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NOTES ON THE BIVALVE SHELLS OF THE COAL-FORMATION OF NOVA SCOTIA.

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The abundant occurrence of shells of bivalve mollusks in the beds associated with coal has long attracted the attention of collectors on both sides of the Atlantic, and various opinions have been entertained as to the affinities of these animals, the nature of their habitat, whether freshwater or marine, and the manner in which they became associated with the coal and its accompanying beds. They occur in extreme abundance in some of the beds of bituminous and carbonaceous shale and in bituminous limestones, and more sparingly in argillaceous and arenaceous shales, throughout the coal-fields of Nova Scotia and Cape Breton, and naturally excited the interest of the writer in his earliest explorations of these beds. It is to be observed also that they not infrequently occur plentifully in the roof-shales of beds of coal.

They were noticed in one of my earliest papers on the coal formation of Nova Scotia in the Journal of the Geological Society of London in 1853.[1] In this article I figured four species of bivalves from the coal-formation of the South Joggins, but without descriptions. Two of them, one the common *Naiadites* and another a narrow *Anthracomya*, were referred to *Modiola*. Two others were referred to *Unio*. One of these is an *Anthracomya* of Unio-like form. The other appears to be a Carbonicola, perhaps *C. angulata*. I remarked at the time on the vast abundance of these shells and their apparently freshwater habitat. This was the first publication so far as I know of these fossils from the Nova Scotia coal region.

These shells were further referred to in the first edition of "Acadian Geology" in 1855; and in the supplement to that work issued in 1860, I proposed for them a new generic name, *Naiadites*, and described them in the following terms, which I quote here, as indicating conclusions which have to a large extent been verified by subsequent discoveries.

"The so-called Modiolæ of the coal-measures are still uncertain as to their affinities. They do not come within the characters of the genera Cardinia, Anthracosia, &c., to which fossils occurring in similar situations in the British coal-fields have been referred. They are all thin shells, marked with growth lines, but destitute of other ornamentation, and, so far as can be observed, without teeth. In so far as external form is concerned they may all be referred to the genera Modiola and Anodon. But mere form may be a very fallacious guide, and I shall notice what seem to me to be the distinct specific forms under the provisional name Naiadites, intending thereby to express my belief that they are probably allied to the Unionidæ. They are certainly distinct from any of the shells of the marine carboniferous limestones, and are never associated with marine fossils. It is possible that their nearest living analogue is the *Bysso-anodonta* of D'Orbigny, from the River Parana."

At the same time five species were described, and indications were given as to their local and stratigraphical distribution. A sixth species was subsequently discovered,

[1] Vol. X, p. 39.

and another referred to the same group has since been found to belong to the genus Anthracosia or Carbonicola.

Before the publication of the second edition of "Acadian Geology" in 1868, I had sent specimens to my friend, the late Mr. Salter, of the Geological Survey of Great Britain, who was at the time studying the British species, and he described them with some other fossils from Nova Scotia which I had placed in his hands, in a paper in the Journal of the Geological Society[1] with figures of three of the species, which he referred to his two new genera *Anthracoptera* and *Anthracomya*, then recently established for the British species. He thus dropped my genus "Naiadites" and substituted two other names of later date. I might have objected to this, but I have made it a rule never to raise questions of priority or of mere nomenclature, and I felt quite sure that Salter was not a man to do any injustice, while I fully recognized his superiority as an authority on fossils of this kind. There was, however, a more important point involved, having relation to the whole question of the conditions of accumulation of coal. Salter held the shells to be probably marine, and on this ground my name Naiadites was objectionable to him, while one of his names, Anthracomya, implied the idea of burrowing creatures allied to the Mya or sand clam. Now, throughout the whole thickness of the coal-formation of Nova Scotia, there is an entire absence of the species of marine mollusks found in the underlying marine limestones, while the bivalve shells in question occur almost exclusively in the coal measures and are not found in the admittedly marine beds. The question was an important one with reference to the mode of accumulation of coal, a subject then engaging my attention; for though the occurrence of a few exceptional beds holding marine shells might be explicable as the result of occasional invasions of the sea on beds usually beyond its reach, the association of these shells with the beds of coal was so constant and intimate that if they could be proved to be marine, a similar conclusion might naturally be

[1] Vol. XIX, p. 80, 1863.

reached respecting the coal itself, and even some of the plants associated with it. I therefore submitted to Mr. Salter and published in my new edition the following facts, tending to show that my so-called Naiadites were fresh-water or estuarine shells.

1. Under the microscope the thicker shells, even those of the Anthracoptera type which most resemble marine species, present an internal lamellar and subnacreous layer and a thin layer of vertical prismatic fibres, covered with a well developed epidermis in the manner of the shells of the Unionidæ or freshwater mussels.

2. The ligament uniting the valves was external, and there seem to have been no hinge teeth. The shells were closed or very slightly open posteriorly, and in some species there are indications of a byssus or "beard" for attachment. The general aspect is in some species that of mussels, in others that of Unios or Anodons.

3. I know of no instance of the occurrence of these shells in the marine limestones or in association with species known to be marine.

4. The mode of their occurrence precludes the idea that they were burrowers, and favors the supposition that they may have been attached by a byssus to floating timber and to one another.

5. The attachment of shells of spirorbis to the outer surface of many specimens seems to show that they were free in clear water when living, while the dense piling together of these shells in some beds almost unmixed with other material, and their occasional occurrence in patches associated with fossil wood, points to the same conclusion.

6. They are associated with fine sediments, vegetable debris, the crusts of minute crustaceans and remains of fishes *more likely to have been inhabitants of fresh or brackish water than of the sea.*

On these grounds, and being unable from the specimens in my possession to make out evidence of generic distinction, I continued to use the name Naiadites; using however, Salter's names as subgeneric, so as to keep our species in harmony with those of England as described by the Geological

Survey. The matter was left in this form in my edition of 1868. It seems, however, that in substituting a figure not perhaps very accurately drawn from a flattened specimen, for the figure which Salter had given from an angular and compressed example, I caused some misunderstanding as to one of the species, leading to the supposition that one of those named by Salter was different from that which I recognized by the same name. The difference was really in state of preservation with some inaccuracy in drawing in both cases. I shall give below copies of these imperfect figures, which however, represent actual appearances which may mislead collectors, along with a figure carefully copied from a young specimen less distorted than usual.

Subsequently to 1868, the pressure of other work prevented me from giving any further attention to these shells, except in collecting such specimens as occurred to me in my visits to the coal-fields of Nova Scotia, and placing these in drawers and collecting-boxes along with the older material. In the autumn of 1892, however. Dr. Wheelton Hind, F.G.S., who had undertaken a thorough revision of the specimens of this kind in English collections, was so kind as to invite me to place in his hands for study and comparison specimens of the species I had described. Unfortunately his letter ·rrived at a time when I was incapacitated by severe illness from attending to the matter, and was unable to avail myself of his kindness until after the publication of his paper on the British species in 1893. As soon as possible, however, a suite of specimens was sent to him, along with a note on their mode of occurrence and distribution, and the result was a joint paper which appears in the Journal of the Geological Society for August, 1894, on which the following statements are based.

On examination and comparison with British specimens, some of which are much better preserved than ours, Hind concludes that my seven species, excluding one which he believes belongs to the genus *Carbonicola* of McCoy, *Anthracosia* of King, are referable to two genera which may be named *Naiadites* (Anthracoptera of Salter) and *Anthracomya* of Salter. The first may be regarded as a member of the family Mytilidæ or mussels, the second as allied to Anodons in the family of the Unionidæ or freshwater mussels, as they are sometimes called.

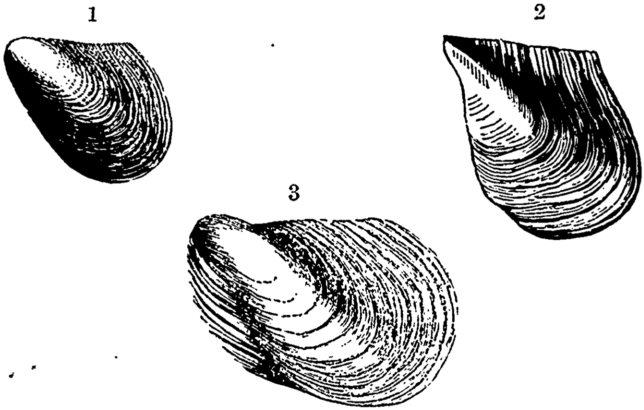
Mr. Wheelton Hind gives the characters of the genera in full. For these characters reference may be made to his paper[1]; but for the benefit of collectors, the following summary of the more important external points may be inserted here:

Genus, NAIADITES, Dawson.

(*Anthracoptera*, Salter.)

Shell Modiola-like, somewhat triangular in form, broad and rounded behind, somewhat pointed in front, beak at anterior extremity, almost terminal, and extending obliquely backward in a more or less pronounced ridge, hinge-line straight, sometimes showing delicate internal striæ, teeth rudimentary; epidermis somewhat wrinkled, surface with concentric lamellæ and lines of growth. A few specimens showing the interior indicate that the hinge-plate was finely striated, and that there was a trifid anterior muscular scar and a larger single posterior one.

1. *Naiadites carbonarius*, Dawson.



Figures 1 to 3.—*Naiadites carbonarius*, Middle Coal-formation, S. Joggins. 1 and 2.—Original figures from imperfect specimens, 3.—More perfect specimen, enlarged x 2.

[1] Journal of Geological Society, May, 1893.

Journal of Geological Society, Vol. X, 1853; Supplement to Acadian Geology, 1860, p. 43; Salter, Journal of Geological Society (Anthracoptera), Vol. XIX, 1863, p. 79; Acadian Geology, 2nd Edition, 1868, p. 204; Wheelton Hind, Journal of Geological Society, Vol. L, 1894.

This is the most common species of the genus, and is very abundant in some shales and bituminous limestones of the coal-formation. So much is this the case, that some thin beds may be said to be made up of these shells, which though somewhat strong, are often much compressed and distorted, so that it is often very difficult to obtain perfect examples. In beds where they are less plentiful they are usually much flattened, by which the general outline of the shell is greatly modified. Owing to these circumstances and also to the fact that the shell is rounder when young and becomes more angular and elongated with age, it is difficult to select typical specimens, and hence the published figures are very dissimilar, (compare the figures in my paper of 1853 in "Acadian Geology" second edition, in Salter's paper of 1863, and in Wheelton Hind's paper of 1894, or figures 1, 2 and 3 of this paper).

This shell is very near in form to *Naiadites modiolaris* (*Avicula modiolaris* of Sowerby), and also to some forms of *N. tumida* Etheridge, resembling them in some respects so closely that it is difficult to distinguish some of the Nova Scotian specimens from these English forms. It is also near to *N.* (*Modiola*) *Wyomingensis* Lea, of the Pennsylvania coal measures. These forms may certainly be regarded as representative species.

It is not improbable that some of the shells from the Carboniferous of Illinois and Ohio, which have been referred to the genus *Myalina*, belong to this genus, as suggested by Dr. Hind. Meek and Worthen have also referred a species from the Keokuk group (Lower Carboniferous) to the genus Anthracoptera (Naiadites)—*A. fragilis* M. and W.[1] White has described *N. Polita* (*Anthracoptera polita*) from the coal measures of the West.[2]

[1] Chicago Academy, 1880.

[2] U. S. Geological Survey, XII, 1880, p. 166.

There can be little doubt, from internal markings and external form as well as from mode of occurrence, that these shells were anchored by a byssus to floating timber and to one another, often in great masses, just as the common mussel is found attached to floating logs in the estuaries of modern Canadian rivers. Mr. Etheridge has noticed a group from the coal-formation of Scotland, apparently attached to a stem of a calamite, and Dr. Hind has noticed the same fact. The specimen is in the collection of the English Geological Survey.

The specimens in my collections in the Peter Redpath Museum, are principally from the South Joggins, where myriads of these shells occur in some of the shales as thickly packed together as possible. Other specimens are from Pictou and from Mabou in Cape Breton. They are confined for the most part to the middle portion of the coal-formation of which they are very characteristic, whereas the shells of the next genus range in great abundance from the millstone grit to the newer coal-formation inclusive.

2. *Naiadites longus*, s. n.

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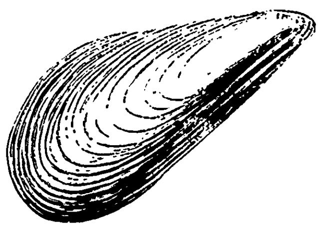

Fig. 4.—*Naiadites longus*, s. n. Middle Coal-formation, S. Joggins, enlarged, × 2.

Wheelton Hind, (long variety of *N. carbonarius*), Journal of Geological Society, Vol. L, 1894, p. 440, Pl. XX, Fig. 1.

This shell, which occurs rarely in beds associated with those holding the typical *N. carbonarius*, is regarded by Dr. Wheelton Hind as a variety of the preceding. It differs however, very much in form, and there do not appear to be intermediate specimens, while it is rare and solitary, and would either seem to have been less gregarious in its habits, or to be represented by mere stragglers from its proper locality. It may therefore, be not unreasonably regarded as a distinct species. Most of the specimens in our collections are from the South Joggins, but there are some from Cape Breton. Compare *N. triangularis*, Sby.

3. *Naiadites mytiloides*, s. n.

5

Fig. 5.—*Naiadites mytiloides*, s. n., Chimney Corner, Cape Breton, enlarged × 2.

This small and pretty species has more the aspect of modern mytili than the others, but its internal markings are unknown. It is narrow in front, with the hinge-line slightly curved and the shell widening to the rounded posterior end, where it is regularly curved. The ventral margin is slightly incurved and flattened in the best preserved specimens; but most of the specimens are more or less crushed. The epidermis is not preserved, and the surface shows only a few concentric growth-lines.

These shells occur abundantly, but for the most part broken or crushed, in shale from the coal-formation of Chimney Corner, Cape Breton, collected by a former student of McGill, Mr. Neighswander. They are nearly uniform in size, about half an inch in length. This shell is from one of the more northern parts of the Cape Breton coal-fields. It may be compared with *Myalina meliniformis*, M. & W. from Illinois, also with *N. Carinata*, Sby., England.

Genus ANTHRACOMYA, Salter.

Shell transverse; slightly inequivalve ? inequilateral, the anterior end being small and rounded, the posterior end rounded and wider. Umbones usually near the anterior end. Hinge-line straight without teeth; ligament external; indications of a byssal furrow in front in some species; surface marked with concentric lamellæ and ridges of growth.

Epidermis thick and sometimes wrinkled, especially in flattened specimens, shell substance usually very thin.

Shells of this genus are more widely distributed, both locally and in time, in the coal-formation of Nova Scotia, than those of the previous genus. Shale surfaces are sometimes crowded with them, though they do not so much enter into the composition of beds of some thickness. There are several species, varying a good deal in form, some being nearly circular, while others are much elongated. There are also two types, one more attenuated and gibbous in front and therefore assuming a more mytiloid aspect, (*e.g. A. elongata*), the other more regularly oval and Unio-like in form (*e.g. A. arenacea*). The first type is in some degree a passage, so far as form is concerned, to the genus Naiadites. The internal surface is not known.

