues to hunt, though her work is useless. It appears insane to us, but she gets her fun out of it. To reproach the insect for such aberration is to suppose it endowed with the little gleam of intelligence which Darwin wished to establish for it. If it is deprived of any such gleam, the reproach cannot lie, and its acts of aberration are the inevitable resultants of an unconsciousness pushed aside from its normal paths.

"A thousand theoretical views do not equal in value one fact. Scientific solutions of problems call for an enormous number of well-established facts, "and that is why I have observed, and above all experimented," says Henri Frabe: 'To observe, although something, is not enough; one needs must experiment; that is to say, one must intervene oneself and make artificial conditions which will put the animal to the necessity of unveiling what would not happen in the normal course of events. Formerly zoology was denied any title to experimental science. The reproof was justified so long as zoology only described or classified. But these are the very least parts of its rôle. It is capable of much higher flights. Observation proposes the problem. It is solved, if it is capable of being solved, by experiment. In my modest sphere I should have deprived myself of the most powerful aid to study if I had neglected experiment. And in its modest outlook entomology has given its share of proofs.''

REPORT OF THE PROCEEDINGS OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

From May, 1910, to May, 1911.

The monthly meetings for the reading of papers and the transaction of the business of the Society were held regularly from October to May, as in former years.

The following subjects were dealt with at those meetings:

1910.

Nov. 7.—"The Aims and Objects of the Society and its Future Policy," by the President, Dr. Milton L. Hersey, M.Sc.

Nov. 28.—"The Latest Developments in the Peace River Country," by Frederick L. Lawrence, F.R.G.S.

Jan. 30.—"The Methods Employed for the Detection of Adulterants in Food," by Charles R. Hazen, B.Sc.

1911.

Feb. 27.—"Some Animal Resemblances," by Prof. A. Willey, D.Sc., F.R.S.

Apr. 3.—"The Charm of Wild Birds," by Herbert K. Job, Esq.

May 1.—"A Glimpse of Aural Mexico and its Sugar Industry," by Charles F. Bardorf, Esq.

The following course of free lectures was given under the auspices of the Society in terms of the Somerville Foundation:

Thursday, February 2nd, 8 p.m.—"A Trip Through the Peace River Country by a Pioneer," Frederick S. Lawrence, F.R.G.S.

Thursday, February 9th, 8 p.m.—"The Roman Wall in Britain," Theo. H. Wardleworth, F.L.S.

Thursday, February 16th, 8 p.m.—"The Electric Furnace and its Uses," Alfred Stansfield, D.Sc., A.R.S.M.

Thursday, February 23rd, 8 p.m.—"The Production of Sound," (illustrated by numerous experiments), Dr. Howard T. Barnes, F.R.S.C. (By the courtesy of McGill University, this lecture was delivered in the Physics Building, Sherbrooke Street.)

Thursday, March 2nd, 8.p.m.—"Northern Lights," Dr. A. S. Eve, M.A., F.R.S.C. (By the courtesy of McGill University this lecture was delivered in the Physics Building, Sherbrooke Street.)

Thursday, March 9th, 8 p.m.—"Heredity and Environment," Prof. Carrie M. Derick, M.A.

All of the above lectures were illustrated with lantern slides.

An important movement was started about ten years ago to create a taste for the study of Natural History among the children of the city. This has been attended with good results. The following were the subjects of the addresses delivered on successive Saturday afternoons:

Saturday, February 4th, 3 p.m.—"Beautiful British Columbia," I. Gammell, B.A.

Saturday, February 11th, 3 p.m.—"A Cup of Cocoa," Prof. Carrie M. Derick, M.A.

Saturday, February 18th, 3 p.m.—"Trees and What They Mean to Canada," Harry Bragg, M.J.I.

Saturday, February 25th, 3 p.m.—"Volcanoes," Prof. J. Austen Bancroft, M.A., Ph.D.

Saturday, March 4th, 3 p.m.—''Mammoths and Mastodons,'' Prof. J. C. Simpson, B.Sc.

Saturday, March 11th, 3 p.m.—''Diamonds,'' Prof. Nevil Norton Evans, M.A.Sc.

All of the above lectures were illustrated with lantern slides.

The Society consists of 200 local members besides a number of corresponding members. Sixteen names were added to the list during the year now ending. The following members died during the year: Prof. D. P. Penhallow, D.Sc., ex-President, who died at sea, October 20th, 1910; Hon. J. K. Ward, M.C.L., Honorary Vice-President; Mr. J. T. Molson, and Mrs. J. H. R. Molson, a warm friend of the Society.

The Annual Excursion of the Society took place to the Boys' Farm at Shawbridge, June 4th, 1910. This farm is situated at the foot of the Laurentian Hills, and afforded a profitable day's outing to the members of the Society and their friends.

It is a matter of regret that the report has again to be made that the interesting and valuable Museum of the Society is still stored in cases, and has been since the sale of the old property in University Street. The crying need of a museum for the instruction of the people is deeply felt in a city the size of Montreal, which at present is without such an institution. A valuable site has been secured on Mountain Street, out of part of the proceeds of the sale of the University Street property; and plans have been prepared for the erection of a suitable building thereon, but thus far it has not been found practicable to procure the funds required for the purpose. This is much to be regretted, as through the museum the Society used to do its most effective educational work. It is hoped that the citizens will realize the loss from which Montreal is suffering for want of a building in which to exhibit the priceless collection of the Society.

Another regret has to be expressed, namely, the continued suspension of the publication of the RECORD OF SCIENCE, the Society's quarterly journal, which for so long a period had rendered signal service to science. The Government of the Province has been appealed to, to aid in reviving this periodical which with its predecessor, "The Canadian Naturalist and Geologist," did so much in the half century of its history, to set forth the natural resources of the province, and good hopes are entertained that such financial assistance shall be obtained from this quarter as will enable the Society to resume the publication.

Otherwise, the Society is in a flourishing condition. It continues to receive most valuable assistance and encouragement, in prosecuting its work, from the scientific staff of McGill University. Their presence at the Society's meetings and on its lecture platform affords a wonderful stimulus to the amateur scientific workers of the Society. The Society also highly appreciated the privilege extended by the university authorities in permitting two of the Somerville lectures to be held in the Physics Building.

Mr. Alfred Griffin, the old and tried superintendent of the Society's premises and property, continues to efficiently discharge the important duties of his office.

The following are the present officers of the Society:

Patron—His Excellency the Governor-General of Canada.

Hon. President—Lord Strathcona and Mount Royal.

President—Milton L. Hersey, M.Sc, LL.D.

Hon. Vice-President—Hon. J. K. Ward.

Vice-Presidents—Frank D. Adams, Ph.D., F.R.S.C., J. A. U. Beaudry, C.E., J. S. Buchan, K.C., B.C.L., Rev. Robert Campbell, M.A., D.D., Miss Carrie M. Derick, M.A., John Harper, C. S. J. Phillips, Major G. W. Stephens, Miss Van Horne.

Secretary—Alfred Griffin.

Hon. Corresponding Secretary—F. W. Richards.

Hon. Treasurer—Jas. W. Pyke.

Hon. Librarian—Harry Bragg.

Hon. Curator—A. E. Norris.

Members of Council—John Harper, Chairman; Chas. S. M. Brown, Hilder Daw, C.E., Prof. Nevil Evans, S. W. Ewing, Joseph Fortier, Albert Holden, H. Lampard, Alex. Robertson, B.A., Farquhar Robertson.

Superintendent—Alfred Griffin.

All respectfully submitted,

ROBERT CAMPBELL,
Delegate to the Royal Society.

REPORT OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

Presented by Alfred E. Barlow, F.R.S.C., Delegate.

On behalf of the Natural History Society of Montreal, I beg to submit the following report for the consideration of the Royal Society of Canada.

Pending the erection of the new building, which will include halls, library and museum, the work of the Society, during the season 1911-12, has been practically confined to giving successful courses of lectures.

The following communications were read at the monthly meetings:

Monday, Nov. 6th, 1911.—"Some Hungarian Plants," by Rev. Robert Campbell, M.A., D.D.

Monday, Nov. 27th, 1911.—"The Dry Rot of Timber," by Miss Carrie M. Derick, M.A. "Notes on the Recent Exposure of Rock, corner of Drummond and Sherbrooke Streets," by H. Lampard, Esq.

Monday, Jan. 29th, 1912.—"Explorations in North-East Quebec," by Dr. Alfred E. Barlow. "Some Recent Additions to the Flora of Montreal," by Rev. Robert Campbell, M.A., D.D.

Monday, February 26th, 1912.—"Some Rare Fungi at St. Andrew's, N.B.," by Miss Van Horne. "Mountain Building," by Dr. J. Austen Bancroft.

Monday, March 25th, 1912.—"A Peep at One of Nature's Laboratories," by Albert G. Nicholls, M.D.

