Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- ☐ Coloured covers/ Couverture de couleur
- ☐ Covers damaged/ Couverture endommagée
- ☐ Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- ☐ Cover title missing/ Le titre de couverture manque
- ☐ Coloured maps/ Cartes géographiques en couleur
- ☐ Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- ☑ Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- ☑ Bound with other material/ Relié avec d'autres documents
- ☑ Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure
- ☐ Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.

- ☐ Coloured pages/ Pages de couleur
- ☐ Pages damaged/ Pages endommagées
- ☐ Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- ☑ Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- ☐ Pages detached/ Pages détachées
- ☑ Showthrough/ Transparence
- ☐ Quality of print varies/ Qualité inégale de l'impression
- ☐ Continuous pagination/ Pagination continue
- ☐ Includes index(es)/ Comprend un (des) index

Title on header taken from:/ Le titre de l'en-tête provient:

- ☐ Title page of issue/ Page de titre de la livraison
- ☑ Caption of issue/ Titre de départ de la livraison
- ☐ Masthead/ Générique (périodiques) de la livraison

- ☐ Additional comments:/ Commentaires supplémentaires:

This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.

10X 14X 18X 22X 26X 30X

12X 16X 20X ✓ 24X 28X 32X

THE CANADIAN

RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF

THE NATURAL HISTORY SOCIETY OF MONTREAL,

AND REPLACING

THE CANADIAN NATURALIST.

VOL. V., (1892-1893.)

MONTREAL:

PUBLISHED BY THE NATURAL HISTORY SOCIETY.

1893.

EDITING AND EXCHANGE COMMITTEE.

FRANK D. ADAMS, Ph.D., *Chairman.*

G. F. MATTHEW, F.R.S.C., St. John, N.B.

REV. R. CAMPBELL, D.D.

J. F. WHITEAVES, F.R.S.C., Ottawa.

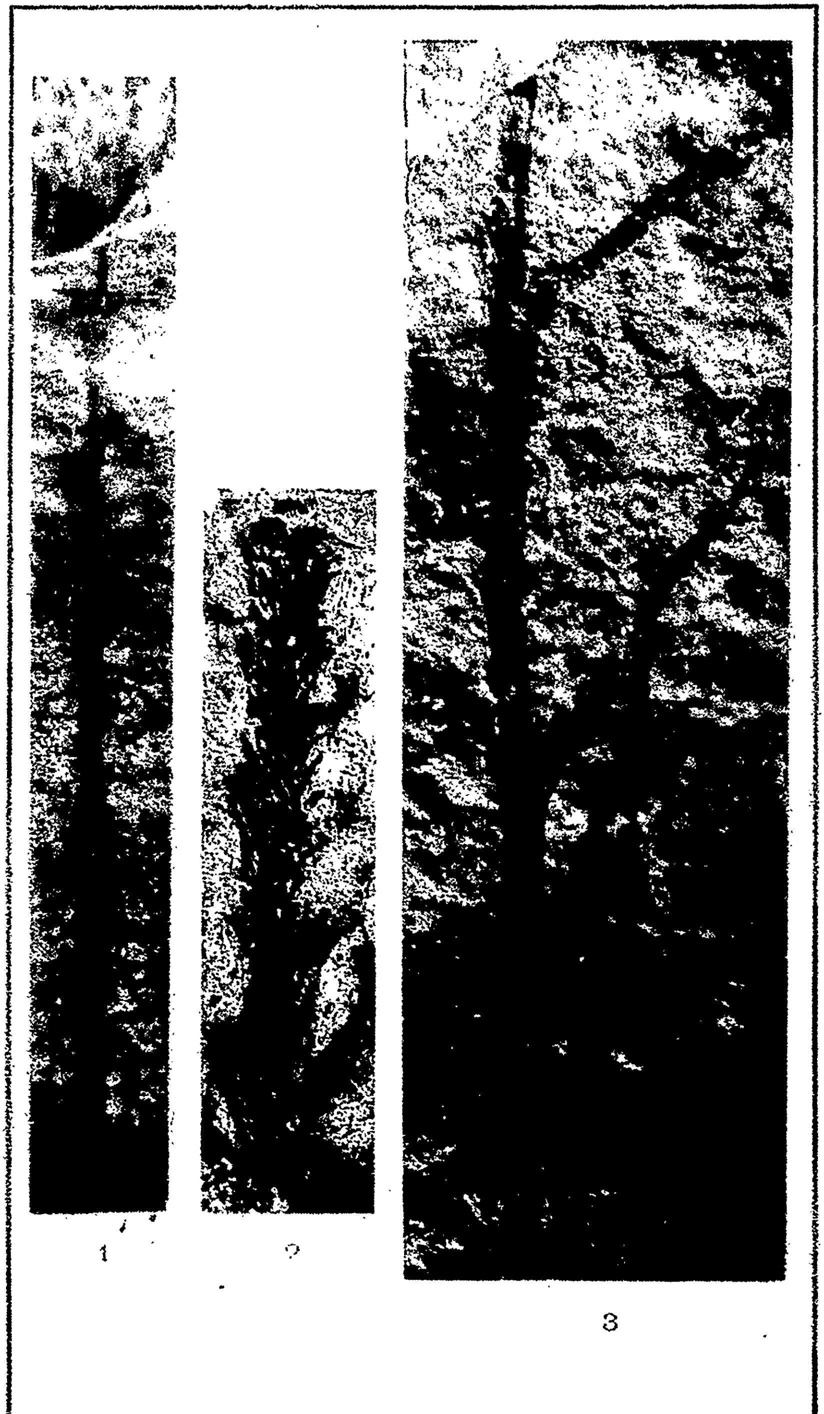
DR. T. WESLEY MILLS.