It is noteworthy that while several of the species range from the Lower Carboniferous or the millstone grit to the upper coal measures, the individuals are usually smaller and more depauperated in the lower beds.

1. *Anthracomya elongata*, Dawson.

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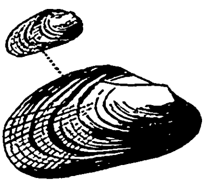

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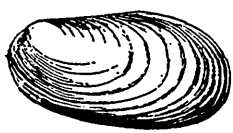

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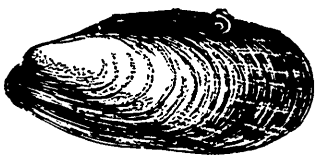

Figs. 6, 7, 8.—*Anthracomya elongata*, Middle Coal-formation, S. Joggins and Mabou, C. Breton. Fig. 6.—Small specimen ,natural size and enlarged. Fig. 7.—Large specimen, natural size. Fig. 8.—Medium specimen with spirorbis attached and anterior end slightly crushed in. Enlarged × 1½.

Supplement to Acadian Geology, 1860, p. 43 (as Naiadites); Salter, Journal of Geological Society, Vol. XIX, 1863, p. 79; Acadian Geology, second edition, 1868, p. 204; Wheelton Hind, Journal of Geological Society, Vol. L, 1894.

This species is characterized by an obliquely ovate form in typical specimens, the length being about double the breadth. The umbones are somewhat elevated and near the narrower anterior end. The straight hinge-line is somewhat oblique and a little more than one-third of the length of the shell. The front margin is slightly sinuated, the posterior margin regularly rounded. The surface is smooth and shining, with concentric lines of growth.

This is by much the most abundant species, and is very variable in form and size. When aged, it is more elongated than when immature, and the hinge-line is relatively shorter and less elevated. It often has shells of spirorbis attached, and occurs in patches in beds holding vegetable fragments, in a manner to suggest that it may have been attached to these.

The collection in the Peter Redpath Museum contains specimens from various members of the Carboniferous system, and from the South Joggins, Pictou, Sydney, Glace Bay, Mabou, Riversdale, Swan Creek and Parrsboro. The shells from the three latter places are from beds low down in the system, and are of small size. In general form this shell resembles *A. Williamsoni*, W. Hind, of the English coal measures, but is less elongate.

2. *Anthracomya laevis*, Dawson.

9

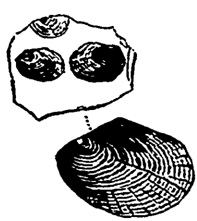

Fig. 9.—*Anthracomya laevis*, Middle Coal-formation, S. Joggins, natural size, and enlarged.

Supplement to Acadian Geology, last edition, (as Naiadites); Salter, Journal of Geological Society, last edition; Acadian Geology, second edition, p. 205; Wheelton Hind, Journal of Geological Society, l. c.

This is small, broad-ovate, the small umbo about one-third of the distance from the anterior end of the straight hinge-line. To the naked eye the younger shells seem almost circular. The shell is very thin and the epidermis smooth and shining, and much wrinkled in flattened specimens. This litlle shell has been found in only one bed, a black shale in the lower part of the Joggins coal-measures near the upper part of the millstone grit. It resembles *A. Scotica* of Great Britain.

3. *Anthracomya arenacea*, Dawson.

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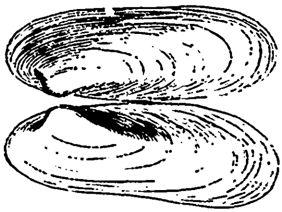

Fig. 10.—*Anthracomya arenacea*, Upper Coal-formation, Pictou, enlarged × 2.

Supplement to Acadian Geology, last edition; Salter, Journal of Geological Society, second edition, p. 205; Wheelton Hind, Journal of Geological Society, l. c.

Shell elliptical, smooth or with very fine concentric lines. Epidermis thin, in many specimens absent. More than twice as long as wide. Anterior margin narrowed in front of beak. Beaks about one-sixth of the length from the anterior end. Posterior end somewhat narrowed at extremity.

This species is usually found in gray arenaceous beds of the upper coal-formation and the millstone grit. It is comparatively rare in the middle coal-formation.

All our museum specimens are from Pictou and Sydney. The species may be compared with *A. lanceolata* of Great Britain.

4. *Anthracomya ovalis*, Dawson.

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Fig. 11.—*Anthracomya ovalis*, Lower Carboniferous, Parrsboro, enlarged × 2.

Supplement to Acadian Geology, 1860; Salter, Journal of Geological Society, l. c., 1863; Acadian Geology, second edition, p. 205; Wheelton Hind, Journal of Geological Society, l. c.

This species has the general form of the smaller specimens of *elongata*, but is broader behind and more tumid in front, so as to be at once distinguishable by the eye. It occurs sparingly in beds from the millstone grit and lower Carboniferous to the middle coal-formation.

Our specimens are from the South Joggins, Riversdale and Parrsboro. It may be compared with *A. dolabrata* of England, but is always much smaller.

5. *Anthracomya obtenta*, Dawson.

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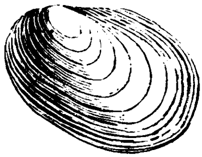

Fig. 12,—*Anthracomya obtenta*, Middle Coal-formation, Mabou, Cape Breton, natural size.

Acadian Geology, second edition, p. 205, (as *A. obtusa*, a name which I find was pre-occupied for a species now included in this genus.)

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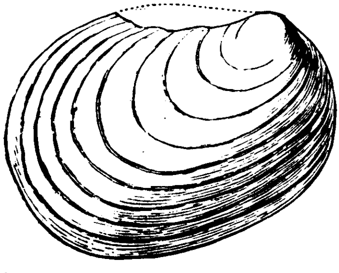


Fig. 13.—*Anthracomya obtenta*, Coal-formation, Pictou, restoration of a flattened and imperfect specimen, enlarged × 2.

General form rounded, and probably when not changed by pressure tumid. Anterior end broad and abruptly rounded; hinge line straight. Beaks raised and somewhat near the front; lower and posterior margins broadly rounded, shell thin, wrinkled when flattened,. strongly marked with growth-lines.

This species resembles somewhat *A. Adamsii* var. *expansa*, England. It is rare. Our only specimens are from McLellan's Brook, Pictou, and Mabou, in Cape Breton, and are mostly flattened, except some very young examples from the latter place.

In addition to fragments of plants and comminuted debris of vegetable matter, the beds holding Naiadites, contain a number of other animal remains, constituting a peculiar fauna altogether different from that of the lower carboniferous marine limestone, and also in many respects distinct from that of the sandstones of the millstone grit and upper coal formation. This fauna, though not that which we would expect in fresh-water lakes or streams under ordinary conditions, seems of such a nature as to be appropriate to bodies of shallow, fresh or brackish water loaded with vegetable matter, or to wide and sluggish creeks traversing the great swamps of the period, and occasionally widening into lagoons, receiving much fresh water from the land, and having but little communication with the open sea. The beds supposed to be thus deposited are carbonaceous or bituminous shales and laminated, impure limestones full of earthy matter, and blackened with bituminous and carbonaceous debris. In addition to the bivalve shells in question, they contain vast numbers of minute bivalve crustaceans. (Bairdia and Carbonia)[1]. Species of *Eurypterus, Diplostylus and Anthropalaemon*, representing crustaceans of higher types. Great numbers of the little *Spirorbis carbonarius* are also attached to many of the plants and other fossils. Numerous scales and teeth of ganoid fishes of the genera *Palæoniscus*, *Rhizodus*, &c.,

[1] Rupert Jones, London Geological Magazine, August, 1894, p. 269, and June, 1889, p. 356.

also occur, and teeth of dipnoid fishes (*Ctenodus*), also various species of sharks (*Ctenoptychius, Psammodus, Diplodus,* &c). Some of these sharks must have attained to a considerable size, and they no doubt found access to the inland waters by the outlets communicating with the sea, and were attracted to visit these comparatively impure lagoons by the abundance of food which they afforded.[1] Very rarely there have been found in these beds bones of amphibians and shells of pulmonate snails, (*Pupa vetusta,* &c.). Animals of these kinds no doubt haunted the margins of the lagoons or creeks; but only occasionally left their remains in deposits accumulating in these places.

We perhaps obtain a glimpse of purer inland waters, similar to those of modern Canadian lakes, by means of a remarkable shell, discovered by Mr. Weston, of the Geological Survey, at the South Joggins in 1893, and which has been described by Mr. Whiteaves, F.G.S., under the name *Asthenodonta Westoni.*[2] It resembles in general form the large pearl-mussel of our modern lakes. (*Margaritana margaritifera* L.) and some specimens are no less than nine inches in length, and of somewhat massive thickness anteriorly. It was found in a sandstone with drift trunks of trees, and may have come from some distance inland. Such a shell could scarcely have been a companion of our little Naiadites or Anthrocomyæ, and points to more favorable conditions for fresh-water molluscan life in lakes or large streams in the interior of the continent.

Conditions favourable to such mollusks were probably, as I have elsewhere suggested, more prevalent in the later Erian or Devonian than in the Carboniferous. Hence the occurrence of such large Anodon-like shells as *Amnigenia Cattskillensis,* Hall in New York, and *Anodon Jukesii* in the Kiltorcan beds in Ireland. The above discovery however now gives reason to believe in similar conditions as existing in higher grounds contemporaneously with the great coal swamps of the low plains of the carboniferous period.

[1] Notices of this fauna will be found in Acadian geology, pp. 202 et seq., and supplements.

[2] Trans. Royal Society of Canada, Section iv, 1893.

The picture presented by the wide swamps and dark ponds and sluggish streams of the coal-formation period, with the creatures of low organization by which they were inhabited, is not an attractive one; but these conditions, which spread so widely over our continents in the carboniferous period, were those suitable to the accumulation of the great deposits of coal so essential to us in the present condition of the world. The animals which form the subject of the present paper, though of little value or interest in themselves, give much information as to the conditions of accumulation of coal, and it is a source of gratification to the writer of this paper to find that as interpreted by their latest investigator, Dr. Wheelton Hind, they tend to establish more firmly the conclusions as to the manner of the production of coal-beds for which he has contended for so many years, and which are so well illustrated by the admirable sections of the coal-bearing rocks seen in the coast-cliffs of Nova Scotia and Cape Breton.

Throughout the thousands of feet of such rocks, constituting the productive coal-measures as exposed in these sections, I have shown [1] that there is an entire absence of properly marine or oceanic remains; and the accumulations of sediment and organic matter, and the animal and vegetable fossils so abundantly present, all point to the existence of wide swampy flats, traversed by ditch-like creeks, and with shallow lakes or lagoons, supporting an exuberant plant-life, and from time to time inundated. In this way the beds of coal, underlaid as they are by underclays with roots, and overlaid by clays and sands containing prostrate and drift plants, and associated with beds holding a fauna appropriate to such conditions, were accumulated by growth *in situ* in the manner of modern bogs The accumulation of successive beds with intervening shales and sandstones, is due to the gradual or intermittent subsidence of the areas of deposition under the weight of the sediments laid down upon them, as we see at the present day in the deltas of great rivers.

[1] Acadian geology, chap. XI.

Such were undoubtedly the conditions of coal accumulation; but we must be prepared to admit many exceptional cases. Vast areas of bog imply great tracts of water-soaked and inundated ground, filling up with drifted vegetable muck. They also necessitate such casualities as bursting of bogs and the floatage of their semi-fluid contents over large areas, as we find now occasionally occurring in Ireland and in Florida. To such causes we may attribute beds of earthy bitumen and of cannel coal, and possibly the coal containing fish scales which I have described in the Joggins section [1] or the celebrated Jarrow coal in Ireland, recently so well described by Mr. Bolton [2] in which fossil fishes and batrachians occur imbedded entire in the coal itself, as if they had been overwhelmed and buried in a torrent of vegetable mud. The Jarrow coal is also, over a large part of its area, destitute of an underclay or "seating" as it is called in Ireland, and it thins out in different directions, as if it had been formed in a limited depression of the surface. Such beds constitute the exception which illustrates if it does not prove the rule, by showing how different our ordinary coal beds must have been had they been formed in such special and peculiar ways.

It is further to be observed that while in many places the coal-formation swamps have been elevated into uplands and mountains, in other regions they have been depressed beneath the sea. The island of Cape Breton affords an excellent example of this. It consists of two broad ridges of old Palæozoic and Pre-Cambrian rocks with a carboniferous depression in the middle, and belts and patches of coal-formation beds around its sides, dipping towards the sea. The soundings show that these coal-formation areas are continuous under the sea with those of Nova Scotia proper on the South and Newfoundland on the North, and that they extend to great distances under the Atlantic to the East and the Gulf of St. Lawrence to the West. Thus we can imagine Cape Breton in the coal-formation period

[1] Acadian Geology, pp. 164, 199.

[2] Manchester Transactions, Vol. XXII, Part 16, 1894.

to have consisted of an elevated nucleus of older rocks, perhaps with interior lakes, while around it stretched a great level expanse of bogs and lagoons now in great part submerged. There might thus be a very marked distinction between the hills, thinly covered perhaps with Ferns and Pines, with clear fresh-water lakes, and the vast swamps densely clothed with Sigillariæ, Lepidodendra, Calamites and Cordaites, and with dark bodies of impure water full of vegetable matter. The faunæ of these districts might be equally different. We know little as yet of the upland fauna; but may hope for more discoveries in this direction, especially in countries like Nova Scotia and Cape Breton, where there were elevated districts in the midst of the areas of coal accumulation. (See Appendix on p. 167.)

The Recent Exploration of the Labrador Peninsula, by Mr. Albert P. Low, B. A. Sc. of the Geological Survey of Canada.

In a most interesting paper entitled—"On some of the larger unexplored Regions of Canada," read before the Ottawa Field Naturalists' Club four years ago, Dr. G. M. Dawson made the somewhat startling statement, that while the entire area of the Dominion is computed at 3,470,257 square miles, at least 954,000 square miles, or between one quarter and one third of the whole, exclusive of the Arctic Islands lying to the north of the continent, is for all practical purposes entirely unknown. While a large portion of the unexplored area lies to the north of the limit of profitable agriculture, considerable regions situated to the south of the limit, still await examination. Large districts again, in which no farmer will ever voluntarily settle, may afford timber which the world will be glad to get when the white pine of our nearer forests shall become more nearly exhausted, while with respect to mineral resources, it is probable that in the grand aggregate the value of those which exist in the unexplored regions will be found, area for area, to be equal to those of the known regions, comparing each particular geological formation with its nearest representative. On the grounds alone, therefore, of geological knowledge, and of the discovery and definition of the reserves of the country in timber and minerals, the exploration of all these unknown or little-known regions may be amply justified.

The exploration of the great unknown districts of the Northern and Western Canada has in the past been carried out chiefly by the Dominion Geological Survey, which most useful Department of the public service, in addition to the very numerous calls made upon it by the more settled portions of the country, with their many and fast developing mining industries, has continued from time to time to send properly equipped exploratory parties into the northern forests and moors and thus gradually building up an accurate knowledge of the character and resources of many of these remoter parts of the Dominion, and these explorations, often very difficult and dangerous, have attached to the staff of the Survey several of the most intrepid and successful young explorers on the continent.