Monday, April 27th, 1912.—"The Algal Flora of the Island of Montreal," by Miss Clare G. Nicholls, M.A.

The Somerville Course of Free Lectures, delivered in the Lecture Hall of the Young Men's Christian Association, was as follows:

Thursday, Feb. 8th, 1912.—"Anchor Ice and Its Influence on the Development of Water Power," by Prof. H. T. Barnes, D.Sc., F.R.S.C.

Thursday, Feb. 15th, 1912.—"Some Facts and Myths About Animals in the East," by Prof. Arthur Willey, D.Sc., F.R.S.

Thursday, Feb. 22nd, 1912.—"The St. Lawrence and the Great Lakes," by John Kennedy, Esq.

Thursday, Feb. 29th, 1912.—"The Natural History of the Slum," by Harry Gragg, M.J.I.

Thursday, March 7th, 1912.—"Some Phases of Economic Botany," by S. Kirsch, Ph.D.

Thursday, March 14th, 1912.—"Certain Diseases of Plants," by Miss Carrie M. Derick, M.A.

The following Half-Hour Talks to Children were given in the hall of the Y. M. C. A.:

Saturday, Feb. 3rd, 1912.—"Flowers and Their Insect Visitors," by Miss Carrie M. Derick, M.A.

Saturday, Feb. 10th, 1912.—"Volcanoes of New Zealand," by J. G. Ross, B.Sc.

Saturday, Feb. 17th, 1912.—"Creatures of Other Days," Prof. J. Austen Bancroft, M.A., Ph.D.

Saturday, Feb. 24th, 1912.—"A Piece of Paper," by S. Kirsch, Ph.D.

Saturday, March 2nd, 1912.—"Some of Our Lilliputian Friends and Foes," by Dr. A. G. Nicholls.

Saturday, March 9th, 1912.—"The Birds of Montreal," by I. Gammell, B.A.

Saturday, March 16th, 1912.—"Our Trees in Winter," by Rev. Robert Campbell, M.A., D.D.

The Society would especially thank McGill University and its professors for valuable assistance given in connection with the courses.

The Annual Field Day was held at Phillipsburg, on the shores of Missisquoi Bay. Its success was in a great part due to Mr. Henry Timmis, who kindly gave the Society the freedom of the quarries and works of the Missisquoi Marble Co. The judges of the botanical and geological specimens were Miss Van Horne and Dr. Milton Hersey.

The press of Montreal has continued generously to give notices and reports of meetings.

The Society records with deep regret the death of three highly valued members, Dr. J. C. Cameron, Wm. Cauldwell and H. Markland Molson.

Eighteen new members were elected during the session.

The officers for 1911-12 are:

Patron—His Royal Highness the Duke of Connaught, K.C., Governor-General of Canada.

Hon. President—The Right Honourable Lord Strathcona and Mount Royal., G.C.M.S., LL.D.

President—Milton L. Hersey, M.Sc., LL.D.

Vice-Presidents—Frank D. Adams, Ph.D., *F.R.C.S.,* Dr. Howard T. Barnes, F.R.S.C., J. S. Buchan, K.C., B.C.L., Rev. Robert Campbell, M.A., D.D., Miss Carrie M. Derick, M.A., J. C. Holden, F.R.G.S., Robert Job, Major G. W. Stephens, Miss Van Horne.

Secretary—Alfred Griffin.

Hon. Corresponding Secretary—Fred. W. Richards.

Hon. Treasurer—Jas. W. Pyke.

Hon. Curator—Prof. Nevil Norton Evans, M.Sc.

Members of Council—John Harper, Chairman; J. A. U. Beaudry, C. E. Bardorf, Chas. S. M. Brown, T. L. Crossley, S. W. Ewing, Joseph Fortier, H. Lampard, C. S. J. Phillips.

*Superin*tendent—Alfred Griffn.

REPORT OF THE NATURAL HISTORY SOCIETY OF MONTREAL.

Presented by Dr. A. G. Nicholls, Delegate.

The Natural History Society of Montreal leg to submit this their Annual Report of the year ending May 31st, 1913, being the 86th Annual Report of this Society.

We are pleased to be able to state, notwithstanding some disadvantages, the past year has been one of substantial progress. The various courses of lectures as stated below, including the Somerville Course and the Saturday Afternoon Talks to Children, have been continued and the attendance showed improvement over the previous year. So great indeed was the interest shown that in each of the above courses seven lectures were given instead of six as in former years.

The papers presented at the Monthly Meetings were of an original character, and of an unusual order of excellence, many of the subjects treating of matters of great economic importance to Canada.

The following is the list:

Monday, Nov. 4th, 1912.—"A Biography of the Beaver," Dr. Arthur Willey.

Monday, Nov. 25th, 1912.—"The Fungi of the Past Season," Rev. Robert Campbell, M.A., D.D.

Monday, Jan. 27th, 1913.—"The Geology of the Island of Montreal," Prof. John Stansfield.

Monday, Feb. 24th, 1913.—"Forest Products," Simon Kirsch, M.A., D.Sc.

Monday, March 31st, 1913.—"Oyster Development, and Oyster Culture in Canada," Dr. Joseph Stafford. "The Fig Moth," H. Lampard, Esq.

Monday, April 28th, 1913.—"Mount Royal, an Active Volcano," J. S. Buchan, K.C., B.C.L.

The Somerville Course of Lectures were as usual well attended, the subjects being particularly interesting. Four of these lectures were given in the Y. M. C. A. Hall, and three in McGill University. We take this opportunity of tendering to the Governors of McGill the deep gratitude of the Society for the use of the lecture halls, and to its professors for valuable lectures and assistance so cheerfully given at all times.

The following is the list:

Friday, Feb. 7th, 1913.—"The Canadian Fisheries," Prof. E. E. Prince, LL.D., F.R.S.C.

Thursday, Feb. 13th, 1913.—"Icebergs," Prof. H. T. Barnes, D.Sc., F.R.S.C.

Thursday, Feb. 20th, 1913.—"The Ottawa Valley, the French River Waterway, (Georgian Bay Canal)," W. J. Poupore, Esq., Ex-M.P.

Thursday, Feb. 27th, 1913.—"Radium," Prof. A. E. Eve, D.Sc.

Thursday, March 6th, 1913.—"Rubber and Rubber Plants," Prof. F. E. Lloyd, M.A.

Thursday, March 13th, 1913.—"Biology and Social Reform," Prof. Carrie M. Derick, M.A.

Thursday, March 20th, 1913.—"The Place of Nitrogen in Nature," Dr. A. F. Ruttan, B.A., F.R.S.C.

The Half-Hour Talks to Children were approciated better than ever, judging by the attendance and the rapt attention with which these lectures were received. The subjects were well chosen, as the following list will show, and the attendance was a very encouraging feature.

Saturday, Feb. 15th, 1913.—"Icebergs," Prof. H. T. Barnes, D.Sc., F.R.S.C.

Saturday, Feb. 22nd, 1913.—"The Birds of Canada," Dr. W. G. M. Byers.

Saturday, March 1st, 1913.—"A Lead Pencil," Chas. S. J. Phillips, Esq.

Saturday, March 8th, 1913.—"Glaciers," Prof. J. Austen Bancroft.

Saturday, March 15th, 1913.—"Glass," Prof. Nevil Norton Evans.

Saturday, March 22nd, 1913.—"Moulds, Some Humble Forms of Plant Life," Dr. A. G. Nicholls, D.Sc., F.R.S.C.

Saturday, March 29th, 1913.—"Indian Corn," Prof. Carrie M. Derick, M.A.

The Annual Field Day was held at Belœil Mountain (St. Hilaire) on the 22nd of June and was a most successful function.

The Society hopes shortly to proceed with the erection of a new building especially adapted to its purposes, through which even greater success may be expected in its work.

It would not be fair to close this report without paying a well deserved tribute to our Secretary, Mr. Alfred Griffin, for his energy and loyalty in all matters concerning the Society. He has completed twenty-five years of service, and the fact that the Society is existing to-day is in no small measure due to his efforts.

OBITUARY NOTICES.

During the last two years, the Natural History Society of Montreal has sustained very heavy losses in its membership, as is indicated in the following obituary notices:

SIR WILLIAM C. VAN HORNE, K.C.M.G.

The Natural History Society of Montreal, meeting this evening for the first time since the lamented death of Sir William Van Horne, on the 11th of September, 1915, takes the opportunity of recording its deep sense of loss in his removal, the esteem in which he was held by the members of the Society, and its appreciation of his kindness in recently agreeing to accept the position of its Honorary President.