DR. B. J. HARRINGTON, B.A., Ph.D., F.G.S.

REV. W. J. SMYTH, B.A., B.Sc., Ph.D.

PROF. J. COX, M.A.

CONTENTS OF VOLUME V.



DEVONIAN PLANTS.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. V. JANUARY, 1892. NO. 1.

Additional Notes on Devonian Plants from Scotland.

By D. P. Penhallow, Professor of Botany, McGill University.

In a recent communication[1] I had an opportunity of discussing the structure and probable affinities of *Parka decipiens* on the basis of material supplied by Mr. Reid and Mr. Graham, of Scotland. Lately, the former gentleman has supplemented his previous large supplies of fossils by a number of interesting specimens which have reached me through Sir Wm. Dawson. This new material is in some respects the same as that already examined, but some of the specimens are much better, while others represent structures more or less wholly wanting in the first collection, and thus enable me to now complete the connection between the different forms in which *P. decipiens* occurs.

The views already expressed are not altered in any essential feature by this additional material, while many of the deductions drawn are verified and strengthened. I have, therefore, deemed it expedient to supplement my previous paper by a presentation of these additional facts, and also to discuss in connection therewith certain other species of Devonian plants associated with *Parka.*

[1] Trans. Royal Soc. Can. IX. iv.

PARKA DECIPIENS. Flem.

Bib.: Jn'l. Geol. Soc. XV. 407; XX. 413; XVII. 534; Miller, Testimony of the Rocks, 1857, 446; Cheek's Edinburgh Journal, 1831; Nature, April 10th, 1890; Page's Advanced Text-book, 1856, 127; Trans. Royal Soc. Can. IX. iv.

In the specimens recently received *Parka decipiens* is represented by both stems and fruit. In the slates from Myreton are two carbonized stems 5 and 5.5 c m. wide. Both are strongly rugose and folded back and forth as if in a highly pliable or partly decaying state when imbedded. The carbonaceous matter is much thicker and more generally abundant than in the case of any of the other specimens examined by me. In the larger of the two, which measured 78 c.m. in length, there were observed to be five rounded pits with an average diameter of 8 mm., strongly suggestive of the possible position of roots. No positive evidence of branches could be obtained.

In a specimen of sandstone from Rescobie, there was found an irregular mass, possibly the rhizome of *P. decipiens*, showing numerous small, round pits and processes about 4 mm. in diameter, also presenting the aspect of root stumps, but from the imperfect state of preservation it was quite impossible to trace any connection between it and the well defined stems of other specimens. From Rescobie there were also obtained two good impressions of masses of sporangia. The remains are ferruginous and belong to the type of the species.

PARKA DECIPIENS, Flem., var. MEDIA, Pen.

This varietal form is represented by stems which were not included in the material upon which the original description was based. They occur in the slates from Myreton, are slightly carbonized and measure from 15–20 mm. in width. In one case there was an imperfectly defined branching. The sandstones from Rescobie also contain ferruginous impressions of stems of the same width—15 mm.—which are distinctly branching, and in one case there is a strongly defined central axis, suggesting that these stems were possessed of a pith which became infiltrated with sand before the surrounding parts collapsed. There was thus preserved a central axis of somewhat coarse sandstone, which now stands prominently above the exterior and flattened structure.

The sporocarps of this variety are represented by very imperfect impressions. In my former paper,[1] I spoke of these remains as showing a distinct radial structure, but having no direct connection with *Parka*—association and their peculiar structure being the only grounds on which relationship could be established. The present material renders a more definite expression on this point possible, and an excellent figure showing not only their characteristic structure, but also the fact that the sporangia are contained in them, is given by Miller,[2] who also quotes Dr. Fleming[3] as saying that "these organisms occur in the form of circular patches, not equalling an inch in diameter, and composed of numerous smaller, contiguous pieces. They are not unlike what might be expected to result from a compressed berry such as a bramble or the rasp." Our original contention, therefore, that these circular bodies with radial structure represent the sporocarps of *Parka*, may be considered as well founded.

PARKA DECIPIENS, Flem., var. MINOR, Pen.

This variety is represented by the full sporocarps and also by branching stems and leaves similar to those already described. The sporocarps answer to all the characteristics already assigned them and further comment is not necessary.