Since Dr. Dawson's paper was read, parties have traversed and carefully examined some of the largest and most desolated of these unexplored portions of the Dominion. Thus in the summer of 1893, Mr. J. B. Tyrell, of the Geological Survey, carried a survey over the Barren Grounds from Lake Athabaska to the west coast of Hudson Bay, crossing an unknown region much larger than Great Britain and Ireland combined, and somewhat larger than Sweden, while Mr. Albert Low, of the same Department, has just returned from an exploration extending over nearly two years, in the largest unknown tract of the Dominion, the interior of the Labrador Peninsula or North-East Territory, comprising some 289,000 square miles, an area equal to twice that of Great Britain and Ireland, with the addition of an area equal to that of Newfoundland. Mr. Low has crossed this area from south to north, and from east to west, and his detailed report when published will contain the first trustworthy account of this great region, which promises to be of very considerable importance on account of the immense mineral deposits which he has discovered there. Mr. Low is a graduate of McGill University, and obtained his geological training under Sir William Dawson. We are glad to be able to present a brief account of his most successful expedition and of the chief scientific results of his survey

Mr. A. P. Low and Mr. T. D. V. Eaton left Ottawa in June, 1893, with instructions, from Dr. Selwyn of the Geological Survey Department, to explore the head waters of the East Main River, then to cross to the head of the Koksoak River and descend it to Ungava Bay, where the party might winter if the conditions proved suitable. The season of 1894 was to be spent in an exploration of the Hamilton River, which flows eastward from the watershed into Hamilton Inlet on the Atlantic coast.

Having procured the services of four young Indians for the whole trip and eight others to assist in transporting the provisions as far as Lake Mistassini, the party left Lake St. John on the 17th June and proceeded by way of the Ashouapmouchouan and Chef rivers to the height of land, and thence by the Perch River into the southern end of Lake Mistassini arriving at the Hudson Bay Post there on the 2nd July. From here only three canoes were used, and an old Indian engaged as guide, who subsequently proved quite useless in that capacity, as he had entirely forgotten the route to Nichicoon, which place he had not visited since his boyhood. After passing up Lake Mistissini sixty miles to the Rupert River, the north channel of this stream was descended some fifty miles, and then a portage route through a number of small lakes was followed to the East Main River, fifty miles farther northward. The East Main was then ascended one hundred and fifty miles to where the route to the Hudson Bay Post of Nichicoon branches off from the main river. The route follows a small branch called Long Portage Creek, for sixty miles, to a number of large lakes discharging their waters into this and other small branches of the river.

Having passed through five of these lakes, the height of land was crossed, and a branch of the Big River was followed northward to Nichicoon Lake. Here fortunately a guide was found who was willing to take the party to Lake Caniapiscow, on the Koksoak River. The route here passes through a number of large irregular lakes, in a north-east direction, for about eighty miles.

From Caniapiscow, the Koksoak River was descended to Ungava Bay, and the Hudson Bay Post reached on the 27th of August, and thus the trip across Labrador from south to north was completed in seventy days.

The conditions at Ungava were not such that the work of the following year could be carried on advantageously, and in consequence the Hudson Bay Company's steamer was taken to Rigoulette, calling on the way at George River, Port Burwell, Nakvack and Davis Inlet. From Rigoulette canoes were again used to the head of Hamilton Inlet, where Messrs. Low and Eaton resolved to winter at the Hudson Bay Post.

The four Indians were sent up the Hamilton River, with instructions to go as far as possible before the river became covered with ice; they succeeded in reaching a point about one hundred miles above the river's mouth. Here they remained until Christmas, when they descended on the ice to the Post.

On the 19th of Jannary, Mr. Eaton started up the river with a party of seventeen men, each hauling two hundred pounds of provisions on a sleigh. He succeeded in ascending seventy miles, when owing to the lack of snow on the rough ice in the heavy rapids, he was obliged to cache the loads and return. A final start was made on the 6th of March, when the party assisted by eight men, proceeded inland with more provisions and outfit sufficient for six months travel.

Arriving at the cache in five days, they continued on seventy miles farther, until they were stopped by open water, extending ten miles below Lake Winokaupow. A second cache was made here, and the whole party returned down stream to the first cache for a second load. When this load and the canoes had been hauled to the foot of the open water, the loads were put int o canoes, and they were tracked and poled up to the lake,—a novel and disagreeable mode of travel, with the thermometer standing a few degrees below zero. From Lake Winokaupow the extra men were sent home on the 1st of April, and the party continued on alone, each person hauling four loads weighing from 250 to 400 lbs. On this account the ground had to be covered seven times and progress was consequently slow, so that the Grand Falls were not reached until the 2nd of May. These Falls are probably the highest and grandest in America. The river here rivals the Ottawa in volume, and has a total fall of eight hundred feet in eight miles, with one sheer drop of three hundred feet where it descends from the table land into a narrow canyon, with perpendicular rocky walls, through which it rushes for five or six miles, until it runs out into the wider and older valley.

On the 19th of May hauling was abandoned, owing to the rotten state of the ice, and the next ten days were passed awaiting open water. At the end of that time the river opened and the party started up it in their canoes, but experienced considerable danger and difficulty from the thick ice coming down from the lakes above. Double loads were made until June 18th, when part of the provisions were cached at Sandy Lake, where several canoe routes meet.

The next twenty-five days were spent exploring the South-west or Ashounipi branch, which was ascended to near the large lake of that name at its head, passing on the way through a bewildering network of lakes. Returning to Sandy Lake, a trip was made to the north-eastward some seventy-five miles to Michikamow Lake. This lake was found to be second only to Mistassini, and is over eighty miles long and thirty miles wide in the broadest part, it is free from islands, and like all the lakes and rivers of this region, abounds with large fish, lake trout, brook trout, land locked salmon, white fish, carp and pike being the most abundant and important varieties. A large area of precious Labradorite was found extending over ten miles along the north shore.

Sandy Lake was again reached and the journey homeward commenced on August 1st. The route followed was by the south-east branch to its head in Attikonak Lake, there crossing the height of land, the Romaine River was descended nearly two hundred miles, and was left about sixty miles from the coast by a difficult portage route, which passes westward through and over a high range of anorthosite mountains to the St. John River. This stream was descended to its mouth, and the Hudson Bay post at Mingan soon after reached. The party then crossed in the packet schooner to Gäspe, and so reached home after an absence of sixteen months, during which time they only once received letters from the outside world.

The scientific results of the exploration may be briefly summed up as follows :—

Surveys were made of over two thousand miles of rivers and lakes, including the greater part of the courses of the East Main, Koksoak or Ungava, and Hamilton rivers; these previously were only roughly laid down on the maps of Labrador, from sketches made by Indians. These surveys will be mapped during the winter, and will add greatly to the geographical detail of the interior.

The great archean complex of central Labrador was passed through in several directions, and interesting facts were secured bearing on the relations of the intrusive syenites, diorites and anorthosites, to the bedded rocks of the complex. A collection of nearly two hundred specimens of typical rocks was brought home, including a number from an immense area of Cambrian rocks, previously unknown, and found to consist of conglomerates, sandstones, limestones and shales, generally all highly charged with iron, and which often occurs as thick beds of hematite interstratified with the limestones and sandstones in such quantities as to rival or surpass the iron fields of the Lake Superior region of the United States.

Parts of the southern, eastern and western boundaries of the area were traced, showing that it is over one hundred miles wide, and extends from near N. Lat. 53. in a north-westerly direction for over three hundred miles, and probably continues in that direction to the westward of Ungava Bay to Hudson Straits, with a total length of over five hundred miles.

Considerable attention was given to the glacial geology of the region, and important points were elucidated in regard to the continental ice cap, such as the position and extent of the névé grounds, the direction of the ice flow from the interior, the formation of interglacial lakes, the amount of continental subsidence and other important facts of interest to glacial geologists. The northern limit and distribution of the forest trees were carefully noted, and a full collection of the plants of the interior made. This collection, though not containing many species new to science, is of economic interest from the extension it affords to the known range and northern limits of the flora of this part of Labrador.

Collections of birds, bird's eggs, butterflies and insects were also made, along with a careful check list of the birds, animals and fish met with during the exploration. Meterological observations were regularly taken, as well as notes on the thickness of ice, and other points of a climatic nature.

Of course on a hurried trip over such an extensive territory, no study in detail could be given to any branch of science, but sufficient material, observations and notes have been collected, to give a general and fairly accurate account of the geology and natural history of a large portion of this great area of north-eastern Canada, about which little was previously known.

CONTRIBUTIONS TO CANADIAN BOTANY.

By JAS. M. MACOUN.

III.

RANUNCULUS ABORTIVUS, L., var. MICRANTHUS, Gray.

Our only specimens of this species are from Quesnelle, B. C. (*John Macoun.*)

RANUNCULUS AQUATILIS, L., var. TRICHOPHYLLUS, Gray.

Cedar Hill, Alberni, and Comox, V. I. (*John Macoun.*) Not recorded before from Vancouver Island.

RANUNCULUS ACRIS, Linn.

Foot of Devil's Lake, Rocky Mts.; Griffin Lake, B. C.; Revelstoke, B. C. (*John Macoun.*) Not before recorded west of Manitoba.

RANUNCULUS BULBOSUS, L.

Revelstoke, B. C. (*John Macoun.*) Only record west of Ontario.[1]

RANUNCULUS CIRCINATUS, Sibth.

R. aquatilis, L., var. *stagnatilis*, DC., Macoun, Cat. Can. Plants, Vol. I., p. 16, Vol. II., p. 296.

Patterson's Creek, Ottawa, Ont. (*W. Scott.*) Wingham, Ont. (*J. Morton.*) Sturgeon Lake, Nipigon River, Ont. (*John Macoun.*) Not before recorded east of Manitoba.

RANUNCULUS CYMBALARIA, Pursh.

Departure Bay, V. I.; Courtney River, Comox, V. I. (*John Macoun.*) Not before recorded from Vancouver Island.

RANUNCULUS CYMBALARIA, Pursh., var. ALPINUS, Hood.

Minute specimens of this variety were collected by the Rev. A. Waghorne, in 1891, at Venison Tickle, Labrador, and on Prince Edward Island, in 1893, by Mr. W. J. Wilson. Our only other specimens are from Anticosti.

[1] The Geographical limits given in these papers refer to Canada only.

RANUNCULUS HEDERACEUS, L.

In wet places, Newfoundland, 1891, 1892. (*Rev. A. Waghorne.*) Only Canadian station.

RANUNCULUS HYPERBOREUS, Rottb.

Pack's Harbour and Venison Tickle, Labrador. (*Rev. A. Waghorne.*) Specimens collected by Dr. Robert Bell at Cape Chudleigh, Hudson Strait, and referred to *R. pygmæus* (Macoun, Cat. Can. Plants, Vol. I., p. 480), are of this species.

RANUNCULUS MACOUNII, Britt., Trans. N. Y. Acad. of Science, Vol. XII., Nov., 1892.

R. repens, Linn., var. *hispidus*, Macoun, Cat. Can. Plants, Vol. I., p. 21 in part.

R. hispidus, Macoun, Cat. Can. Plants, Vol. II., p. 298.

This species includes most of our western specimens that had been referred to *R. hispidus* Mx. Our herbarium specimens are from Nipigon, Lake Superior; Pheasant Plain, Cypress Hills, and Crane Lake, Assin.; Red Deer River, Alberta; Wigwam River, Rocky Mts.; Donald, Columbia River, B. C.; Sproat, B. C.; Port Haney, B. C.

RANUNCULUS NATANS, C. A. Meyer.

New Westminster, B. C. (*John Macoun.*) The western limit of this species in Canada.

RANUNCULUS PYGMÆUS, Wahl.

Summit of Mt. Aylmer, Devil's Lake, Rocky Mts. Alt. 8,300 ft. (*John Macoun.*) Rare in Canada.

ISOPYRUM BITERNATUM, T. & G.

Not rare in the vicinity of London, Ont. (*J. Dearness.*) New to Canada.

CALTHA PALUSTRIS, L., var. SIBIRICA, Regel.

C. asarifolia, DC.

Lulu Island, mouth of Fraser River, B. C., 1889; Courtney River, Comox, Vancouver Island, 1893. (*John Macoun.*) Growing in salt marshes at both stations. Leaves reniform-cordate, with the sinus very obtuse (some leaves without sinus). No form of *C. palustris* before recorded west of Rocky Mountains.

COPTIS TRIFOLIA, Salisb.

Damp woods, Mt. Mark, Vancouver Island. Alt. 3,000 ft. (*John Macoun.*) Not before recorded west of Rocky Mts.

COPTIS ASPLENIFOLIA, Salisb.

Port Simpson, B. C. (*Jas. McEvoy.*) In marshes, near Union Mines, Comox, V. I. (*John Macoun.*) Not before recorded from Vancouver Island.

AQUILEGIA BREVISTYLA, Hook.

The following are new stations for this species: Severn Lake, Keewatin; Fort McMurray, Athabasca River (*Jas. M. Macoun*); Fort Good Hope, Mackenzie River (*Miss E. Taylor*); Francis River, lat. 61° (*Dr. G. M. Dawson*).

DELPHINIUM AJACIS, L.

Escaped from cultivation and naturalized at Lake Scugog, Ont. (*W. Scott.*)

ACTÆA SPICATA, L., var. ARGUTA, Torrey.

Prof. Macoun describes this as the "British Columbia form." We have it also from the Rocky Mountains and Vancouver Island—Devil's Lake, Rocky Mts.; Cameron Lake and vicinity of Victoria, V. I. (*John Macoun.*) Prof. Macoun gives the range of *A. alba* as from Nova Scotia "through the wooded country to the Coast Range in British Columbia." Our most western station for this species is Nipigon, Lake Superior. Western specimens that were referred here prove to be the white-berried variety of *A. spicata*, var. *arguta*.

NIGELLA DAMASCENA, L.

Escaped from cultivation and naturalized along roadsides, Wingham, Ont. (*J. A. Morton.*)

BERBERIS AQUIFOLIUM, Pursh.

Revelstoke and Deer Park, Columbia River, B. C. (*John Macoun.*) Eastern limit in Canada.

PAPAVER SOMNIFERUM, Linn.

Escaped from cultivation and naturalized at Sicamous, B. C. (*John Macoun.*)

ESCHSCHOLTZIA CALIFORNICA, Cham.

Naturalized and spreading in the vicinity of Victoria, Vancouver Island. (*John Macoun.*)

CORYDALIS GLAUCA, Pursh.

Recent explorations have greatly extended the limits of this species as given by Prof. Macoun (Cat. Can. Plants, Vol. I., p. 36). New stations are: Summerside, Prince Edward Island; Beaver Creek, Selkirk Mountains, B. C.; Revelstoke, B. C.; Griffin Lake, B. C. (*John Macoun*); Rupert River, N. E. Ter. (*Jas. M. Macoun*); East Main River, N. E. Ter. (*A. Ross*); Fort Good Hope, Mackenzie River (*Miss E. Taylor*); north shore of Lake Athabasca, N. W. T. (*Jas. W. Tyrrell*).