The Society was glad to recognize that Sir William added to his many accomplishments that of being an ardent and enthusiastic lover and student of nature. In the midst of an unusually busy life, and while occupied with vast projects, he found time to cultivate a taste for art and science. A keen observer of men and things, the glories and wonders of creation, as displayed in the lofty mountains and rapidly flowing rivers, with which his calling made him familiar, greatly moved him. At the same time, he had an eye for the smallest objects, the perfection of whose curious structure engaged his attention. He had a keen perception of what was symmetrical and beautiful in nature and art; and found his chief pleasure and recreation in placing on canvas the impressions which his sensitive and susceptible mind had received in his large and varied converse with the works of God.

Sir William in later years gave special attention to the Fungi of the Dominion, in the knowledge of which he became expert. For many years, while occupying the practical oversight of the Canadian Pacific Railway, he laid the Society under obligations by generously providing for the comfort and pleasure of the guests of the Society in its annual scientific excursions; and in recently electing him to the highest distinction in its gift, that of Honorary President, it sought to make acknowledgment of the valued favours and services which he had rendered to it in the past, while hoping that he might yet be spared for many years to reflect honour upon it and promote its usefulness. It has seemed good to the Lord of Life that it should be otherwise, and the Society bows to the Divine will.

But while making mention of its own sorrow and sense of loss in Sir William's decease, the Society would express its special and profound sympathy with Lady Van Horne, and Miss Van Horne and the other members of his family, in the great sorrow with which they have been visited, praying God to abundantly sustain them in their grief.

The Secretary is instructed to communicate to Lady Van Horne a copy of the foregoing resolution.

Yours very sincerely,

Hon. Corresponding Secretary.

LIEUTENANT-COL. JEFFREY BURLAND.

The Natural History Society of Montreal is called upon to mourn the sudden death of one of its most prominent members, the late Lieutenant-Colonel Jeffrey Hale Burland, which took place on October 9th, 1914. This Society was one of the numerous activities, commercial, benevolent, social and scientific, to which Lieutenant-Colonel Burland's public spirit and versatile talents were directed. He was specially interested in the question of the proper housing of the Society, with its library and museum. Being an honour man in

Natural Science of McGill University, he was also interested in the scientific work of this Society, and encouraged those who were prosecuting original research in the domain of nature. The Society records its profound sympathy with Mrs. Burland and the other members of his family in the acute bereavement which has befallen them; but feels satisfaction, as they doubtless also do, in the fact that at the time of his decease he was busily engaged in the benevolent and patriotic task of providing for the care of sufferers in the dreadful conflict in which the British Empire is struggling.

He was son of the late George Burland, and was born in Montreal, March 19th, 1861. After his father's death he became President and Manager of the British-American Note Company. He was President of the Montreal Board of Trade in 1911, a Life Governor of the Montreal General Hospital, also of the Hospital for the Insane and the Western Hospital. He founded the Royal Edward Tuberculosis Institute. He commanded the 6th Fusiliers in 1892; and, in 1897, took part in the late Queen Victoria's Jubilee. He had undertaken the charge of Red Cross arrangements and died suddenly at his post in England.

MR. JOHN HARPER.

The Natural History Society of Montreal would place on record its sense of the heavy loss it has sustained in the death, on August 2nd, 1914, of Mr. John Harper, one of its oldest and most honoured members, who occupied for several years the responsible position of Chairman of the Council of the Society, the duties of which he discharged with singular fidelity and zeal. Mr. Harper was specially interested in Botany, his work as a scientific drug manufacturer involving necessarily a large acquaintance with plant products. Mr. Harper was born at Hurstbourne, Hampshire, England, October

18th, 1837, and he was therefore in his 77th year when he died. He came to Canada in 1857, and for 57 years he was in the employment of Carter, Kerry & Co., drug manufacturers. Mr. Harper for many years held the position of Treasurer of the Mechanics' Institute of Montreal, as well as of the evening technical schools of the city, so that he is gratefully remembered as a most useful citizen.

PROFESSOR JOSEPH BEMROSE.

The Natural History Society of Montreal has suffered a great loss in the death of Professor Joseph Bemrose, which occurred on May 25th, 1914. An Englishman by birth, he had long resided in this city, being consulting and scientific chemist in the extensive drug firm of the Lymans. When the former Medical Faculty of Lennoxville University required the services of a Professor of Chemistry, the position was tendered to Mr. Bemrose, and he filled it with eminent ability and to the satisfaction of all concerned. After the Lennoxville Medical Faculty was merged in that of McGill, Professor Bemrose accepted engagements as Consulting Chemist to any that needed his services.

Prof. Bemrose long occupied a seat on the Council of the Natural History Society, and was a most useful member of it. He was specially interested in the botanical side of the Society's work, being directed to it by the knowledge of officinal plants which he obtained in his chemical studies. He brought to bear upon the counsels of the Society wide scientific knowledge, both theoretical and practical, and until the end of his life, notwithstanding failing health, continued to attend the meetings of the Society. The members recall with pleasure the qualities of mind and heart which he displayed in his intercourse with them, and express deep sympathy with his relatives in their affliction.

DR. C. E. BARLOW.

The Natural History of Montreal records the profound sorrow which it felt when the startling news reached the city of the fact that Dr. C. E. Barlow, one of its most distinguished members, along with his wife, perished by the sinking of the Empress of Ireland, on the 29th day of May, 1914. Dr. Barlow was a native of Montreal, where he was born 17th June, 1861, and early entered the service of the Geological Survey of Canada. He was specially expert as a mineralogist, and the numerous reports which he drew up of the geological resources of the Dominion are of outstanding value. Dr. Barlow contributed many scientific papers of importance to the transactions of the Natural History Society. He was one of the Society's Somerville lecturers, and was always ready to further its interests by speech and pen when called upon to help in the prosecution of its work. Not this Society alone but also the entire community in which he was known mourn the tragedy by which a life of such great promise as his was prematurely cut off. The Society begs to tender its warmest sympathy to the members of his family on the sad calamity.

His father, Robert Barlow, under whom he received his early training, had been engaged in the offices of the Ordnance Survey, London. Coming under the influence of Principal Dawson and Dr. Harrington while at college, Charles took up the subject of Natural Science and especially Geology, in which he graduated with honours. The Temiskaming region was the chief scene of his explorations and he became the recognized authority on nickel, copper, silver, cobalt, iron, gold and other ore deposits in the territory north of the great lakes.

MR. HENRY HERBERT LYMAN, B.A.

In common with the citizens of Montreal in general, the members of the Natural History Society were shocked to learn that one of its most learned members, Mr. Henry Herbert Lyman and his wife, were among the passengers who lost their lives by the sinking of the ill-fated steamship, "Empress of Ireland," on the 29th day of May, 1914. Equally prominent as a merchant and a man of science, his loss is deeply felt. Being one of the most skilled Entomologists of the Dominion, Mr. Lyman was a frequent contributor to the transactions of the Natural History Society, and was also one of its Somerville lecturers. Only a couple of days before his lamented death he had presented to the Royal Society of Canada the annual report, which the Entomological Society is wont to make to the Royal Society, this being his last public act. The Natural History Society is specially gratified to learn that he has left a legacy of $10,000, conditionally, to the Society, thus showing the depth of his interest in its operations. The Society expresses its deep sympathy with his relatives in the acute sorrow which has overtaken them.

He was son of the late Henry Lyman of Montreal and was born here on 21st December, 1854. He was educated at the High School and McGill University, receiving the Logan Medal when he graduated B.A., in 1876. He took his Master's degree in 1880. He was trained in the office of Lymans, Clare & Company, of which his father was the senior partner, and, in 1885, became a member of the firm. He was President of the Entomological Society of Ontario, F.R.G.S., Senior Major of the Royal Scots, a strong imperialist and one of the originators of the Imperial Federation League.

MR. GUY DRUMMOND.

The Natural History Society of Montreal has again to mourn the loss of a valuable member, in the person of

Mr. Guy Drummond, who died gloriously, fighting for the rights of humanity, and the liberties of the Empire, on the field of Langemarck. Although still but a young man he had already made his influence deeply felt in all circles in his native city. Having entered upon what promised to be a brilliant commercial career, having barely tasted of the joys of his own home, and having in possession and prospect everything calculated to make life dear to him, he yet, on the call of duty, patriotically risked the sacrifice of all, and when he came to face the enemy died heroically, making, with others who shared his fate, the name of Canada famous. Mr. Drummond took an intelligent interest in the work of this Society, and his cordial support of it for many years to come was confidently counted on. The Society extends its profoundest sympathy to his bereaved widow and to Lady Drummond and her family.

MR. THOMAS CRAIG.

On March 29th, 1915, at a meeting of the Natural History Society, held in the Physics Building of McGill University, on motion of Mr. J. S. Buchan, K.C., seconded by Mr. W. Drysdale, a cordial vote of thanks was recorded to Mr. Leslie Craig, who has donated to the Society his late father's scientific library, consisting of 225 volumes and a very large, classified collection of cuttings on numerous subjects in several hundred large envelopes with an index.

The Society takes this opportunity, when thanking Mr. Leslie Craig for this valuable donation, which will be carefully preserved in the Museum of the Society, of recording its sincere sorrow at the death of his father, Mr. Thomas Craig, which occurred on June 20th, 1915. A resolution to that effect was passed by the Society at its opening meeting on October, 1915, but was omitted to be placed in the Society's Minutes.

Mr. Craig, senior, was for many years a valued member of the Natural History Society, having been elected in January, 1902. He took an active and interested part in the Society's proceedings, always ready out of his large range of knowledge of scientific subjects, to contribute to the discussions of the Society. He was especially helpful to the Microscopical Section of the Natural History Society, of which he was for several years President. He had the honour of being elected a Fellow of the Royal Microscopical Society in 1889. He was also a member of the American Miscroscopical Society, and his name was held in high regard also in other microscopical societies. He was a deep and earnest student of nature; of a genial temperament and generous disposition, he was never too busy to help the struggling enquirer materially as well as in sharing with him his extensive knowledge.

The Society records its deep sympathy with his son, Mr. Leslie G. Craig, on the death of his honoured and much-mourned father.

MR. JONATHAN HODGSON.

Dear Mrs. Hodgson,—

I am directed by the Natural History Society of Montreal to communicate to you the following resolution passed by the Society at its last meeting:

The Natural History Society of Montreal places on record the deep sense of loss which it has sustained in the decease of Mr. Jonathan Hodgson, one of its life members. He was one of the oldest members of the Society, and was interested in it as he was in all institutions which had for their aim the enlightenment and betterment of the community. The Society sympathizes with his mourning family in their great sorrow and commends them to the compassions of the God of all consolation. It is ordered that a copy of this resolution be sent to his family. On behalf of the Society,

ROBERT CAMPBELL, Vice-President, presiding.

BOOK NOTICES.

'The Canadian Oyster; Its Development, Environment and Culture,'' by Jos. Stafford, M.A., Ph.D., Ottawa. The Mortimer Co., Ltd., 1913.

This volume is included in the report of the Committee on Fisheries, Game and Furbearing Animals, a department of the Commission of Conservation of Canada, to the Government of the Dominion. It deals with a subject of great popular interest. There are many among us who appreciate the succulent bivalve and we are anxious that its continued production shall be secured.

The Natural History Society has been kept tolerably well informed on the subject. Some years ago Professor MacBride read an interesting paper before it, the result of his observations at the Biological Station at Malpeque. Dr. Stafford has from time to time made communications to the Society of his studies on the subject, and last year Dr. Willey gave an interesting paper on the Pacific Coast Oyster, *Ostrea lurida.* Dr. Stafford, in this treatise, gives the results of his observations on the Canadian Oyster, *Ostrea Virginiana,* up to the date of the submission of the report, and we are indebted to him for a considerable advance in the knowledge we have hitherto had of the subject.

He introduces the discussion of the matter in these terms: ''A knowledge of the normal development of a young oyster from the egg is of fundamental importance in formulating any national scheme of artificial propagation, as well as in framing suitable laws for the protection and encouragement of the oyster industry as a source of wealth to the country.'' He then goes on to deplore that though this shellfish was well-known to the ancient Greeks and Romans, and was greatly esteemed by them and *bon vivants* all along the ages, ''yet we have not a single, concise, direct, intelligible, true and satisfactory account of *where, when* and *how* an egg becomes an oyster." Dr. Stafford now, in some measure, supplies the desiderata. Part I. of his book is devoted to a consideration of these points. The details given throw much light on the anatomy of the oyster, and the gradual development of its organic parts. In the plankton stage, it is not easy to distinguish it from other embryo bivalves; but careful and continued observation had enabled him at length to detect the difference between the oyster larva and the oyster spat, an important advance in the knowledge of the subject. The former are developed in the month of July and the latter in the month of August. His observations were made at the Biological Stations on the coasts of New Brunswick and Prince Edward Island, in the years 1904 to 1909. He visited British Columbia with a view to studying conditions there in 1910.

Part II. is taken up with the discussion of the environment, culture and biological and physical phenomena of the oyster, and deals with such matters as tide, depth of water, fresh water, salinity, lime, temperature at the bottom, and the structure of the typical oyster bays, contrasted with the Bay of Fundy.

He devotes a chapter to the consideration of the practicability of transplanting the oyster virginana to Pacific waters. Several attempts in this direction did not meet with much success; but his search after specimens resulting from those attempts encourages him in the belief that, with proper care and previous examining of the grounds to which the eggs are committed, success may attend further future efforts.

The volume is very finely provided with illustrations, seven plates in all, with a map of Malpeque Bay. It concludes with a full bibliography of the subject.

R. C.

SUMMARY REPORT OF THE GEOLOGICAL SURVEY.

Department of Mines for the year 1915.

This volume contains brief reports on the work of all the divisions of the Geological Survey. The economic side is, of course, given prominence, that is, the Geological and Mineralogical Department, as it is in these the people are chiefly interested. Fuller reports are to follow. Although geological investigations and topographical mapping naturally occupied the first place in the work of the survey, attention was also given to other branches of science—Botany, Zoology, Anthropology, Archæology, and their various subdivisions. The relative importance attached to the different sections of natural science may be gathered from the fact that the Geographical Staff includes 33 members, besides 3 palæontologists, while only 3 botanists and 1 ornithologist were employed.

Of course, the newer western provinces receive most attention, notably Alberta and British Columbia and the Yukon Territory, because of the immense rock formations to be found in the vast mountain ranges of those provinces. But some work was done in all the provinces, our friend, Mr. J. A. Dresser, devoting his attention and time to the Lake St. John Basin, in the Province of Quebec.

Our octogenarian naturalist, Professor John Macoun, now permanently residing on Vancouver Island, where, owing to the mildness of the climate, he is able to prosecute field work throughout the year, reports 826 species of flowering plants from the island, and more than a thousand species of mosses, seaweeds and fungi. Mr. Harold St. John, temporary botanist, spent the season collecting in the County of Saguenay, and reports finding 50 species, which he is studying under the direction of Prof. M. L. Fernald, of Harvard University. The result of the naming and describing of this collection will be looked forward to with interest by botanists.

Although only one ornithologist was employed, a goodly number of birds was reported, Mr. Taverner having volunteer workers corresponding and co-operating with him, and sending him specimens, Perhaps the most valuable of the list of birds is that collected by Capt. Joseph Bernard, on the Arctic Coast, N.W.T. They number 33 in all.

CANADA DEPARTMENT OF MINES, GEOLOGICAL SURVEY, MUSEUM BULLETIN No. 12, ON EOCERATOPS CANADENSIS, WITH REMARKS ON OTHER GENERAL GENERA OF CRETACEOUS HORNED DINOSAURS.

By Lawrence M. Lambe.

This Bulletin embraces, in detail, the report of the veteran Vertebrate Palæontobogist, Mr. Lambe, of which an outline is given in the volume of the Geological Survey Report noticed above.

The following is a brief description of the ancient inhabitant of the Red Deer region of Alberta: "*Eoceratops* appears to have had a short skull, compact and deep in front, and tapering behind. The lower jaw is robust, the nasal bones are remarkably deep and the supraorbital horncores are large in comparison with the inconspicuous nasal horncore. This compactness of the anterior half of the skull with great depth is also found in *Brachyceratops,* a form in which the nasal horn was the principal weapon of defence. In comparison with *Eoceratops,* the later *Triceratops* has lengthened the face and added greatly to the size of the supraorbital horncore to the neglect of the nasal horn. In *Diceratops,* with the enlargement of the browhorns, there is the concomitant non-development of the nasal one." The Bulletin is illustrated with eleven plates, which enable the reader the more clearly to grasp the contents of the valuable report.

Meteorol...rintendent.

DAYS.	Mean.		inches.	Rain and snow melted.	DAYS.
1	68.9		..	T	1
SUNDAY........2	68.7		..	.20	2.....SUNDAY
3	60.9		..	.08	3
4	64.2		..	...	4
5	69.8		..	...	5
6	73.9		..	...	6
7	75.5		..	T	7
8	68.3		..	...	8
SUNDAY........9	69.4		..	...	9.....SUNDAY
10	74.9		..	.07	10
11	70.8		..	.22	11
12	62.4		..	...	12
13	64.7		..	...	13
14	65.3		..	1.09	14
15	65.8		..	T	15
SUNDAY.......16	65.5		..	.01	16.....SUNDAY
17	68.6		..	...	17
18	68.5		..	.25	18
19	69.6		..	...	19
20	67.6		..	T	20
21	64.1		..	.28	21
22	64.9		..	.11	22
SUNDAY.......23	66.9		..	...	23......SUNDAY
24	60.4		..	...	24
25	56.2		..	...	25
26	54.9		..	...	26
27	59.3		..	...	27
28	62.7		..	...	28
29	57.9		..	1.08	29
SUNDAY....... 30	62.8		..	1.42	30......SUNDAY
31	67.0		..	T	31
Means......	65.830		..	4.81	......Sums
40 Years means for and including this month.	66.46		..	3.48	40 Years means for and including this month.