CORYDALIS AUREA, Willd., var. OCCIDENTALIS, Gray.

New stations for this plant are: Okonagan Lake, B. C. (*J. McEvoy*); Kamloops, B. C. (*John Macoun*); Telegraph Creek, B. C., lat. 58° (*Dr. G. M. Dawson*).

NASTURTIUM PALUSTRE, DC., var. OCCIDENTALE, Wat.

Sproat, B. C.; Courtney Village, near Comox, Vancouver Island. (*John Macoun.*) References under *N. palustre*, DC., var., in Macoun's Cat. Can. Plants, Vol. II., p. 300, go here.

NASTURTIUM OFFICINALE, R. Br.

In rivulets and pools, Banff, Rocky Mts.; in springs on Sea's farm, near Victoria, Vancouver Island. (*John Macoun.*) Not before recorded west of Ontario.

NASTURTIUM INDICUM (L.), DC.

Specimens found growing on ballast heaps at Nanaimo, Vancouver Island, by Prof. Macoun, in 1893, have been doubtfully referred here by Dr. N. L. Britton. Whatever this plant may prove to be, it is a species new to Canada.

BARBAREA VULGARIS, R. Br., var. ARCUATA, Koch.

Finlayson River, lat. 61°. (*Dr. Geo. M. Dawson.*) Revelstoke, B. C. (*John Macoun.*) Most northerly and easterly stations for this variety.

ARABIS CONFINIS, Wat.

Fort Simpson and Peel's River, Mackenzie River. (*Miss E. Taylor.*) Our most northerly specimens.

ARABIS HUMIFUSA, var. PUBESCENS, Wat.

North shore of Lake Athabasca, N. W. T., 1893. (*J. W. Tyrrell.*) Our only other specimens are from Hudson Bay.

ARABIS LYALLII, Wat.

Prof. Macoun (Cat. Can. Plants, Vol. I., p. 487) places the western limit of this species at the summit of the Selkirk Mts. More westerly stations are Toad Mt., Kootanie Lake, B. C., alt. 5,500 ft., and Mt. Queest, Shuswap Lake, B. C., alt. 6,000 ft. (*Jas. M. Macoun.*)

CARDAMINE BREWERI, Wat.

C. pratensis, L., var. *occidentalis*, Macoun, Cat. Can. Plants, Vol. II., p. 601.

In springs and ditches, Goldstream, Victoria, Comox and Nanaimo, Vancouver Island. (*John Macoun.*) New to Canada. Specimens of this plant collected by Prof. Macoun at Nanaimo, in 1887, were called *C. pratensis*, var. *occidentalis*, by Dr. Watson. A recent comparison of our specimens with the type at Harvard, by Prof. Macoun, shows our plant to be *C. Breweri*.

CARDAMINE PRATENSIS, Linn., var. ANGUSTIFOLIA, Hook.

North shore of Lake Athabasca, N. W. T. (*Jas. W. Tyrrell.*)

DRABA NIVALIS, Jacq., var. ELONGATA, Wat.

First collected on the mountains at Kicking Horse Lake by Prof. Macoun in 1885, and referred to *D. stellata*, Jacq. Other stations are Kicking Horse River, Rocky Mts., alt. 4,000 ft., and Roger's Pass, Selkirk Mts., alt. 5,500 ft., 1890. (*Jas. M. Macoun.*) Mountains near Banff, Rocky Mountains, 1891. (*John Macoun.*)

SISYMBRIUM ALLIARIA, L.

Naturalized along roadsides in Beechwood Cemetery, Ottawa, Ont., 1891. (*W. Scott.*) Only Canadian station known to us.

SISYMBRIUM OFFICINALE, Scop.

Prof. Macoun (Cat. Can. Plants, Vol. I., p. 46) limits the distribution of this species to Ontario and the eastern provinces. It has been since found at Sicamous, B. C.; Nelson, Kootanie Lake, B. C.; Esquimault and Nanaimo, Vancouver Island. (*John Macoun.*)

SISYMBRIUM SINAPISTRUM, Crantz.

First noted in 1885 along the Canadian Pacific Railway in the Rocky Mountains. It has since become one of the most troublesome weeds in Manitoba and Assiniboia. Its western limit, as shown by our specimens, is Roger's Pass, Selkirk Mts.. B. C. It is noteworthy that this plant thrives equally well on the dry prairies and at the summit of the Selkirk Mountains, where seldom a day passes without rain.

ERYSIMUM ORIENTALE, R. Br.

Collected at Castle Mt., Rocky Mts., in 1885, by Prof. Macoun, but not recorded, and, in 1891, at the foot of Devil's Lake, Rocky Mts. Probably introduced at the time the Canadian Pacific Railway was being constructed, and now thoroughly naturalized. Mr. Jas. Fletcher reports that this plant has become a troublesome weed in many parts of the North-West.

ERYISIMUM PARVIFLORUM, Nutt.

Rocky fields, Chaudière, near Ottawa, Ont. (*W. Scott.*) Probably introduced from the west in grain. We have no other record east of Manitoba.

BRASSICA CAMPESTRIS, Linn.

Ottawa, Ont. (*Wm. Macoun.*) Waste places, Golden, B. C., and Revelstoke, B. C. (*John Macoun.*)

BRASSICA CAMPESTRIS, L., var. OLIEFERA, DC.

Waste places, Ottawa, Ont. (*W. Scott.*)

BRASSICA SINAPISTRUM, Boiss.

Prof. Macoun gives Ontario as the western limit of this species. We have now specimens from Fort Walsh, Alberta; Kananaskis, Rocky Mts.; Sicamous, B. C.; Cedar Hill, Vancouver Island. (*John Macoun.*)

BRASSICA RAPA, L.

Escaped from cultivation and naturalized in many parts of Canada. Not included in Prof. Macoun's Catalogue. Our specimens are from Yarmouth, N. S.; Kamloops, B. C.; waste places, North Arm, Burrard Inlet, B. C.; fields and meadows, Cedar Hill and Beacon Hill, Vancouver Island; meadows at Comox and on ballast heaps at Nanaimo, Vancouver Island. (*John Macoun.*)

BRASSICA ALBA, Gray.

On ballast heaps at Nanaimo, Vancouver Island. (*John Macoun.*) Not before recorded west of Ontario.

BRASSICA NIGRA, Koch.

On ballast and in waste places, Nanaimo, Vancouver Island. Well naturalized, as it was found in 1887 and 1893. (*John Macoun.*) Not before recorded west of Ontario.

CAPSELLA DIVARICATA, Wahl.

Northeast coast of Newfoundland. (*Rev. A. Waghorne.*) Dead Islands, Labrador, 1882 (*J. A. Allen.*) Dry ground, Kamloops, B. C. (*John Macoun.*) Our only other specimens are from Spence's Bridge, B. C.

LEPIDIUM SATIVUM, L.

In cultivated fields near Victoria and at Sooke, Vancouver Island. (*John Macoun.*) Not before recorded west of Winnipeg, Man.

THLASPI ARVENSE, L.

This weed grows yearly more troublesome throughout the Northwest. It has now crossed into British Columbia, being well distributed along the line of the Canadian Pacific Railway at the summit of the Selkirk Mountains.

RAPHANUS RAPHANISTRUM, Linn.

Naturalized in fields at Agassiz, B. C., and in waste places at Esquimault and Cedar Hill, Vancouver Island. (*John Macoun.*)

SPIESIA OXYTROPIS BELLI, Britton, n. sp.

Acaulescent, tufted, loosely villous, with white hairs. Stipules membranaceous, ovate or oblong, acute or acuminate, imbricated, villous or glabrate, 5″–7″ long; leaves 3′–6′ long; leaflets oblong or oblong-lanceolate, subacute at the apex, rounded at the base, 3″–4″ long, 1″–2″ wide; in verticils of three or four; peduncles about equalling the leaves; inflorescence capitate; pods oblong, erect-spreading, densely pubescent, with black hairs or some longer whitish ones intermixed, about 9″ long and 3″ in diameter, about three times as long as the black-pubescent calyx, very nearly or quite two-celled by the intrusion of the ventral suture, their tips erect; corolla not seen.

Digges' Island, Hudson Bay (*R. Bell*, 1884); Chesterfield Inlet, Hudson Bay (*J. W. Tyrrell*, 1893). Types in the herbarium of the Geological Survey of Canada.

The only other North American species thus far described with verticillate leaflets is *S. splendens*, with which the one here proposed has but little affinity. There are, however, a number of northern Asiatic species sharing this character, but I am unable to refer the Hudson Bay plant to any of them. (*N. L. Britton.*)

CERCIS CANADENSIS, L.

Pelee Island, Lake Erie. (*John Macoun.*) One tree of this species was pointed out to Prof. Macoun in 1892. An old resident remembered having seen this tree in his boyhood, but knew of no other on the island. It grows close beside the lake, and is doubtless indigenous.

MYRIOPHYLLUM ALTERNIFOLIUM, DC.

Brigham's Creek, near Hull, Que., 1891. (*W. Scott.*) The only other Canadian station is Lake Memphramagog, Que.

PEUCEDANUM BICOLOR, Wat.

Hillsides at Sproat, Columbia River, B. C., 1890. (*John Macoun.*) New to Canada.

PEUCEDANUM AMBIGUUM, Nutt.

Hillsides at Deer Park, Columbia River, B. C. (*John Macoun.*) Eastern limit in Canada.

LINNÆA BOREALIS, Gronov., var. LONGIFLORA, Torr.

In woods on both sides of Lower Arrow Lake, Columbia River, B. C., 1890. (*John Macoun.*) First record from interior of British Columbia.

LONICERA CÆRULEA, Linn.

Vicinity of Wingham, Ont. (*J. A. Morton.*) Our only record for Ontario east of Lake Superior.

ASTER PTARMICOIDES, Torr. & Gray, var. LUTESCENS, Gr.

Dry prairies, Indian Head, Assiniboia, 1893. (*F. G. Marwood.*) Not collected since 1872, when it was found by Prof. Macoun in the Touchwood Hills, N. W. T.

ANTENNARIA LUZULOIDES, Torr. & Gray.

Common on the hills behind Deer Park, Columbia River, B. C., 1890. (*John Macoun.*) Rare in Canada.

LEPACHYS COLUMNARIS, Pursh.

Skead's Mills, near Ottawa, Ont. (*W. Scott.*) A common prairie plant introduced from the west by the Canadian Pacific Railway.

ARNICA CORDIFOLIA, Hook., var. ERADIATA, Gray.

In woods, Little Shuswap Lake, B. C., 1889; Deer Park, Columbia River, B. C., 1890. (*John Macoun.*) New to Canada.

LACTUCA SCARIOLA, L.

Naturalized along the bank of the Niagara River and in waste places at Niagara, Ont. (*R. Cameron.*) Abundant around Windsor and Chatham, Ont., and as far east as Smith's Falls, Ont., 1894. (*John Macoun.*)

VACCINIUM CORYMBOSUM, Linn., var. PALLIDUM, Gray.

At Stamford and "The Whirlpool," Niagara River, Ont., 1891. (*John Macoun.*) First record west of Nova Scotia.

LINARIA CYMBALARIA, Mill.

Naturalized at Wingham, Ont. (*J. A. Morton.*) Our only other station in Canada is St. John, N. B.

LINARIA CANADENSIS, Dumont.

Collected at Nanaimo, Vancouver Island, in 1893, by Mr. Wm. Scott. Not elsewhere known in Canada west of New Brunswick.

CONOBEA MULTIFIDA, Benth.

Growing in wet gravel at South Point, Pelee Island, Lake Erie, 1892. Not uncommon. (*John Macoun.*) New to Canada.

VERONICA CHAMÆDRYS, Linn.

Naturalized at Niagara Falls, Ont. (*R. Cameron.*) First record west of Quebec.

MICROMERIA DOUGLASII, Benth.

Along the edge of rocky woods at Hot Springs, Kootanie Lake, B. C., 1890. (*Jas. M. Macoun.*) Between Shuswap Lake and Enderby, B. C., 1891. (*Jas. McEvoy.* Herb. No. 1234.)[1] Not rare on Vancouver Island, but not before recorded from interior of British Columbia.

PODOSTEMON CERATOPHYLLUS, Michx.

Very abundant on flat limestone rocks in Brigham's Creek, Hull, Que. Collected by Prof. Macoun, Aug. 29th, 1894. Not before collected in Canada.

URTICA URENS, Linn.

Along the Dallas Road, Beacon Hill, Victoria, Vancouver Island, 1893. (*John Macoun.*) First record west of New Brunswick.

[1] Whenever herbarium numbers are given, they are the numbers under which specimens have been distributed from the herbarium of the Geological Survey of Canada.

SALIX ARBUSCULOIDES, Andr.

Specimens of this rare and little known willow were collected in 1893 by Mr. J. W. Tyrrell on the barren grounds between Lake Athabasca and Chesterfield Inlet. (Herb. No 1716.) Our only other specimens of this species were collected by Dr. Richardson.

SALIX BALSAMIFERA, Barratt.

Barren grounds between Lake Athabasca and Chesterfield Inlet, 1893. (*J. W. Tyrrell.* Herb. No. 1715.) Not before recorded north of the Saskatchewan.

SALIX RICHARDSONI, Hook.

One specimen of this rare willow was collected by Mr. J. W. Tyrrell at Chesterfield Inlet Hudson Bay, in 1893. Not before recorded from vicinity of Hudson Bay.

SALIX PHYLLICIFOLIA, Linn.

We have specimens of this willow from several stations between Lake Athabasca and Chesterfield Inlet, collected in 1893 by Mr. J. W. Tyrrell, so that it is probably common throughout that region. Specimens collected in the vicinity of Hudson Strait by Dr. Robert Bell, and referred to *S. chlorophylla*, Andrs., by Prof. Macoun (Cat. Can. Plants, Vol. I., p. 446), are of this species.

LISTERA BOREALIS, Morong, Bull. Torr. Bot. Club, Vol. XX., p. 31.

Stems very delicate, 3′–5′ high, glabrous below, glandular-pubescent, and with long, silky, scattered hairs among the inflorescence, sheathed by two obtuse, membranous scales at the base; roots thickened, somewhat fleshy; leaves oval, slightly sheathing, obtuse at the apex, 4″–8″ long, 2″–4″ broad, entire, bearing on the surface a few silky hairs, otherwise very glabrous. Raceme two- or three-flowered. Bracts scarcely 1″ long, much shorter than the pedicels. Sepals and petals nearly equal, linear, obtuse, about 2″ long, lip 4″–5″ long, 2″ broad at the obtuse apex, ciliolate above; apical lobes very obtuse, 1″ long, the intermediate tooth obsolete; basal lobes ½″ long, very obtuse.

Column slightly incurved, 1½″ long. Flowers greenish-yellow, the lip with a purplish middle, and purplish nerves radiating into the apical lobes. The flowers and column, as well as the leaves and upper stem, bear the silky hairs mentioned, some of which are 2″ long.

Collected by Miss E. Taylor at Fort Smith, Great Slave River, in 1892.