AN...

Direction	N	N
Miles.............	62	1
Duration in hours...	9	1
Mean Velocity......	6.9	

The greatest mileage in one hou...
Total mileage, 6925
Resultant direction, N 78° 50′W...

...adings reduced to sea-level and ...ahrenheit

...hourly readings taken from self-...ents.

...ative, saturation being 100. Mean ... every four hours from self-record-

...ans.

...ans.

ABSTRACT FOR THE MONTH OF AUGUST, 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER				*BAROMETER				‡ Mean relative humidity.	WIND		Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour					
1	68.9	75.9	63.3	12.6	29.89	29.96	29.83	.13	60	NW	11.0	26	T	...	T	1
SUNDAY........2	68.7	82.0	60.3	21.7	29.83	29.88	29.74	.14	68	W	10.0	53	.20	...	.20	2.....SUNDAY
3	60.9	68.2	54.0	14.2	29.99	30.11	29.88	.23	51	NE	9.0	80	.08	...	.08	3
4	64.2	74.5	52.3	22.2	30.13	30.17	30.09	.08	51	NE	5.4	94	...	...	...	4
5	69.8	82.0	57.7	24.3	30.10	30.16	30.03	.13	60	SE	6.4	92	...	...	...	5
6	73.9	85.4	62.0	23.4	30.00	30.07	29.93	.14	58	SW	10.4	78	...	...	...	6
7	75.5	86.7	66.5	20.2	29.95	30.01	29.89	.12	61	SW	9.2	44	T	...	T	7
8	68.3	73.8	64.2	9.6	30.05	30.09	29.98	.11	55	NE	9.5	0	...	...	...	8
SUNDAY........9	69.4	81.6	55.6	26.0	30.05	30.10	29.98	.12	54	S	4.3	73	...	...	...	9.....SUNDAY
10	74.9	91.0	62.9	28.1	29.92	29.98	29.85	.13	74	SW	10 2	28	.07	...	.07	10
11	70.8	77.4	62.8	14.6	29.91	30.09	29.83	.26	74	SW	12.9	22	.22	...	.22	11
12	62.4	70.2	53.0	17.2	30.14	30.20	30.08	.12	51	NE	9.6	93	...	...	...	12
13	64.7	74.2	54.3	19.9	30.04	30.11	29.92	.19	53	NE	6.5	78	...	...	...	13
14	65.3	78.0	58.4	19.6	29.79	29.87	29.72	.15	73	SW	11.6	31	1.09	...	1.09	14
15	65.8	76.2	58.5	17.7	29.83	29.90	29.78	.12	64	NW	12.0	67	T	...	T	15
SUNDAY.......16	65.5	73.2	56.3	16.9	29.98	30.02	29.91	.11	63	NW	11.5	75	.01	...	.01	16.....SUNDAY
17	68.6	77.0	61.3	15.7	29.95	30.00	29.91	.09	66	W	7.2	61	...	...	...	17
18	68.5	75.3	62.9	12.4	29.86	29.91	29.83	.08	79	SW	11.9	23	.25	...	.25	18
19	69.6	78.4	63.5	14.9	30.02	30.11	29.92	.19	58	NE	7.3	57	...	...	...	19
20	67.6	77.3	59.0	18.3	30.08	30.16	29.99	.17	57	SE	6.1	46	T	...	T	20
21	64.1	68.9	59.9	9.0	29.84	29.93	29.76	.17	81	NW	8.3	0	.28	...	.28	21
22	64.9	73.0	57.3	15.7	29.97	30.01	29.89	.12	58	NW	10.6	86	.11	...	.11	22
SUNDAY.......23	66.9	76.6	55.9	20.7	29.78	30.01	29.56	.45	69	SW	11.6	23	...	...	...	23......SUNDAY
24	60.4	64.3	55.0	9.3	29.86	30.06	29.61	.45	55	NW	13.0	73	...	...	...	24
25	56.2	63.7	49.0	14.7	30.17	30.26	30.08	.18	50	NW	12.1	98	...	...	...	25
26	54.9	62.6	47.5	15.1	30.27	30.31	30.21	.10	59	NE	5.2	56	...	...	...	26
27	59.3	67.6	50.0	17.6	30.19	30.28	30.10	.18	56	SE	5.5	69	...	...	...	27
28	62.7	72.8	52.3	20.5	30.08	30.11	30.05	.06	54	NE	9.1	87	...	...	...	28
29	57.9	61.3	54.8	6.5	29.97	30.07	29.80	.27	81	SE	11.0	0	1.08	...	1.08	29
SUNDAY....... 30	62.8	70.0	56.6	13.4	29.82	29.88	19.71	.17	72	NW	9.7	36	1.42	...	1.42	30......SUNDAY
31	67.0	75.0	58.5	16.5	29.93	29.97	29.86	.11	69	W	10.2	74	T	...	T	31
Means......	65.830	74.65	57.60	17.05	29.980	30.058	29.894	.164	62.30		9.31	55.66	4.81	...	4.81	......Sums
40 Years means for and including this month.	66.46	74.67	58.03	16.01	29.948	.....	.....	.141	72.26		11.59§	57.73¶	3.48	...	3.48	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction..........	N	N E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles.............	62	1427	194	655	360	1648	844	1735	
Duration in hours...	9	157	33	88	52	152	58	165	
Mean Velocity......	6.9	9.1	5.9	7.4	6.9	10.8	14.5	10.5	

The greatest mileage in one hour was 18 on the 11th and 23rd.
Total mileage, 6025
Resultant direction, N 78° 50′W. Resultant mileage, 1600.

The greatest heat was 91.0° above zero on the 10th. The greatest cold was 47.5° above zero on the 26th, giving a range of 43.5°.

The warmest day was the 7th. The coldest day was the 26th.

The highest barometer reading was 30.31 on the 26th. The lowest barometer reading was 29.56 on the 23rd, giving a range of .75 inches.

The minimum relative humidity observed was 25 on the 9th.

Thunderstorms on 6 days.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

§ 26 years means.

¶ 33 years means.

Meteoro rintendent.

DAYS.	† Mean.	inches.	Rain and snow melted.	DAYS.
1	68.5	..	.18	1
2	73.9	..	.76	2
3	66.2	..	...	3
4	61.9	..	.10	4
5	60.4	..	...	5
SUNDAY........6	58.4	..	.36	6.....SUNDAY
7	58.1	..	.24	7
8	51.8	..	.12	8
9	51.5	..	...	9
10	52.5	..	T	10
11	53.9	..	...	11
12	55.8	..	...	12
SUNDAY.......13	57.2	..	...	13.....SUNDAY
14	59.6	..	...	14
15	61.7	..	...	15
16	62.1	..	...	16
17	66.0	..	...	17
18	67.0	..	...	18
19	59.4	..	...	19
SUNDAY.......20	64.7	..	...	20......SUNDAY
21	71.4	..	...	21
22	75.6	..	...	22
23	68.6	..	.01	23
24	57.0	..	.26	24
25	52.7	..	.15	25
26	48.0	..	.01	26
SUNDAY.......27	46.0	..	.35	27......SUNDAY
28	42.5	..	...	28
29	42.5	..	.02	29
30	47.8	..	T	30
Means......	58.759	..	2.56	......Sums
40 Years means for and including this month.	58.46	.	3.46	40 Years means for and including this month.

AN

Direction	N	N
Miles..............	232	
Duration in hours...	33	
Mean Velocity......	7.0	

Total mileage, 6538.
Resultant direction, N 76° 9′W
Resultant mileage, 3365.

dings reduced to sea-level and
renheit

urly readings taken from self-
ts.

ive, saturation being 100. Mean
very four hours from self-record-

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ABSTRACT FOR THE MONTH OF SEPTEMBER 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER † Mean.	THERMOMETER Max.	THERMOMETER Min.	THERMOMETER Range.	*BAROMETER † Mean.	*BAROMETER Max.	*BAROMETER Min.	*BAROMETER Range.	‡ Mean relative humidity.	WIND General direction.	WIND Mean velocity in miles per hour	Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
1	68.5	78.2	58.3	19.9	29.92	29.98	29.83	.15	76	SW	8.8	29	.18	...	.18	1
2	73.9	82.9	68.2	14.7	29.79	29.84	29.73	.11	75	W	11.5	47	.76	...	.76	2
3	66.2	73.9	58.0	15.9	29.88	29.98	29.81	.17	58	W	11.4	94	...	...	...	3
4	61.9	69.2	55.2	14.0	29.84	29.96	29.79	.17	61	W	11.6	68	.10	...	.10	4
5	60.4	69.4	52.0	17.4	30.02	30.07	29.97	.10	60	W	10.5	99	...	...	...	5
SUNDAY........6	58.4	62.0	55.6	6.4	29.83	29.98	29.66	.32	79	S	10.5	0	.36	...	.36	6.....SUNDAY
7	58.1	66.0	50.0	16.0	29.73	29.89	29.65	.24	79	NW	9.7	16	.24	...	.24	7
8	51.8	59.3	47.9	11.4	30.04	30.16	29.90	.26	67	NW	11.5	39	.12	...	.12	8
9	51.5	57.2	46.2	11.0	30.23	30.26	30.17	.09	62	NW	9.6	41	...	...	...	9
10	52.5	58.2	47.0	11.2	30.24	30.28	30.19	.09	59	NE	7.0	34	T	...	T	10
11	53.9	62.3	46.4	15.9	30.21	30.24	30.18	.06	62	NE	5.5	79	...	...	...	11
12	55.8	67.2	44.5	22.7	30.30	30.39	30.23	.16	56	W	4.5	93	...	...	...	12
SUNDAY.......13	57.2	69.4	46.6	22.8	30.46	30.51	30.40	.11	60	S	3.6	92	...	...	...	13.....SUNDAY
14	59.6	69.9	48.4	21.5	30.46	30.53	30.38	.15	65	S	5.0	81	...	...	...	14
15	61.7	72.7	49.3	23.4	30.35	30.40	30.32	.08	64	W	6.8	84	...	...	...	15
16	62.1	73.6	50.4	23.2	30.39	30.44	30.34	.10	65	W	5.3	92	...	...	...	16
17	66.0	77.3	51.2	26.1	30.30	30.38	30.21	.17	59	W	8.0	91	...	...	...	17
18	67.0	73.8	60.0	13.8	30.20	30.25	30.16	.09	53	NE	9.5	79	...	...	...	18
19	59.4	69.3	50.9	18.4	30.16	30.23	30.10	.13	55	NE	7.6	97	...	...	...	19
SUNDAY.......20	64.7	74.3	51.5	22.8	29.99	30.10	29.86	.24	65	SW	13.2	57	...	...	...	20......SUNDAY
21	71.4	79.1	63.8	15.3	29.98	30.03	29.94	.09	64	W	13.5	87	...	...	...	21
22	75.6	84.2	68.5	15.7	29.88	29.97	29.78	.19	61	W	13.9	92	...	...	...	22
23	68.6	78.2	60.0	18.2	29.82	29.88	29.79	.09	75	NW	12.1	40	.01	...	.01	23
24	57.0	60.1	52.8	7.3	29.86	29.89	29.83	.06	81	W	6.5	0	.26	...	.26	24
25	52.7	57.2	46.1	11.1	29.96	30.11	29.84	.27	72	NW	10.5	38	.15	...	.15	25
26	48.0	54.2	41.0	13.2	30.11	30.16	30.03	.13	52	NW	11.3	95	.01	...	.01	26
SUNDAY.......27	46.0	52 6	42.0	10.6	30.12	30.27	29.95	.32	73	N	8.7	35	.35	...	.35	27......SUNDAY
28	42.5	47.1	36.5	10.6	30.38	30.43	30.28	.15	54	NE	9.1	53	...	...	...	28
29	42.5	51.4	32.1	19.3	30.24	30.43	29.96	.47	62	S	6.8	70	.02	...	.02	29
30	47.8	52.0	44.0	8.0	29.98	30.14	29.87	.27	79	N	8.0	0	T	...	T	30
Means......	58.759	66.74	50.81	15.93	30.090	30.173	30.005	.108	65.11		9.08	67.35	2.56	...	2.56	......Sums
40 Years means for and including this month.	58.46	66.24	50.86	15.38	30.021	.....	.....	.192	......		12.11§	53.12¶	3.46	...	3.46	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles..............	232	770	95	112	476	1068	1890	1895	0
Duration in hours...	33	94	17	18	61	108	190	182	17
Mean Velocity......	7.0	8.2	5.6	6.2	7.8	9.9	9.9	10.4	0

Total mileage, 6538.
Resultant direction, N 76° 9′W.
Resultant mileage, 3365.

The greatest heat was 84 2° above zero on the 22nd. The greatest cold was 32.1° above zero on the 29th, giving a range of 52.1°.

The warmest day was the 22nd. The coldest day was the 29th. (28th had the same mean temperature.)

The highest barometer reading was 30.53 on the 14th. The lowest barometer reading was 29.65 on the 7th. This gives a range of .88 of an inch.

The minimum relative humidity observed was 31 on the 26th.

Fog on 2 days.

Hail on 1 day.

Aurora on 1 day.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

§ 26 years means.

¶ 33 years means.

Meteoro *intendent.*

DAYS.	† Mean.		Inches.	Rain and snow melted.	DAYS.
1	51.7		.	...	1
2	55.6		.	...	2
3	60.1		.	...	3
SUNDAY........4	62.6		.	...	4.....SUNDAY
5	62.4		.	T	5
6	45.6		.	...	6
7	48.1		.	...	7
8	55.8		.	.20	8
9	54.8		.	.05	9
10	60.5		.	.29	10
SUNDAY.......11	64.2		.	0.7	11.....SUNDAY
12	47.9		.	...	12
13	37.2		.	...	13
14	42.2		.	...	14
15	48.6		.	.38	15
16	52.8		.	.05	16
17	54.2		.	.76	17
SUNDAY.......18	54.5		.	T	18......SUNDAY
19	46.8		.	.18	19
20	50.1		.	...	20
21	62.0		..	...	21
22	49.1		..	...	22
23	44.2		..	...	23
24	45.4		..	..	24
SUNDAY.......25	42.5		..	T	25......SUNDAY
26	39.7		2	.12	26
27	28.7		T	T	27
28	37.1		4	.10	28
29	40.8		.	.07	29
30	40.9		.	.12	30
31	39.7		.	...	31
Means......	49.159		.6	2.39	......Sums
40 Years means for and including this month.	46.38		4	3.13	40 Years means for and including this month

AI

Direction	N	N
Miles..............	501	1
Duration in hours...	54	
Mean Velocity......	9.3	1

Total mileage, 7606.
Resultant direction, N 78° W.
Resultant mileage, 2270.

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ABSTRACT FOR THE MONTH OF OCTOBER 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER				*BAROMETER				‡ Mean relative humidity.	WIND		Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour					
1	51.7	56.9	47.3	9.6	30.24	30.29	30.16	.13	64	W	9.6	63	...	...	...	1
2	55.6	62.4	46.5	15.9	30.28	30.35	30.22	.13	63	W	11.7	97	...	...	...	2
3	60.1	69.8	50.6	19.2	30.12	30.20	30.05	.15	54	W	12.0	95	...	...	...	3
SUNDAY........4	62.6	71.2	51.5	19.7	30.06	30.12	30.01	.11	53	SW	10.4	94	...	...	...	4.....SUNDAY
5	62.4	70.4	54.9	15.5	30.02	30.18	29.95	.23	61	W	12.7	89	T	...	T	5
6	45.6	54.9	38.7	16.2	30.35	30.41	30.25	.16	50	NE	10.4	91	...	...	...	6
7	48.1	57.2	35.9	21.3	30.16	30.30	30.00	.30	52	W	7.8	85	...	...	...	7
8	55.8	62.9	52.0	10.9	29.98	29.99	29.96	.03	81	W	8.3	0	.20	...	.20	8
9	54.8	57.6	52.9	4.7	29.99	30.03	29.97	.06	83	NE	7.4	0	.05	...	.05	9
10	60.5	66.2	52.9	13.3	29.90	29.98	29.83	.15	82	SW	11.0	1	.29	...	.29	10
SUNDAY.......11	64.2	71.2	57.0	14.2	29.75	29.82	29.68	.14	69	SW	13.4	54	.07	...	0.7	11.....SUNDAY
12	47.9	59.2	37.6	21.6	30.02	30.28	29.84	.44	60	NW	12.1	64	...	...	...	12
13	37.2	43.0	32.3	10.7	30.48	30.57	30.33	.24	58	E	6.3	92	...	...	...	13
14	42.2	51.1	33.9	17.2	30.51	30.60	30.38	.22	59	S	6.5	92	...	...	...	14
15	48.6	55.2	38.6	16.6	30.16	30.34	30.03	.31	73	SW	10.2	3	.38	...	.38	15
16	52.8	55.7	49.0	6.7	30.06	30.11	29.97	.14	71	NE	9.0	0	.05	...	.05	16
17	54.2	59.2	48.7	10.5	29.81	29.93	29.72	.21	82	S	8.4	0	.76	...	.76	17
SUNDAY.......18	54.5	59.2	49.8	9.4	29.89	29.96	29.79	.17	80	NE	10.3	8	T	...	T	18......SUNDAY
19	46.8	49.8	44.0	5.8	30.02	30.13	29.95	.18	76	NE	12.4	0	.18	...	.18	19
20	50.1	57.9	42.9	15.0	30.17	30.21	30.13	.08	74	SW	8.2	34	...	...	...	20
21	62.0	69.4	54.8	14.6	30.07	30.15	29.97	.18	56	SW	13.5	89	...	...	...	21
22	49.1	62.0	40.5	21.5	30.35	30.51	30.13	.38	45	NE	11.6	96	...	...	...	22
23	44.2	54.2	34.5	19.7	30.33	30.52	30.01	.51	51	SW	9.3	92	...	...	...	23
24	45.4	50.7	39.2	11.5	30.08	30.17	29.95	.22	53	NE	12.3	73	...	...	..	24
SUNDAY.......25	42.5	48.2	34.8	13.4	29.96	30.16	29.71	.45	54	SW	8.4	35	T	...	T	25......SUNDAY
26	39.7	48.5	32.0	16.5	29.67	29.85	29.55	.30	67	SW	12.5	0	.10	0.2	.12	26
27	28.7	32.0	24.8	7.2	29.90	29.94	29.85	.09	52	NW	12.1	41	...	T	T	27
28	37.1	47.2	24.4	22.8	29.77	29.84	29.71	.13	74	SW	12.6	20	.06	0.4	.10	28
29	40.8	42.8	36.8	6.0	29.90	29.96	29.84	.12	71	S	7.2	0	.07	...	.07	29
30	40.9	43.6	35.7	7.9	29.79	29.90	29.71	.19	76	NW	8.1	0	.12	...	.12	30
31	39.7	45.9	30.6	15.3	29.96	30.05	29.86	.19	55	NW	11.1	88	...	...	...	31
Means......	49.159	55.98	42.10	13.88	30.056	30.150	29.952	.205	64.55	NW	10.22	48.80	2.33	0.6	2.39	......Sums
40 Years means for and including this month.	40.38	53.23	39.58	13.72	30.014	.....	.....	.225	75.79		13.27§	41.72¶	3.05	0.84	3.13	40 Years means for and including this month