PHALARIS MINOR, Retz.

On ballast heaps at Nanaimo, Vancouver Island. (*John Macoun.* Herb. No. 323.) New to Canada.

AGROSTIS INFLATA, Scribner, n. sp.

Culms rather stout, 3–5 inches high, branched below. Sheaths smooth, striate-veined, much exceeding the internodes, inflated, especially the uppermost, which partially encloses the short (1–2in.), densely flowered panicle. Ligule prominent. Leaf-blade flat, ½–2in. long. Spikelet 1½ lines long. Empty glumes lanceolate, awn-pointed, especially the second one, scabrous on the keel. Flowering glume about half the length of the empty ones, slender-awned on the back near the middle, awn exceeding the glumes, callus minutely hairy on the anterior side.

Described from specimens collected on rocks at Esquimault, Vancouver Island, by Prof. John Macoun, June 9th, 1893. (Herb. No. 258.) More mature, rather shorter and stouter specimens, with slightly broader, more striate-veined sheaths, were collected on rocks at Beacon Hill, Vancouver Island, August 7th, 1893. (Herb. No. 259.)

Prof. Scribner further writes: "The spikelets in this grass are very nearly those of *Agrostis microphylla*, Steud., and it may prove to be only a much depressed form of that species." But this does not seem to me probable. An examination of our specimens of *A. microphylla* from Oregon, Washington, and British Columbia shows nothing like these plants, with the exception of specimens collected by Dr. G. M. Dawson on Texada Island, Gulf of Georgia, which answer well to the description of *A. inflata*, though a little taller.

AVENA STRIGOSA, Schreb.

A weed in cultivated fields near Sooke, Vancouver Island, 1893. (*John Macoun.* Herb. No. 48.) New to Canada.

POA TRIVIALIS, L., var. FILICULMIS, Scribner, new var.

Culms smooth, very slender from a creeping rhizome, radical leaves short, those of the culm 1–2 inches long, a line wide or less, acute, scabrous; ligule 2 lines long, acute. Panicle 1–2 inches long, pyramidal. Spikelets two-flowered, $1\frac{1}{2}$ lines long, much longer than the pedicels. Empty glumes very acute, narrow-lanceolate, the first one-nerved a little shorter than the three-nerved second glume, both scabrous on the sharp keel. Flowering glume $1\frac{1}{4}$ lines long, acute, distinctly five-nerved, pubescent on the sharp keel for one-half its length, and with a cobwebby tuft at base.

In wet meadows at Comox, Vancouver Island, 1893. (*John Macoun.* Herb. No. 282.)

VISCOMETRY.

ANTHONY McGILL, B.A., B. Sc.,

Assistant Analyst, Inland Revenue Laboratory, Ottawa.

In making determinations of the viscosity of cylinder oils, I have been in the habit of using an improvised instrument made by jacketing an ordinary 50 cc. pipette. The pipette is conveniently filled by connecting its upper end to a suction pump (Bunsen's), and a series of readings can be very rapidly made at about 208° F. to 210° F., using free steam. In order to obtain concordant results, it is necessary to cut off the lower tube of the pipette very short, and to allow it to protrude beyond the cork in the lower end of the steam jacket but a very little way. I have found it practicable to run a cylinder oil at 208° to 210° Fah., averaging 49 sec. for 25 cc. in ten successive experiments, the greatest deviation from this average being less than 2 seconds.

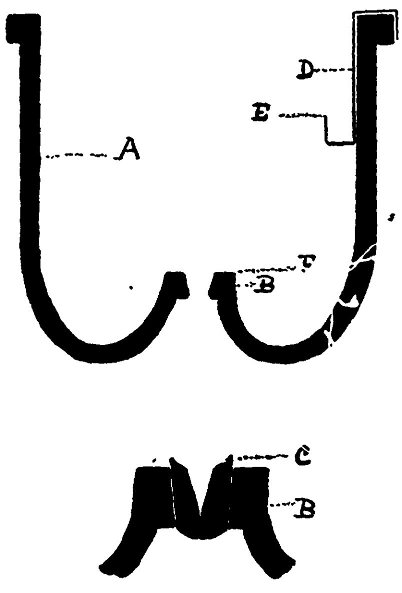
This is a better result than I have been able to get with

Dr. Lepenau's Leptometer (described in Schœdler's "Untersuchungen der Fette, u.s.w.", Leipzig, 1890, pp. 68-69), using the same oil in both of the cups. In spite of very careful workmanship, this instrument is so complicated that exact results are all but impossible with it; and the interchangeable nozzles, even if made strictly alike, will give different rates of delivery unless, in adjusting them, they be placed so that the planes in which they are bent are made absolutely parallel; a condition very difficult to fulfil in working with the instrument.

At the best, the Leptometer has no advantage over the simple apparatus first described, since it desiderates the employment of a standard sample of oil.

The only instrument claiming to do away with the necessity of a standard sample, with which I am acquainted, is Redwood's Viscometer, and my experience with it has been unsatisfactory and disappointing. A full description of the instrument will be found in Allen's "Commercial Organic Analysis," vol. II., pp. 198, 199.

In a series of nine experiments, I got results at 200° F., varying from 114 sec. to 155 sec., and no two alike, (50 cc. of oil used.) At 250° F., the readings varied from 87 sec. to 99 sec., and in all these trials the utmost care was taken to secure uniform conditions. On considering the construction of the instrument, one finds many things which serve to explain these very discrepant results. The inner cup only contains 85 cc. of oil at the beginning of the test. This oil is in contact below with a thick plate of copper, the oil on one side of this plate being at a temperature of 200° F. or 250° F., while the air of the laboratory, on the other side of the plate, is at 60° or 70°. Of course a very rapid lowering of the temperature of the oil results. Further, the upper surface of the oil is in contact with the air directly, and is losing heat rapidly throughout the time of the experiment, and this in a varying degree, since every current of air in the laboratory affects it. The agate tubulure is imbedded in the copper bottom of the cup, and its temperature can never be that of the oil in the middle of the cup. Since all but 35 cc. of the oil is run out at each experiment, the rate of flow is constantly changing from the decreasing effect of gravity, and this change is complicated by the thickening due to cooling, a varying and a very important function of the rate of flow. Finally, the tubulure being placed at the lowest point of the cup, is sure to be obstructed by any particles of dust present in the oil. Unless the oil in the cup be constantly agitated during the time of the experiment—a condition inconsistent with trustworthy work—it will be found that a sensitive thermometer slowly raised and lowered in the oil cup will indicate strata of varying temperatures at the bottom, middle, and top of the cup, and my own observations have assured me that while the main mass of oil in the cup may be at 250° F., that which is passing through the tubulure is, at least, ten degrees lower than this.



A is a cylindrical vessel of brass, 5 inches in each dimension; B is a ae-entering cone, $1\frac{1}{4}$ inches high, 1 inch diam. below and $\frac{1}{2}$ inch at top. Into this are fitted (by ground joints) the nozzles C, as shewn enlarged in the lower figure. D is a strip of bent copper to serve as a gauge. The vertical distance between the points E and F is $2\frac{1}{2}$ inches.

In the instrument diagramed in the figure, I have tried to overcome the objectionable features of the Redwood construction. The copper vessel first used by me is replaced by a brass vessel cast in one piece and shaped on the lathe; its walls are one-quarter of an inch thick, and its other dimensions as formerly. The large size of the cup enables it to contain 1,200 cc. of oil at the beginning of each test. The small portion (50 cc.) withdrawn flows at a practically uniform rate throughout the time that the experiment lasts, since the large horizontal area of the vessel makes the variation of rate due to gravity to be insignificant. The oil is withdrawn from the middle of the whole quantity contained in the vessel, and although the outer layers of oil may slightly change their temperature, the middle portion is sensibly constant during the time of the test. The tubulure (I used at first the agate tube from the Redwood instrument, but now it is replaced by nozzles of phosphor-bronze bored to $\frac{1}{16}$, $\frac{1}{8}$ and $\frac{3}{8}$ inch respectively) is not placed at the bottom of the vessel; consequently particles of dust, sand, etc., which may be accidentally present, do not interfere with the working. Finally, the shape of the conical tube carrying the agate makes it very convenient to insert the necessary flask, whose neck fitting somewhat closely into the hollow cone prevents the cooling effect of air currents upon the mouthpiece, a very important consideration, since they constitute an unascertainable and, no doubt, a varying factor in the results obtained with other instruments. I employ a ring burner in heating the oil, and a wooden spatula for stirring it. It is convenient to use two flasks, so that one may be draining while the other is in use. In this way a very large number of experiments may be made, even at high temperatures, in a short time. The inexpensive character of the apparatus is in contrast with the complicated apparatus of Redwood. I have found the following results using a cylinder oil:—

Temp.	*No. of Tests.*	*Max.*	*Min.*	*Mean.*
250° F.	11	34.0 sec.	33.0 sec.	33.5 sec.
200° F.	16	45.3 "	44.5 "	44.8 "

In order to determine the change in the rate of flow due to lowering of the level, I made series of tests taking, in each case, three successive portions of 50 cc. The initial level is always $2\frac{1}{2}$ inches above the upper surface of the nozzle:

1. Temp. 250° F. (means)—

	1st, 50 cc.	2nd, 50 cc.	3rd, 50 cc.
	33.5 sec.	34.7 sec.	36.0 sec.
At 200° F.—	44.8 sec.	47.2 sec.	50.6 sec.

The withdrawal of 150 cc. causes the level to fall about three-eighths of an inch, corresponding to an increase in time of about $2\frac{1}{2}$ seconds at 250° F., and about $5\frac{1}{2}$ seconds at 200° F., a guarantee that any slight error in the adjustment of original level can have but a very trifling effect on the rate of flow. The following experiments were made with a sample of glycerine diluted to the density of Redwood's standard rape oil, viz.:—1.226 at 15.5° C.

Redwood's Viscometer.—The temperature of the laboratory during these experiments was 68° F. I attempted to keep that of the dilute glycerine at 60°, but found this to be impossible. The following series of *seven* tests were made at 59.5° to 61.5°:—

Max., 483 sec. *Min.*, 460 sec. *Mean.*, 469.5 sec.

With the form of instrument which I have described above, I found it quite easy to keep the temperature constant to within 0.5 degree during the time of the experiment:—

No. Expts.	*Temp.*	*Max.*	*Min.*	*Mean.*
5	60.0° F.	313.5	310	311.7 sec.
5	60.5° F.	308.4	306	307.0 "
7	61.0° F.	305.0	300	302.1 "
6	70.0° F.	209.0	205	207.0 "
4	75.0° F.	166.0	164	165.0 "

The above represent consecutive series of tests, and illustrate the extremes of experimental error. (See note p. 168.)

Parasitic Protozoa.

W. E. Deeks, B.A., M.D.

It is not the purpose of the writer to bring forward any new data in regard to the organisms considered, but merely to give a somewhat popular summary of three types of Protozoa which are capable of entailing grave disturbances in man when they gain access to his tissues. The various branches of science have multiplied so rapidly in recent years and the results achieved by the small army of investigators are so numerous, that it is very difficult to keep pace even in one department.

When the morbid processes present in man began to be studied microscopically for their aetiological factors, it was scarcely anticipated that living organisms were the prime cause in a great many instances. Such, however, is the case, and in consequence pathologists unintentionally became biologists. The fact that the majority of the results published by the former class of men are to be found only in Medical and Pathological journals, and the thought that probably a summary of some of the results connected with certain forms of *Protozoa* and their relation to disease might not be uninteresting to the readers of the Record, have prompted this paper.

For a long time it has been known that the alimentary tract of different animals is subject to the presence of parasites, some of the stages of which may penetrate the deeper tissue and there remain until death, in an encysted condition, or in some cases may even cause death by their depredations as in Trichinosis. Familiar examples of these are the *Nematoda* or round worms of a great many different species; the *Trematoda* or flukes, which pass some of their stages in the intestinal canal and livers of the host causing the fatal condition in sheep known as the liver rot; and the *Cestoda* or tape worms, which require to pass through two hosts generally before the different phases of its life cycle are completed. The no less familiar instances of the different members of *Œstridæ* whose larvæ are found in the stomach as the botfly, or beneath the epidermal tissues as the *Hypoderma bovis* of the ox might be mentioned, but the pathological bearing of these is practically insignificant when compared to the effects which some of the Protozoa are capable of producing. The great impetus given to investigators in morbid processes by Pasteur in his classical fermentatoin experiments and bacteria discoveries as causes of diseases, has also resulted in the discovery that some of the diseases so fatal to the human race are due, not to bacteria but to Protozoa. Among those more definitely ascribed to these organisms may be mentioned Dysentery, Malaria and Cancer.

Tropical Dysentery often occurs epidemically and is an extremely fatal disease. It is usually confined to the Tropics but cases are often met with in temperate regions. Most of these have contracted the disease in the countries where it is more or less endemic. The organism causing it has been termed by Lösch, *Amœba Coli;* by Councilman and Lafleur, *Amœba Dysenteriæ.* It has been described as "A unicellular, protoplasmic, motile organism from ten to twenty micromillimetres in diameter, consisting of a clear outer zone ectosarc and a granular inner zone endosarc, containing a nucleus and one or more vacuoles." It appears to be taken in drinking water and in the alimentary tract sets up more or less definite lesions. These consist of œdematous and infiltrated areas which soon become necrotic and slough leaving undermined ulcers which may perforate the intestinal wall. The amœba has been found constantly present in the invading wall of the ulcer, of the surrounding lymph spaces, or blood vessels. The result of these lesions is a prolonged and frequently bloody flux which may terminate fatally. Sometimes the organism, probably through the blood or lymph channels gains access to the liver with the result that necrotic areas and abscesses form. These may discharge their contents either in the abdominal or thoracic cavity and are very fatal in their termination. The abscesses invariably contain large numbers of the organisms. What the life history of this creature is outside of the host is unknown. Its presence in the host may be merely one phase of its existence and it is difficult to state where the other phases are passed. Being an amœba it is only reasonable to suppose that it undergoes conjugation, encystment and sporulation, as do the other members of the genus whose life histories are better known, and these may take place in the cells near the necrotic areas and if so it would ally them closely to the next two forms to be considered.

Another dicease from which the human race has long suffered is *Malaria.* It was not, however, until 1880, that Laveran, a Frenchman, announced the discovery of a parasite in the blood of paitents suffering from malarial fever. A few years later well-known Italian pathologists certified to the correctness of Laveran's observations and more recently these have been confirmed the world over.

The red blood cell of man is about the 1-2500th of an inch in diameter and it is within it that the life phases of the organism appear to be passed. The different forms observed may be thus summarized.

1. Inside the red blood cell irregular clear bodies showing amœboid movements, occupying a small part or nearly the whole of the cell.

2. Colorless bodies containing pigments which appear to have taken up the whole blood cell or have even become larger than the original blood cell was.

3. Bodies having a segmented appearance.

4. Bodies broken up into spores.

5. Crescentric bodies with pigment masses.

6. Actively moving flagellate bodies smaller than the red blood cell.

Whether all these forms are merely different phases in the life history of one form or whether they represent two or more varieties is as yet unknown. It is probable, however, that there are at least two varieties judging from the clinical history of the disease, which is characterized by definitely recurring chills, at the end of twenty four, forty-eight, or seventy-two hours. The chills seem to be syncronous with the segmenting stage of the organism as these are invariably present when the chills occur and are found only at this time.