ANALYSIS OF WIND RECORD.

Direction	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles.............	501	1513	360	167	385	1981	1581	1118	0
Duration in hours...	54	148	49	20	55	175	143	96	4
Mean Velocity......	9.3	10.2	7.3	8.3	7.0	11.3	11.1	11.6	0

Total mileage, 7606.
Resultant direction, N 78° W.
Resultant mileage, 2270.

The greatest heat was 71.2° above zero on the 4th and 11th. The greatest cold was 24.4° above zero on the 28th, giving a range of 46.8°.

The warmest day was the 11th. The coldest day was the 28th.

The highest barometer reading was 30.60 on the 14th. The lowest barometer reading was 29.55 on the 26th. This gives a range of 1.05 inches.

The minimum relative humidity observed was 29 on the 7th.

Fog on 4 days.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording instrument.

§ 27 years means.

¶ 33 years means.

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DAYS.	Mean.		Rain and snow melted.	DAYS.
SUNDAY........1	54.6		T	1.....SUNDAY
2	45.9		.10	2
3	32.8		T	3
4	41.9		.16	4
5	42.4		.04	5
6	35.6		.01	6
7	35.7		.10	7
SUNDAY....... 8	38.8		...	8.....SUNDAY
9	29.8		T	9
10	23.5		T	10
11	24.4		.19	11
12	29.6		.40	12
13	26.5		.35	13
14	22.4		T	14
SUNDAY.......15	28.7		1.33	15.....SUNDAY
16	38.9		.35	16
17	25.5		.02	17
18	13.2		..	18
19	28.5		.18	19
20	26.8		.81	20
21	25.1		T	21
SUNDAY.......22	25.5		T	22..... SUNDAY
23	15.2		...	23
24	20.1		.02	24
25	37.7		.08	25
26	43.9		...	26
27	34.5		...	27
28	22.2		...	28
SUNDAY........29	29.3		...	29..... SUNDAY
30	40.7		T	30
Means......	31.33	3	4.14	......Sums
40 Years means for and including this month.	32.86	5	3.56	40 Years means for and including this month.

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Direction	N
Miles..............	363
Duration in hours...	47
Mean Velocity......	7.7

Total mileage, 10581
Resultant direction, N 89° 18
Resultant mileage, 5429.

[...]dings reduced to sea-level and [...]renheit

[...]urly readings taken from self-[...]ts.

[...]ive, saturation being 100. Mean [...]very four hours from self-record-

[...]s.

[...]s.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER † Mean.	Max.	Min.	Range.	*BAROMETER † Mean.	Max.	Min.	Range.	‡ Mean relative humidity.	WIND General direction.	Mean velocity in miles per hour	Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
SUNDAY.......1	54.6	62.3	44.1	18.2	29.73	29.84	29.59	.25	53	W	12.9	52	T	...	T	1.....SUNDAY
2	45.9	54.7	34.6	20.1	29.65	29.92	29.52	.40	65	NW	13.0	16	.10	...	.10	2
3	32.8	35.4	27.9	7.5	29.99	29.99	29.74	.25	62	W	8.0	23	T	T	T	3
4	41.9	57.2	33.9	23.3	29.57	29.73	29.38	.35	73	NW	10.0	11	.16	T	.16	4
5	42.4	47.1	38.2	8.9	29.64	29.76	29.58	.18	38	W	11.5	37	.04	...	.04	5
6	35.6	38.2	33.5	4.7	29.99	30.17	29.79	.38	35	N	5.9	0	.10	T	.01	6
7	35.7	41.4	30.7	10.7	30.04	30.23	29.69	.54	64	SW	9.6	0	.07	0.3	.10	7
SUNDAY.......8	38.8	44.3	32.7	11.6	29.81	29.93	29.71	.22	59	NW	12.8	3	...	...	...	8.....SUNDAY
9	29.8	33.5	25.6	7.9	30.07	30.16	29.96	.20	46	NW	10.5	30	...	T	T	9
10	23.5	26.2	21.2	5.0	30.10	30.17	29.99	.18	50	NE	6.9	14	...	T	T	10
11	24.4	27.6	21.2	6.4	29.86	29.93	29.79	.14	73	E	6.8	0	...	2.2	.19	11
12	29.6	33.3	25.3	8.0	30.10	30.23	29.89	.34	67	W	9.1	45	...	4.0	.40	12
13	26.5	42.0	19.4	22.6	29.91	30.25	29.53	.72	73	NE	18.4	0	.09	2.6	.35	13
14	22.4	26.0	17.4	8.6	30.30	30.48	29.98	.50	65	W	18.1	93	...	T	T	14
SUNDAY.......15	28.7	37.8	17.9	19.9	30.07	30.44	29.52	.92	75	SE	14.5	1	1.33	...	1.33	15.....SUNDAY
16	38.0	48.1	33.1	15.0	29.50	29.68	29.33	.35	68	W	22.0	40	.35	T	.35	16
17	25.5	33.1	12.3	20.8	29.87	30.23	29.71	.52	60	W	24.6	25	...	0.2	.02	17
18	13.2	22.9	3.3	19.6	30.44	30.52	30.31	.21	47	NW	9.9	72	...	...	...	18
19	28.5	35.0	22.9	12.1	30.24	30.37	30.08	.29	64	S	13.9	55	...	2.5	.18	19
20	26.8	30.0	24.2	5.8	29.64	29.98	29.48	.50	80	NE	19.8	0	...	8.2	.81	20
21	25.1	28.6	22.8	5.8	29.56	29.66	29.47	.19	68	W	18.5	69	...	T	T	21
SUNDAY.......22	25.5	33.8	15.4	18.4	29.77	30.02	29.66	.36	65	SW	20.1	10	...	T	T	22.....SUNDAY
23	15.2	18.9	12.5	6.4	30.28	30.47	30.06	.41	67	NW	19.4	57	...	...	...	23
24	20.1	29.4	9.2	20.2	30.33	30.54	30.01	.53	68	SW	18.4	48	...	0.3	.02	24
25	37.7	40.0	29.3	10.7	29.84	29.96	29.75	.21	71	W	26.0	0	.08	...	.08	25
26	43.0	49.2	35.6	13.6	29.56	29.75	29.46	.29	68	W	26.4	0	...	...	...	26
27	34.5	47.4	21.8	25.6	30.00	30.43	29.50	.93	54	NW	18.3	89	...	...	...	27
28	22.2	26.7	17.4	9.3	30.61	30.66	30.46	.20	51	W	6.0	84	...	...	...	28
SUNDAY.......29	29.3	40.1	19.4	20.7	30.60	30.66	30.54	.12	64	S	13.2	86	...	...	...	29.....SUNDAY
30	40.7	46.0	32.9	13.1	30.39	30.53	30.25	.28	64	SW	16.5	0	T	...	T	30
Means......	31.33	37.87	24.52	13.35	29.980	30.156	29.791	.365	63.86		14.696	31.66	2.23	20.3	4.14	......Sums
40 Years means for and including this month.	32.86	38.86	27.07	11.79	30.001	.....	.....	2.72	79.32		15.39§	28.16¶	2.19	13.35	3.56	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction..........	N	N E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles..............	303	553	296	476	1088	1776	3210	2814	0
Duration in hours...	47	38	29	42	87	99	187	180	11
Mean Velocity......	7.7	14.7	10.2	11.3	12.5	17.9	17.2	15.6	0

Total mileage, 10581
Resultant direction, N 89° 18' W.
Resultant mileage, 5429.

The greatest heat was 62.3° above zero on the 1st. The greatest cold was 3.3° above zero on the 18th. This gives a range of 59.0°.

The warmest day was the 1st. The coldest day was the 18th.

The highest barometer reading was 30.66 on the 28th and 29th. The lowest barometer reading was 29.33 on the 16th. This gives a range of 1.33 inches.

The minimum relative humidity observed was 38 on the 17th and 18th.

Fog on 1 day.
Hail on 2 days.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording instrument.

§ 27 years means.

¶ 33 years means.

Meteor*tendent.*

DAYS.	† Mean.	Rain and snow melted.	DAYS.
1	45.2	.09	1
2	42.8	.40	2
3	39.2	.01	3
4	27.8	...	4
5	20.2	...	5
SUNDAY........6	20.6	...	6.....SUNDAY
7	25.3	...	7
8	25.6	...	8
9	20.8	...	9
10	19.2	...	10
11	19.2	...	11
12	23.9	...	12
SUNDAY.......13	30.9	.25	13.....SUNDAY
14	21.7	.91	14
15	8.8	.05	15
16	8.8	.06	16
17	13.9	T	17
18	17.8	T	18
19	26.3	.33	19
SUNDAY.......20	18.1	...	20..... SUNDAY
21	22.9	.55	21
22	16.4	.01	22
23	— 1.0	T	23
24	— 4.9	.03	24
25	— 7.2	...	25
26	—10.0	...	26
SUNDAY.......27	1.2	T	27..... SUNDAY
28	22·0	T	28
29	26.4	.28	29
30	28.1	.02	30
31	9.3	T	31
Means......	18.70	2.99	......Sums
40 Years means for and including this month.	19.21	3.72	40 Years means for and including this month.

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Direction	N
Miles..............	33
Duration in hours...	7
Mean Velocity......	4.7

Total mileage, 11896.
Resultant direction, N 61° 44
Resultant mileage, 3948.

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renheit

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ive, saturation being 100. Mean
very four hours from self-record-

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ABSTRACT FOR THE MONTH OF DECEMBER, 1914.

Meteorological Observations, Taken at McGill College Observatory. Height above sea-level, 187 feet. C. H. McLEOD, *Superintendent.*

DAYS.	THERMOMETER † Mean.	THERMOMETER Max.	THERMOMETER Min.	THERMOMETER Range.	*BAROMETER † Mean.	*BAROMETER Max.	*BAROMETER Min.	*BAROMETER Range.	‡ Mean relative humidity.	WIND General direction.	WIND Mean velocity in miles per hour	Per cent. of possible Sunshine	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAYS.
1	45.2	47.8	42.6	5.2	30.21	30.22	30.19	.03	80	SW	11.0	0	.09	...	.09	1
2	42.8	45.8	39.6	6.2	30.09	30.18	29.97	.21	81	SE	8.7	0	.40	...	.40	2
3	39.2	47.3	33.1	14.2	30.24	30.45	29.98	.47	66	NW	17.5	4	.01	...	.01	3
4	27.8	33.1	24.4	8.7	30.57	30.64	30.48	.16	54	NE	6.5	66	.....	...	...	4
5	20.2	24.8	16.3	8.5	30.69	30.72	30.65	.07	53	NE	14.4	89	.....	...	...	5
SUNDAY........6	20.6	25.0	16.0	9.0	30.62	30.68	30.53	.15	57	NE	17.6	88	...	...	...	6.....SUNDAY
7	25.3	30.9	18.8	12.1	30.34	30.52	30.15	.37	46	NE	22.3	33	...	...	...	7
8	25.6	30.0	21.0	9.0	30.12	30.25	30.07	.18	44	NE	26.5	56	...	...	...	8
9	20.8	24.3	18.6	5.7	30.29	30.33	30.26	.07	59	NE	16.5	20	...	...	...	9
10	19.2	23.0	17.3	5.7	30.14	30.25	30.06	.19	57	NE	13.1	11	...	...	...	10
11	19.2	25.1	13.7	11.4	30.05	30.09	30.03	.06	50	NW	14.3	84	...	...	...	11
12	23.9	30.0	17.2	12.8	30.19	30.20	30.10	.10	61	W	13.3	60	...	...	...	12
SUNDAY.......13	30.9	34.6	26.9	7.7	30.00	30.20	29.59	.61	67	S	14.1	0	...	5.8	.25	13.....SUNDAY
14	21.7	31.3	7.4	23.9	29.36	29.58	29.14	.44	67	NW	20.4	30	...	9.1	.91	14
15	8.8	12.6	6.0	6.6	29.76	30.13	29.52	.61	60	NW	26.3	26	...	0.6	.05	15
16	8.8	12.9	2.3	10.6	30.29	30.35	30.19	.16	63	W	15.8	6	...	1.3	.06	16
17	13.9	20.5	4.6	15.9	30.37	30.44	30.33	.11	67	W	17.8	72	...	T	T	17
18	17.8	23.0	11.3	11.7	30.35	30.40	30.25	.15	63	SW	16.9	51	...	T	T	18
19	26.3	34.5	16.9	17.6	29.94	30.20	29.76	.44	69	SW	20.8	0	T	3.3	.33	19
SUNDAY.......20	18.1	32.0	13.4	18.6	30.25	30.42	29.87	.55	49	NW	17.0	94	...	...	...	20..... SUNDAY
21	22.9	33.1	10.6	22.5	29.81	30.33	29.47	.86	72	SW	20.6	0	T	5.5	.55	21
22	16.4	25.0	0.9	24.1	29.68	29.91	29.53	.38	59	NW	26.6	27	...	0.1	.01	22
23	—1.0	5.0	—4.2	9.2	30.00	30.18	29.92	.26	52	NW	11.4	35	...	T	T	23
24	—4.9	—1.0	—7.7	6.7	30.15	30.22	30.06	.16	59	NE	8.1	0	...	0.3	.03	24
25	—7.2	—2.8	—10.8	8.0	30.23	30.33	30.10	.23	61	W	9.9	72	...	...	...	25
26	—10.0	—7.4	—15.6	8.2	30.53	30.66	30.35	.31	57	W	11.8	86	...	...	...	26
SUNDAY.......27	1.2	18.0	—10.7	28.7	30.33	30.63	30.15	.48	67	S	13.2	0	...	T	T	27..... SUNDAY
28	22.0	28.5	14.0	14.5	30.26	30.31	30.22	.09	64	SW	14.7	0	...	T	T	28
29	20.4	31.5	23.8	7.7	29.88	30.24	29.38	.86	72	S	12.7	0	T	1.8	.28	29
30	28.1	39.8	10.8	29.0	29.62	30.13	29.26	.87	64	NW	25.4	20	.02	...	.02	30
31	9.3	12.4	4.0	8.4	30.31	30.37	30.21	.16	56	NW	10.6	72	...	T	T	31
Means......	18.70	24.84	12.34	12.51	30.152	30.308	29.993	.310	61.18	NW	15.99	35.43	0.52	27.8	2.99	......Sums
40 Years means for and including this month.	19.21	25.95	12.24	13.72	30.025	.....	.....	.299	82.0		14.78§	25.0¶	1.27	25.04	3.72	40 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction..........	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALMS
Miles..............	33	2067	193	400	700	2132	2327	3144	0
Duration in hours...	7	177	18	33	58	126	147	162	16
Mean Velocity......	4.7	16.8	10.7	12.1	12.1	16.9	15.8	19.4	0

Total mileage, 11896.
Resultant direction, N 61° 44′ W.
Resultant mileage, 3948.

The greatest mileage in one hour was 39 on the 22nd.

The greatest heat was 47.8° above zero on the 1st. The greatest cold was 15.6° below zero on the 26th. This gives a range of 63.4°.

The warmest day was the 1st. The coldest day was the 26th.

The highest barometer reading was 30.72 on the 5th. The lowest barometer reading was 29.14 on the 14th. This gives a range of 1.58 inches.

The minimum relative humidity observed was 33 on the 7th.

Fog on 3 days.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of readings taken every four hours from self-recording hygrometer.

§ 27 years means.

¶ 33 years means.