There may, however, be but one variety and the irregular recurring chills or their frequency be due to the invasion of the system at the same time of the organisms in different stages of development and which in consequence segmented on successive days. This remains, however, to be proven. That this organism belongs to the Protozoa and that it will and does account for all the morbid processes present seems now to he undoubted. It produces a more or less rapid destruction of the red cells with a consequent anæmia and abnormal discharge of pigment resulting from their destruction. This pigment is in part eliminated by the kidneys, and in part by the liver in the cells of which large quantities are invariably present. But what is its form, or how does it develop apart from the human body?

Malaria is found in low ,marshy regions characterized by a luxuriant vegetation,, along low sea coasts, estuaries or the banks of sluggish streams, in temperate as well as tropical climes. Moisture seems to be particularly favorable to its development as it seems more active in spring and autumn. In those districts where at one time malaria was very common, but which have since been drained and cultivated it has almost disappeared. It has not, however, been discovered in the water or soil of these districts and its mode of life there is as yet a mere matter of speculation.

The other condition referred to as probably due to a species of Protozoa is *cancer*. There is no condition more universal, more fatal, and more dreaded than this, and for ages some of the greatest thinkers have attempted to give a rational explanation for its ætiology and its treatment. Unfortunately as yet surgery is the only effective remedy known and then only in its primary stages. Theory after theory has been advanced to explain its cause, heredity, irritation, embryological cell disturbances, etc., but it is only very recently that a plausible explanation has been given, and tl is seems to be the result of the labor of several pathologists who have all reached the same conclusion.

The question, however, cannot as yet be considered as settled and it will take years of confirmatory observations before the circumstances and conditions favorable to its development and destruction are known. The results so far achieved may be thus summarized :—

All *Epitheliomas* (the most frequent variety of cancer) have certain microscopical organisms associated with them which are more numerous in actively growing malignant types; that they pass through amœboid, resting and sporulation stages; that they undoubtedly belong to the *Protozoa;* that the irritation, in some way set up by their presence, causes proliferation in the surrounding cells, which make up the cancerous mass. The organism is extremely minute, and makes its appearance first in the nucleus of the growing cancer cell. It then enlarges and may subdivide several times. The nucleus is destroyed by it, the nuclear capsule or caryotheca ruptures and the organism escapes into the body of the cell. Here it undergoes further development, encysts and sporulates, and these escaping, invade other cells and the process is repeated. These are briefly the results so far obtained and the various observers seem to be very uniform in their conclusions.

Here then we have three organisms which are parasitic on man, are similar to each other morphologically and in the stages which they undergo, but which produce far different effects upon their host and this is because of the different parts invaded. As to the allied nature of the *Plasmodium* malariæ and the cancer organism there can be little doubt. As to their relation to *Amœba Coli* we cannot say, because we only know the latter as yet in the amœba stage; the sporulation and encysting condition may yet be discovered in the cells which are destroyed.

Now the question arises to what group of the Protozoa do they belong, and to what forms are they most nearly allied. The Protozoa have been subdivided into two branches, the *Gynomyxa* and the *Corticata.* These are distinguished by the absence in the former, and the presence in the latter of a distinct membrane which gives in their dominant phase a more or less uniform shape while in the *Gynomyxa* the amœboid phase predominates and the protoplasm of the cell is naked. Belonging to this *Gynomyxa* is a form known as the *Protomyxa Aurantiaca* discovered by Haeckel on some Spirula shells off the Canary Islands. In this form the different life phases can be observed. They are the large amœboid plasmodium, voracious and active which in a short time surrounds itself with a cell wall. This then becomes segmented and spores result which are coverd by a sort of chitinous coat, and are in consequence called *chlamydospores.* The coat of these soon ruptures and a flagellula escapes that is an organism possessing a protoplasmic extension in the form of a flagellum. This gradually being converted into an amœba, several of which run together to form the original plasmodium. So here five stages can be recognized, a plasmodium, cyst, chlamydospore, flagellula, and Amœba. This gives the series of life phases through which a simple form passes and they can be watched with comparative ease under the microscope. Belonging to the corticata is a large group the members of which pass through a similar series of stages and which are parasitic. The group is known as the *Sporozoa.* They infest the cells of the alimentary tract principally, of nearly every form of animal, insects, lobsters, frogs, rabbits, etc. The life history of them is as follows: A chlamydospore gives rise to one or more flagellulæ which in the stage invade the cell of the host. Here it gradually increases in size and becomes amœboid or Englenoid in form having a differentiated cell wall and nucleus and of a more or less definite shape. This seems to be the mature condition, soon two of these fuse together and this is followed by encystment and then sporulation. The spores, after receiving their chitin-like coat, are known as chlamydospores, thus completing the life cycle. Several forms of these *Gregarinidae* or *Sporozoa* are now known and their analogy to the stages of the *Proteomyxa aurantiaca* is obvious. One of this group, the *Drepanidium ranarum* is parasitic on the frog, and the flagellula or falciform stage is passed in the red blood corpuscle; so here is a perfect analogy. Now compare these stages with those of the Plasmodium malariæ or the Protozoa of the cancer cell, and it is quite evident that a close relationship exists.

It may also be shown yet that the *Amœba Coli* also is a related form the sporulation and encystment stages of which have been overlooked. So that here are three forms of Protozoa, all of which pass through similar life phases, all produce similar lesions. These consist of œdema, infiltration, and followed by necrosis of the cells attacked, but which produce entirely different symptoms clinically owing to the different parts invaded. They are closely related to the gymnomyxa and the corticata, but more closely to the latter where they are grouped along with the sporozoa, all of which are parasitic forms passing through similar life phases. The *Amœba Coli* is probably more nearly allied to *Protomyxa aurantiaca* because of the predominating amœboid phase.

THE ANNUAL FIELD DAY.

The Annual Field Day of the Society was held this year on Saturday, June 2nd, and was the largest and most successful outing ever taken by the Society. The place selected by the committee was Chûte aux Iroquois on the River Rouge, since the arrival of the railway named Labelle, in honour of the late Cure Labelle of St. Jerome, to whose untiring efforts directed towards the opening up of this section of the "North Country," its recent advancement is largely due.

Despite the threatening weather, some five hundred ladies and gentlemen, including professional men of science, clergymen, men of business—all lovers of nature,—assembled at the Windsor Street Station of the Canadian Pacific Railway, where a special train awaited them, and after a short delay, owing to the necessity of securing extra cars to accommodate the unexpectedly large number of excursionists, the train left the station shortly after eight o'clock, reaching Labelle, a distance of one hundred and one miles about 12.30 p. m.

The scenery along the route was varied and beautiful. Passing over the great plain of central Canada which extends as far as St. Jerome, the party at this point entered the Laurentian highlands, ascending the valley of the North River. This is at first wide and fertile, but the country rapidly rises, and at Ste. Adele and St.e Agathe becomes very hilly and rugged, the latter point being a little over thirteen hundred feet above sea level. This portion of the country and on to a point a short distance past St. Faustin is underlain by a great mass of intrusive rock which is known as the Morin Anorthosite, and is, geologically, of the highest interest. From this point the line of the Great Western Railway continues to ascend until the height of land is reached near St. Faustin; this is 1520 feet above the St. Lawrence at Montreal. The North River was here left behind, and the train descended into the valley of the River Rouge, which, flowing south, falls into the Ottawa, opposite the village of L'Orignal. Running up the valley, Labelle was soon reached, being situated on the river at a point where the Rouge having cut its way through the sandy drift which mantles the country, precipitates itself over a series of high ledges of the underlying Laurentian gneiss, forming the picturesque Chute aux Iroquois. This is at present the terminus of the railroad. Tracks have, however, been laid three miles beyond this station, and the promoters of the railway look to the day when it will reach Lake Nominingue, and even the upper waters of river Lievre, thus opening up a region said to be of great fertility and one offering great inducement to the sportsman and tourist.

The village of Labelle consists of a saw and grist mill, a church, two stores, and two hotels, besides a dozen other houses, and as has been mentioned is situated on the banks of the Rouge. The volume of the river here is comparatively large and the falls could supply water-power for several mills. In the centre of the channel, at the head of the falls, the water is parted by a large rock, which has been utilized as a pier, for the erection of a bridge. From this bridge an excellent view of the chute may be had as the river rushes in a boiling torrent below. All through this section of the country are innumerable lakes and streams, and a few miles to the east, from the waters of Trembling Lake there arises a long ridge known as Trembling Mountain, whose summit is the highest point in the Laurentians of this part of Canada, rising 2505 feet above the St. Lawrence at Montreal.

Lunch had been served in the train, and upon the arrival at Labelle, Botanical, Geological and Entomological parties were organized under their several leaders, Dr. Campbell and Mr. Cushing having been elected to take charge of the Botanical party, Dr. Adams, of the geological, while Mr. Winn acted as leader to the students of Entomology. The majority of the excursionists, however, preferred to wander over the beautiful country or climb the neighbouring hills sketching or photographing.

A very pleasant stay of about four hours was thus made at Labelle and the party again gathered at the train for the homeward journey. Before leaving a short address was made by Mr. J. D. Rolland, President of the Great Western Railway who had several stories to tell of the settlers and their success, and concluded by moving a vote of thanks to Mr. Blanchard, the Mayor of Labelle, for the preparations which he had made for the society's reception. Mr. Blanchard in responding referred with pride to the productive character of the country, instancing the neighbouring parish of Saint Jovite, which has a population of 235 families in which there are 608 children under four years of age, while two settlers are the happy fathers of twenty-one children each!

Short speeches were also made by Dr. Wesley Mills, Mr. John S. Shearer, Dr. Bigonnesse of St. Jerome and others. The society then left for Montreal, tea being served on the train. Prizes had been offered for the best collections in Natural History, and were awarded as follows: Geological collections—named specimens—1st prize, Mr. Arthur Cole, B.A.; 2nd prize, Mr. J. Gwillim. Unnamed specimens, Miss Isabel Brittain, B.A. Botanical collection—1st prize, Miss MacLaughlan.

On arriving at Montreal the excursionists paused for a moment in the Windsor Station, at the request of Dr. Wesley Mills, to vote their thanks to the authorities of the Canadian Pacific Railway for the excellent arrangements which had been made for the convenience of the party, thus bringing to a close a most delightful excursion.

Appendix to Paper on Bivalve Shells of the Coal Formation.

Note on Genus *Carbonicola*, McCoy. (*Anthracosia*, King.)

This genus, which occurs abundantly in the Coal Formation of Great Britain, is represented, so far as known, in Nova Scotia by only two small species, both from the lower part of the Coal Formation, or possibly from the Lower Carboniferous. One of these is *C. angulata* (*Naiadites angulata*, Acadian Geology, p. 204, fig. 46.) It is from Parrsboro, from beds holding fossil plants and, so far as known, no marine shells. The other, *C. Bradorica* (*Anthracosia Bradorica*, Ac. Geol., p. 314, fig. 133 b) is from a shale supposed to be Lower Carboniferous, at Baddeck, Cape Breton. The affinities of these shells are at present uncertain, but will probably be discussed by Dr. Wheelton Hind in a forthcoming paper. Its associations would seem to indicate that the *habitat* of some of the species was similar to that of the genus *Anthracomya*, which at Parrsboro are found in neighboring beds. The figure of *C. Bradorica* is reproduced here to show the characteristic form.

Carbonicola Bradorica.

Note.

The deepest bore-hole in the world is at Paruschowitz, in Upper Silesia, Germany On May 17, 1893, a depth of 2,000 meters (6,552 feet) was attained, when drilling was interrupted pending a series of thermometrical observa-.

tions, for the carrying out of which the hole is being sunk. When these observations are completed, drilling will be resumed and continued as far as possible. The diameter of the hole at the bottom is 7 cm. (about 2.8 inches). The rod of the drill is composed of Mannesman tubes, without which it is doubtful if the present great depth (through hard rock) could have been reached.

Note to Paper on Viscometry.

It should be mentioned that the above experiments were made with my viscometer in its original form, employing the Redwood nozzle.

Erratum.

In Vol. VI., No. 2, p. 91, on top line, for the word *anticlinal* read *synclinal.*

ABSTRACT FOR THE MONTH OF JULY, 1894.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY.... ...1		84.2	67.1	17.1							....	S,W.	15.4	....	....	.	58	....	...	....	1 ....SUNDAY
2	78.28	89.8	66.4	23.4	29.9267	30.000	29.827	.173	.6583	63.8	66.5	S.W.	16.0	7.8	10	0	48	0 15	....	0.15	2
3	68.80	80 2	65.0	15.2	29.7513	29.811	29 706	.105	.5585	79 7	61.8	S.W.	12.4	7 3	10	1	47	0.89	....	0.89	3
4	65.58	74.2	59.8	14.4	29.7403	29.756	29.713	.043	.4897	79 0	58.3	S.W.	17.8	2 5	7	0	81	0.08	....	0.08	4
5	62.42	68 0	55 8	12.2	29.8157	29 837	29.776	.061	.4147	74.0	53 7	W.	12 5	4.3	10	0	44	0.01	....	0.01	5
6	66.58	77.0	52.1	24.9	29.7170	29.843	29 611	.232	.4648	72.2	57.0	W.	12.2	2 3	10	0	80	Inap	....	Inap	6
7	60.68	67 4	58.5	8.9	29.7547	29.879	29.658	.221	.4165	78.7	53.8	W.	15.1	9.5	10	7	41	0.23	....	0.23	7
SUNDAY.........8	.....	63.2	52.0	11.2	......	.....	......	....	. ..	...	....	W.	15.2	....	...		22	Inap	....	Inap	8 ....SUNDAY
9	63.32	70.1	55.4	14.7	30.0402	30.064	30.022	.042	.4203	73.0	54.0	S.W.	13 7	6.2	10	0	34	0.03	....	0.03	9
10	64.67	74.5	58.6	15.9	30.0257	30.067	29.986	.081	.4403	72.3	55.5	W.	12.7	6.5	10	2	31	Inap	....	Inap	10
11	67.12	76.0	56.0	20.0	29.9110	29.991	29 835	.156	.5072	77.3	59.2	S.W.	13.3	6.2	10	0	50	Inap	....	Inap	11
12	68 57	74.5	63.1	11.4	29.7355	29.899	29.691	.208	.6062	87 2	64 5	S.W.	17.0	10.0	10	10	08	0.09	....	0.09	12
13	69.00	79 9	62.0	17.9	29.6877	29.811	29.587	.224	.5733	81.0	62.8	S.W.	17.5	8 0	10	3	53	0.34	....	0.34	13
14	67.13	75.8	54 4	21.4	29.8373	29 836	29.810	.086	.4827	73.3	58.0	W.	6 0	7.7	10	0	49	....	...	....	14
SUNDAY 15	....	74 4	59.6	14.8	......	.....	......	...	. ...	..	....	S.E.	7 5	....	...		56	....	....	....	15 ....SUNDAY
16	68.12	78.1	58.1	20.0	30 0957	30.117	30.079	.038	.4318	64.2	55.5	S.W.	4.8	1.7	7	0	83	....	...	....	16
17	72 57	83.2	59.5	23.7	30.1282	30.166	30.103	.063	.4895	62.8	53.5	S.W.	6.5	3.3	8	0	90	....	....	...	17
18	74 82	85.0	62 0	23 0	30.0812	30.147	30.013	.134	.5557	65.5	61.8	S.W.	6.5	3.0	8	0	76	....	....	....	18
19	78.83	88.4	69.1	19.3	29.9282	30.006	29.870	.136	.6955	70 0	63.2	S.W.	12.8	1 2	4	0	74	..	...	....	19
20	77.48	89.5	67.8	21.7	29.8083	29.863	29 738	.125	.6402	69.0	65.8	S.W.	23 3	3.8	10	0	76	0 13	. ..	0.13	20
21	62.40	70 5	57.1	13.4	29.9538	30.033	29.904	.099	.4380	77.7	55 7	N,E.	14.8	8.3	10	0	07	0.34	....	0.34	21
SUNDAY........22	.....	78 1	55.9	22.2	......	......	......	....	....	....	..	N E	5.2	...	..	..	98	0 01	....	0.01	22 ....SUNDAY
23	72.48	82 7	60.6	22.1	30 0517	30.094	30.014	.080	.5310	67.8	60.5	S.E.	7.0	0.8	5	0	96	....	....	....	23
24	61 90	72.8	58.6	14.2	29.9312	30.039	29.852	.187	.4905	88.8	58.3	S.E.	9 8	10.0	10	10	03	0.41	....	0 41	23
25	68.38	79.0	59 9	19.1	29.9477	30.046	29.891	.152	.5297	77.3	60.5	S.W.	13.3	7.7	10	1	42	Inap	....	Inap	25
26	60.47	68.6	53.6	15.0	30.2322	30.292	30.109	.183	.3672	70 5	50.4	N.	8.6	4 3	10	0	56	...	....	....	26
27	73.32	84.5	56.4	28.1	30.0665	30.169	29.954	.215	.5785	70 2	62.2	S.W.	12.9	4 2	7	0	75	....	...	....	27
28	80.18	89.0	74.1	14.9	29.8785	29.950	29.802	.148	.6468	63 0	66.3	S.W.	22 5	6.2	10	0	35	...	....	....	28
SUNDAY 29	.	84.3	68 5	15 8	......	....	....	....	.....	. ..	...	S.W	20 7	....	..		48	0.01	....	0.01	29 ....SUNDAY
30	71.58	82.5	62 5	20 0	29.8573	30 010	29.806	.204	.5712	74.3	62.3	S.W.	19.0	4.0	10	0	69	0 10	.....	0.10	30
31	62.10	69.6	53.0	16.6	30 0520	30.100	30.008	.092	.3562	65.3	49.5	S.W.	9.6	1.5	4	0	100	....	...	...	31
....Means	68.73	77 90	60.08	17.82	29.9214	....	.....	.134	.5136	73.2	59.25	S. 58½° W.	12.96	5.3		.	55.7	2.82	....	2.82	Sums ....
20 Years means for and including this month	63 82	77.31	60.70	16.61	29.8923	....	.....	.140	.5002	71.1	....	......	....	5 4	..	.	¶57.0	....	....	....	20 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	502	246	85	526	420	5259	1967	635	
Duration in hrs .	47	32	13	53	50	353	139	52	5
Mean velocity...	10 7	7.7	6.5	9.9	8.4	14.9	14.2	12.2	0.0

Greatest mileage in one hour was 29 on the 13th. and 29th.

Greatest velocity in gusts 48 miles per hour, on the 30th.

Resultant mileage, 6465.
Resultant direction, S. 58½° W.
Total mileage, 9640.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only.

The greatest heat was 89.8° on the 2nd; the greatest cold was 52°.0 on the 8th, giving a range of temperature of 37°8 degrees. Warmest day was the 28th. Coldest day was the 26th. Highest barometer reading was 30.292 on the 26th: lowest barometer was 29.611 on the 6th, giving a range of 0.681 inches. Maximum relative humidity was 97.0 on the 3rd and 24th. Minimum relative humidity was 42 on the 16th.

Rain fell on 19 days.

Auroras were observed on 1 night.

Fog on 2 days.

Thunderstorms on 4 days.

ABSTRACT FOR THE MONTH OF AUGUST, 1894.

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

DAY.	THERMOMETER.				BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	Max.	Min.	Range.				General direction.	Mean velocity in miles perhour	Mean.	Max.	Min.					
1	64.75	71.2	57.6	13.6	30.0352	30.073	30 002	.071	.3633	59.8	50.2	N.	7.7	6.5	10	0	51	Inap.	....	Inap.	1
2	65.33	71.5	60.0	11.5	29.8608	29.977	29.788	.189	.5055	79.8	58.8	S.E.	9.7	8.3	10	0	02	0 12	....	0.12	2
3	69.43	79.3	61.0	18.3	29.7462	29.840	29 666	.174	.5197	71.8	59.5	S.W.	18.6	7 8	10	1	51	Inap.	....	Inap.	3
4	60.28	65.7	56.3	9.4	29.9227	30.015	29.839	.176	.3647	70 3	50.3	S.W.	20.0	6 7	10	0	48	....	....	....	4
SUNDAY........5	.....	76 7	55.3	21.4	....	......	.....	...	.....	....	....	S.W.	18 2	....	....	..	79	....	....	....	5 ....SUNDAY
6	69.77	79.4	61.3	18.1	30.0412	30.122	29.907	.215	.4675	64.7	57.0	S.W.	19.0	5.0	10	0	78	....	....	....	6
7	68.33	78 2	64.1	14.1	29.9470	30.001	29.884	.117	.4922	71.5	58.3	S.W.	15.3	8.0	10	0	12	Inap.	....	Inap.	7
8	67.52	80.6	56.6	24.0	29.8623	29.903	29.813	.090	.4807	71.8	57.3	S.W.	13.0	5.5	10	0	53	0.02	....	0.02	8
9	59.07	68.6	51.8	16.8	29.9650	30.019	29.896	.123	3668	74.5	50.3	N.	17.0	6.8	10	3	60	0.59	....	0.59	9
10	60.00	68.0	52.4	15.6	30.0720	30.104	30.037	.067	.3258	63.3	47.2	N.W.	11.7	4.2	7	0	80	0.01	....	0.01	10
11	60.33	68.5	50.5	18.0	30.1497	30.213	30.094	.119	.3257	63.3	47.3	S.E.	5.7	1.5	4	0	80	....	....	....	11
SUNDAY........12	.....	69.1	54.2	14.9	......	......	......	....	..	....	....	S.E.	10.0	...	...	.	10	0.40	....	0.40	12 ....SUNDAY
13	63.08	70.0	58.0	12.0	29.9443	30.005	29.912	.093	.5148	89.5	60 0	S.	6.7	7.2	10	0	00	0.11	....	0.11	13
14	68.25	79.5	59.2	20.3	29.9710	30 049	29.888	.161	.5572	81.8	62.0	S.	8.4	4.3	10	0	63	....	...	...	14
15	64.77	70 1	59.0	11.1	29.8133	29.885	29 744	.141	.5335	86 2	60 7	N.W.	15 5	8.3	10	0	11	0 36	....	0.36	15
16	61.80	69.5	53.8	15.7	29.9415	29.982	29 906	.076	.3243	60.3	47.2	N.W.	12.5	1.8	10	0	85	....		....	16
17	60 47	69.5	52.2	17.3	30.0270	30.074	30.003	.071	.3040	58.8	45.2	N.	7.4	0.7	3	0	72	....	....	....	17
18	61.32	69.5	52.0	17 5	29.9492	29.998	29.906	.092	.4348	79.7	54.8	S.W.	10.7	5.8	10	0	06	0.02	....	0.02	18
SUNDAY.. 19	....	70.8	52.2	18.6	....	.....	......	....	.....	.	....	N.	8.2	....	...	.	44	Inap.	....	Inap	19 ....SUNDAY
20	61.30	71.5	53.0	18.5	29.9272	30.026	29.866	.160	.3667	67.0	49.8	N.W.	16 4	4.8	10	0	40	0.01	....	0.01	20
21	52.15	60.5	49.0	11.5	30.0385	30.062	29.997	.085	.2452	63.3	39 7	N.W.	20.2	3.0	7	0	85	....	....	...	21
22	59.68	73.1	45.0	28.1	29.9940	30.068	29.939	.029	.3442	66.7	48.0	S.W.	24.6	5 2	10	0	38	...	....	....	22
23	66.65	75.5	58.3	17.2	29 9973	30.053	29.953	.100	.4398	67.8	55.2	S.W.	22.5	3.3	10	0	53	....	....	....	23
24	70.73	80.5	63.1	17.4	29.9315	29 989	29.876	.113	.5093	67.2	59.0	S.W.	21 2	5 8	10	0	44	...	....	....	23
25	68.77	77.2	64 0	13.2	29.8945	29.990	29.851	.139	.5288	73.5	60.0	S.W.	20.4	6.5	10	0.	89	0.05	....	0.05	25
SUNDAY........26	.....	64.8	44.8	20.0	....	......	......	....	.....	....	....	N.	12.4	....	....	..	90	....	....	. .	26 ....SUNDAY
27	54.48	60.2	45.6	14.6	30.0548	30.153	29.928	.225	.3315	78.0	47.3	S.E.	8.4	7.2	10	0	22	0.06	....	0.06	27
28	58.77	65.8	52.4	13.4	29.9992	30.084	29.882	.202	.4102	82.2	53.7	N.W.	13 1	10.0	10	10	11	....	....	....	28
29	57.83	64.2	45.9	18.3	30.0540	30.115	29.995	.120	.3320	70.2	47.5	N.	6.7	7 5	10	0	38	....	....	...	29
30	58.98	66 2	53.6	12 6	29.8643	29.923	29.827	.096	.3978	80.2	52 7	N.E.	5.7	6.7	10	0	03	....	....	....	30
31	62.30	72.6	53.0	29.6	29.8910	30.047	29.811	.236	.4078	73.2	53.0	S.W.	16.1	5.0	10	0	60	0 05	....	0.05	31
....Means	62.82	71.55	54.69	16.86	29.9591	....	......	.129	4146	71.7	53 04	S. 62⅔° W.	13.7	5.7	..	.	47.0	1.80	....	1.80	Sums ....
20 Years means for and including this month	66 75	75 07	58.68	16.43	29.9421	....	.....	.133	.4805	72.8	....	......	....	5 4	..	..	¶54.5	....	....	....	20 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	1139	453	294	592	897	4612	657	1516	
Duration in hrs..	99	44	44	63	81	250	58	104	1
Mean velocity...	11 5	10.3	6.7	9.4	11.1	18.4	11.3	14.6	

Greatest mileage in one hour was 35 on the 3rd.
Greatest velocity in gusts 48 miles per hour, on the 24th.

Resultant mileage, 4454.
Resultant direction, S. 62⅔° W.
Total mileage, 10160.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only.

The greatest heat was 80.6° on the 8th; the greatest cold was 44.8° on the 26th, giving a range of temperature of 35°8 degrees.

Warmest day was the 24th. Coldest day was the 21st. Highest barometer reading was 30.213 on the 11th: lowest barometer was 29.666 on the 3rd, giving a range of 0.547 inches. Maximum relative humidity was 99 on the 14th. Minimum relative humidity was 38 on the 17th.

Rain fell on 16 days.

Auroras were observed on 1 night.

Fog on 5 days.

Earthquake on the 27th.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1894.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches	Snowfall in inches.	Rain and snow melted.	DAY.
1	59.87	71.7	44.5	27.2	30.0082	30.103	29.912	.191	.3345	64.7	47.3	S.W.	16.4	6.3	10	0	46	Inap.	....	Inap.	1
SUNDAY........2	.....	66.5	52.8	13.7	....	......	......	...	.. .	....	...	S.W.	17.4	....	....	..	0[illegible]	....	....	....	2 ....SUNDAY
3	55.02	63.8	47.9	15.9	30 1868	30 253	30.102	.151	.3268	75.2	47.2	N. E.	12.1	10.0	10	10	24	....	....	..	3
4	64.40	74.2	51.0	23.2	29.9993	30.097	29.910	.187	.4837	79 5	57.7	S.	14.3	5 7	10	0	00	0 15	....	0.15	4
5	68.75	74 5	61.2	13.3	29.9808	30.069	29.917	.152	.5825	81.8	62.8	S.W.	17 5	5 5	10	0	00	0 10	....	0.10	5
6	67.10	73.6	64.0	9 6	30.0933	30.214	30.040	.174	:4307	64.7	54.7	S.W.	12.8	5.8	10	0	42	....	....	....	6
7	60.70	64 8	55.2	9.6	30.0467	30.079	29.948	.131	4135	78.0	53.8	N. E,	10.5	0.3	10	0	50	...	....	....	7
8	58.67	65.8	47 7	18.1	29.8913	30 070	29.762	.308	.4498	88.2	55.2	N. E.	16.8	8.3	10	0	00	0.29	....	0.29	8
SUNDAY........ 9	.....	75.7	61.8	13.9	....	......	......	....	. ..	....	....	W.	14 0	...	...	.	61	0.01	....	0.01	9 .... SUNDAY
10	63.75	75.4	54.3	21 1	29.6583	29.816	29.532	.284	4935	81.0	57.7	S W.	20.2	6.7	10	0	62	0.22	....	0.22	10
11	54.15	61.1	49.0	11.5	29.9617	30.139	29.821	.318	.2968	71.5	44 7	W.	15.0	2.3	8	0	06	Inap.	....	Inap.	11
12	55.52	63.8	45.2	18.6	30.3582	30.436	30.237	.199	.3118	70.0	45.5	S.W.	9.3	0.0	0	0	96	....	....	....	12
13	60.32	69 5	47 0	22.5	30.4943	30.626	30 397	.229	.4168	79.2	53.3	S.E.	9.7	6.3	10	0	52	....	....	...	13
14	58.95	62.3	57 0	5.3	30.2672	30 357	30.171	.186	.4687	93.7	57.2	S.	11.6	10.0	10	9	00	0.11	...	0 11	14
15	62.85	70 4	56.9	13.5	30.0783	30.106	29 967	.199	.5302	92 3	60 5	S.E.	6 1	8.5	10	3	29	....	....	...	15
SUNDAY........16	....	74.3	63.4	10.9	....	......	......	....	.....		....	S.W.	13.0	....	...	.	07	0.07	..	0.07	16 ....SUNDAY
17	63.27	71.3	53.1	18.2	30.0895	30.145	30.058	.087	.3997	70.5	52.7	S.W.	7 5	0.8	3	0	73	....	....	...	17
18	63 72	71.5	55 9	15.6	30.0618	30.107	30.028	.079	.4412	76.0	55.7	N. E.	6 2	2.3	10	0	55	...	....	....	18
19	60.92	67.5	53.6	13.9	30.0063	30.061	29.923	.138	.4265	79.7	54.2	N. E.	11 7	9.2	10	5	08	0.04	....	0.04	19
20	60.22	64.9	56.2	8.7	29.7015	29.828	29 560	.268	5000	95.8	59.0	N. E.	11 2	10.0	10	10	0[illegible]	1.65	....	1.65	20
21	64.23	71.3	56.1	15.2	29.8810	29.933	29.769	.164	.5110	85.8	59 3	S.W.	15.8	5.8	10	0	28	0.01	....	0.01	21
22	67.07	78.5	57.6	20.9	29.9238	29.976	29.860	.116	.5273	79 7	60.0	S.W.	15.2	1.7	10	0	34	...	....	....	22
SUNDAY........23	.....	74.5	58.9	15.6	....	......	......	....	.....	....	....	S	18.1	....	....	..	42	0.04	....	0.04	23 ....SUNDAY
24	54.03	64.1	48.6	15.5	29.9142	30.025	29.746	.279	.3455	82.5	48.8	S.W.	16 4	8.3	10	0	11	....	....	....	23
25	45.57	51.7	40 0	11.7	30.2878	30.449	30.110	.339	.2473	80.8	39.7	N.W.	7.8	6 7	10	0	0[illegible]	....	....	....	25
26	45.38	53.2	35.0	18.2	30.4122	30.559	30.242	.317	.2597	84.5	40.8	S.E.	8.4	0.8	5	0	12	....	....	.	26
27	54.30	63.8	40.8	23.0	30.1305	30.213	30.073	.140	.3147	74.7	46.0	S.	11.1	5.8	10	0	70	0.04	....	0.04	27
28	58.60	69.2	47.0	22.2	30.0593	30.108	30.020	.088	.3940	81.2	52.2	S. W.	7.4	0.8	5	0	68	....	....	..	28
29	63.82	73.4	54.3	19.1	....	30.051	29.983	.068	.4667	79.0	56.7	S. W.	11.7	0 0	0	0	69	....	....	...	29
SUNDAY....... 30	.....	69.6	48.6	21.0	30.0265	......	......	.236	.....	...	....	S.E.	15.3	...		0	62	....	....	.	30 ....SUNDAY
............Means	59.65	68.40	52.17	16.22	30.0608	.....	......	.192	4141	79.6	52 91	S. 31¼° W.	12.7	5.4	..	..	33.6	2.73	....	2.73	Sums ....
20 Years means for and including this month......	58.52	66.64	50.81	15.83	30.0187	.....	......	.179	.3811	75 4	....	......	....	5 6	..	..	¶53.3	....	....	....	20 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............	290	1105	152	1017	1462	3914	852	339	
Duration in hrs..	29	95	20	85	124	251	72	38	6
Mean velocity...	10.0	11.6	7.6	12.0	11.8	15.6	11.8	8.9	

Greatest mileage in one hour was 32 on the 2nd.

Greatest velocity in gusts 48 miles per hour, on the 23rd.

Resultant mileage, 4254.

Resultant direction, S. 31¼° W.

Total mileage, 9131.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only.

The greatest heat was 78.5° on the 22nd; the greatest cold was 35.0° on the 26th, giving a range of temperature of 43.5 degrees.

Warmest day was the 5th. Coldest day was the 26th. Highest barometer reading was 30.626 on the 13th; lowest barometer was 29.532 on the 10th, giving a range of 1.094 inches. Maximum relative humidity was 99. on the 15th, 20th & 21st. Minimum relative humidity was 47 on the 1st.

Rain fell on 14 days.

Auroras were observed on 1 night.

Fog on 4 days.

Lightning on 5 days.

Severe thunderstorms on the 8th and 20th.

Heavy thunder on 3 days.

Extremely smoky atmosphere on the 2nd.

ABSTRACT FOR THE MONTH OF OCTOBER, 1894.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches	Snowfall in inches.	Rain and snow melted.	DAY
1	51.90	55.8	49.4	6.4	29.8695	29.[illegible]60	29.812	.148	.3023	73.0	46.2	S.W.	14.6	10.0	10	10	07	0 10	....	0.10	1
2	49.10	54.2	44.1	10.1	29.9060	29.989	29.817	.172	.2283	65.8	38.0	N.W.	9.7	8.7	10	3	46	Inap.	....	Inap.	2
3	53.6[illegible]	62.5	47.8	14.7	29.7818	29.946	29.658	.288	.3493	82.8	48.3	E.	14.9	10.0	10	10	00	0 36	....	0.36	3
4	58.12	65.5	52.5	13.0	29.7102	29.736	29.673	063	4153	86.3	53.8	S.W.	14.5	7.8	10	2	11	0.04	....	0.04	4
5	51.78	56.5	49.7	6.8	29.5707	29.639	29.532	.107	.3438	89.0	48.5	S.W.	14 2	7.7	10	0	00	0.08	....	0.08	5
6	48.42	56.5	40 0	16.5	29.8920	30.085	29 699	.386	.2428	71.3	39.0	W.	13.9	6.5	10	0	14	....	....	....	6
SUNDAY. 7	.....	51.5	39.1	16.0	......	......	....	...	.....	....	..	W.	6 3	....	....	..	32	...	....	....	7 ....SUNDAY
8	54.57	62.3	42.6	19.7	29.8432	30.043	29.685	.358	.3193	75.7	46.7	S.	9.5	6.8	10	0	25	0.44	....	0.44	8
9	46.62	55.7	42.0	13.7	29.8255	29 904	29.761	.143	.2393	76.2	39.0	S.W.	11.5	7.3	10	0	00	0.01	....	0.01	9
10	44.58	48.3	40.7	7 6	29.5893	29.863	29.353	.510	.2760	92.2	42.8	N.	16.2	8.3	10	0	00	0.98	....	0.98	10
11	45.32	50 3	43.1	7.2	29.7090	30.043	29 460	.583	.2498	82.3	40.2	W.	15.0	8 7	10	6	00	0.18	....	0 18	11
12	45 75	52.2	38.1	14.1	30.1505	30.195	30.093	.102	.2247	74.0	37.5	W.	6 6	4 5	10	0	17	Inap.	...	Inap.	12
13	47.65	51.6	42.1	9.5	29.7915	29.951	29.631	.320	.3083	92.7	45.7	S.	3.1	10.0	10	10	00	0.56	....	0.56	13
SUNDAY.... ...14	....	51.5	35.0	16.5	.. ...	......	......	....	. ..	...	....	W.	12.5	...	...		00	0.10	Inap.	0.10	14 ....SUNDAY
15	37.15	47.5	34.1	13.4	29.8525	29.947	29.664	.283	.1340	60.8	24.8	W	29 0	7.7	10	1	00	....	Inap.	Inap	15
16	43.52	47.0	36.2	10.8	29.5242	29.827	29.183	.644	2570	90.5	41.0	S W.	19 7	10 0	10	10	00	0.30	..	0.30	16
17	46.60	52.7	40.2	12.5	29.3972	29 640	29.174	.466	.2268	75.2	37.7	S.W.	25.3	7.2	10	1	16	0.03	....	0.03	17
18	43 78	51.3	38.0	13.3	29.9107	30.052	29.745	.307	.1958	70.0	33.5	W.	18.3	3.8	10	0	69	....	....	....	18
19	48.03	56.9	41.1	15.8	30.0150	30.102	29.928	.174	.2605	78.8	41.8	S.W.	9 0	5.7	10	0	54	...	...	....	19
20	47.20	52.3	42.1	10.2	30.0915	30.179	29.986	.193	.2827	86.8	43.7	N. E.	8.3	10.0	10	10	00	0.01	..	0.01	20
SUNDAY.. 21	.....	55.5	40.7	14.8	. .....	.....	......	...	.....		....	N. E,	9 7	....	....	.	12	Inap.	....	Inap.	21 ....SUNDAY
22	48.50	58.1	40.5	17.6	30.2430	30.270	30 193	.077	.2833	82.2	43.3	N. E.	6.5	3.0	10	0	83	...	....	....	22
23	53.15	57.9	48.2	9.7	30.2187	30.264	30.176	.088	.3400	84.5	48.2	S	0 7	10.0	10	10	00	0.06	....	0.06	23
24	50.20	54 3	48.1	6.2	30.1887	30.261	30.023	.238	.3268	89.8	47.2	S.	2.5	10.0	10	10	00	Inap.	....	Inap	24
25	48.90	56.5	47 0	9.5	30.2105	30.299	30 106	.193	3000	86.7	45 2	N.	7.3	7.5	10	0	19	Inap.	...	Inap	25
26	48.17	53.7	38.2	15.5	29.9858	30.091	29.919	.172	.2893	85.8	44.0	N.	11.8	4.3	10	0	12	0 01	....	0.01	26
27	51.12	58.5	42.6	15.9	29.9,80	30.048	29.931	.117	.3050	82.2	45 5	N.	7.0	1.7	10	0	36	....	....	...	27
SUNDAY 28	.....	60.3	42.0	18.3	....	......	......	....	.....	...	....	S.W.	4 1	....	...	..	69	...	....	..	28 ....SUNDAY
29	49.85	60.7	41.0	19.7	30.0687	30.103	30.036	.067	.2962	83 3	41.2	N.	12.2	1.7	10	0	72	Inap.	...	Inap	29
30	49.43	61.7	38.0	23.7	30.1002	30.154	30.050	.104	.2588	75.3	40.8	N.	12.5	3 3	5	0	68	....	...	....	30
31	49.77	53.6	47.2	6.4	29.6915	29 995	29.375	.620	.3077	86.0	45.7	S.	20.3	8.3	10	5	00	0 77	....	0.74	31
....Means	48.62	55.37	42.30	13 07	29.8942	....	.....	.256	2801	80.7	42.57	S. 62¼° W.	11.8	7.0	..	..	21.4	4.03	Inap.	4.03	Sums ....
20 Years means for and including this month	45.56	52.57	38.87	13.70	29.9958	....	....	.211	.2455	76 6	....	.....	....	6 5	..	.	¶40.2	3.21	1 34	3.34	20 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..............	1083	647	434	541	686	3175	2084	151	
Duration in hrs..	108	64	45	50	89	213	133	13	29
Mean velocity...	10.0	10.1	9.6	10.8	7.7	14.9	15 7	11.6	

Greatest mileage in one hour was 43 on the 31st.

Greatest velocity in gusts 48 miles per hour, on the 31st.

Resultant mileage, 3575.

Resultant direction, S. 62¼° W.

Total mileage, 8801.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only

The greatest heat was 65.5° on the 4th; the greatest cold was 34.1° on the 15th, giving a range of temperature of 31.4 degrees.

Warmest day was the 4th. Coldest day was the 15th. Highest barometer reading was 30.299 on the 25th: lowest barometer was 29.174 on the 17th, giving a range of 1.125 inches. Maximum relative humidity was 99 on the 5th, 10th 27th & 29th Minimum relative humidity was 47 on the 15th.

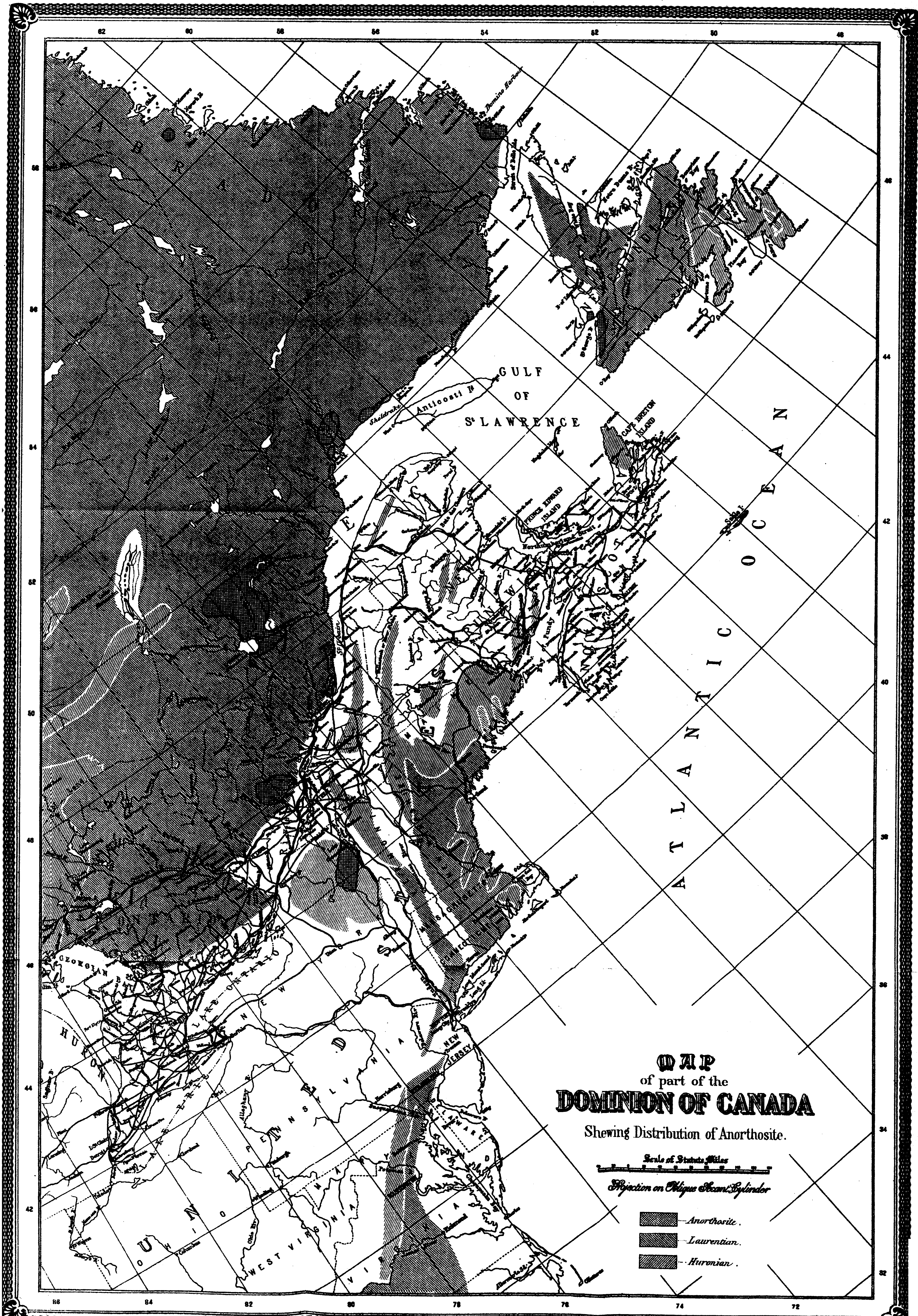
Rain fell on 22 days.

Snow fell on 2 days.

Lunar halos on the 9th and 12th.

Fog on 3 days.

Rainbow on the 16th.


MAP
of part of the
DOMINION OF CANADA
Shewing Distribution of Anorthosite.
Scale of Statute Miles
Projection on Oblique Secant Cylinder
Anorthosite.
Laurentian.
Huronian.
GULF
OF
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CAPE BRETON ISLAND
PRINCE EDWARD ISLAND
ATLANTIC OCEAN
LAKE ONTARIO
NEW JERSEY
WEST VIRGINIA