The stems (Plate I, fig. 3) show the usual rugose surface and characteristic branching, and in the figure here given the generic characteristics of form are well shown. Near the base of the figure are what appears to be two branches. These, on closer inspection, prove to be separate structures lying *across* the stem of *Parka*. The lower

[1] Trans. Royal Soc. Can. IX. iv.
[2] Testimony of the Rocks, 44 ; fig. 121.
[3] Cheek's Edinburgh Journal, 1831.

one answers to what Salter has described, from the same formation, as roots,[1] but which are probably referable to *Psilophyton*. To this same category—roots—Kidston refers a plant figured by Salter[2] some years ago, but which would appear from the figure given to belong more properly to *Parka decipiens* var. *minor*.

A revision of the descriptions of *Parka* to embrace the new facts at hand would be as follows:—

GENUS PARKA. Flem.

Aquatic plants with creeping, rugose stems, linear leaves and sessile sporocarps, bearing two kinds of sporangia. Sporangia, 2 mm. in diameter; macrospores, 40 μ; microspores, 15 μ.

These fossils occur in micaceous slaty or sandy shales. Their most characteristic appearance is that of oval bodies or fragmentary masses showing rounded discs or impressions of such. They are sometimes carbonized, often ferruginous. From the Lower Devonian of Myreton, Rescobie, Blairgowrie, Thurso and Caithness, Scotland. Reid and Graham.

PARKA DECIPIENS, Flem. Stems about 4–5 c.m. in diameter, showing branching about 11 c.m. distant. Leaves, linear, 1 c.m. broad, with somewhat rounded terminations. Sporocarps, oval, 3.5×5.5 c.m., being more or less conspicuous impressions of the contained sporangia.

The sporocarps are sometimes complete, though generally found in fragments, either carbonized or ferruginous.

α. MEDIA, Pen. Stems, 15–20 mm. wide, and with the oval sporocarps nearly entire, 13×20 mm. broad, and often showing a distinctly radial reticulation. Impressions of the sporangia distinct, usually carbonaceous. Leaves unknown.

β. MINOR, Pen. Stems, 4 mm. broad, with branches 2.5–3 c.m. distant. Leaves linear, 1.5–2 mm. broad, sometimes finely veined, Sporocarps oval, 6–11 mm. broad. Impressions of the sporangia distinct, usually carbonized.

[1] Jn'l. Geol. Soc., Plate V, figs. 3, 4.

[2] *Ibid*, Plate V, fig. 6.

British Mus. Cat. Pal. Plants, 233.

LYCOPODITES MILLERI. Salter.

Bib: Quart. Jn'l. Geol. Soc. XIV. 75, pl. V. 8 a, b, XV. 407 fig. 3, XXXIII, 215, 216; Miller, Testimony of the Rocks, 1857, 55, fig. 12; Kidston, Brit. Mus. Cat. Pal. Plants, 232; Dawson, Can. Nat. VIII, Feb. 1878, fig. c.; Solms-Laubach, Fos. Bot.

This species is represented by a carbonised stem 8 mm. wide and 24 cm. long, somewhat thicker at the lower end. There are two obvious branches which divide dichotomously. Impressions of scales are obvious though poorly defined—for the most part obscure. The whole aspect of the plant reminds one strongly of *Lycopodium clavatum* as already noted by previous observers. The leaves are evidently narrowly lanceolate and acute. Comparison with another specimen from Caithness, now in the Peter Redpath Museum of McGill College, and with Salter's description of this plant,[1] shows complete identity. It is an unfortunate circumstance, however, that in none of the specimens so far collected, has the fruit been obtained. If a true lycopod, then from its resemblance to recent species, we might conceive the fruit to have been produced as a special spike raised on a more or less elongated branch as in *Lycopodium clavatum.* But in the present state of our knowledge of of this plant, such views must necessarily be regarded as purely conjectural.

Since this plant was first described by Salter, various attempts have been to identify it with *Lepidodendron* and *Psilophyton*,[2] in consequence of which some confusion has arisen relative to its true characteristics. An examination of all the specimens now in the Dawson collection of McGill College, and careful comparison with type specimens of *Lepidodendron* and *Psilophyton* in the same collection, as well as a review of the descriptions and figures published from time to time leads me to the conclusion that the name *Lycopodites* as assigned to this plant by Salter must be maintained, and this view is strengthened by comparison with *L. matthewi*, Dn., and *L. richardsoni*, Dn.[3]

[1] Jn'l. Geol. Soc. XIV, 75.
[2] Kidston, Brit. Mus. Cat. Pal Plants, 232.
[3] Jn'l. Geol. Soc. XIV., 75 Plate V., figs 8 a, b.

In the original description of this plant by Salter,[1] he states that "the leaves are very indistinct, but about 1/8 of an inch long, lancolate (obtuse ?) and much curved upward to one side (the upper side probably). There is some indication of their being set on in spiral lines, instead of quincuncially." This points directly to the probability of the plant having a prostrate, creeping habit of growth after the manner of our modern *Lycopodium clavatum*, and is a view well borne out by all the specimens which have passed through my hands. This resemblance is also heightened by the fact that the extremities of the branches in *L. milleri* are often somewhat swollen exactly as may be seen in a growing plant of *Lycopodium clavatum.* This, Sir Wm. Dawson has regarded as the possible fruit,[2] but I should rather consider it as representing the terminal bud. The leaves show no distinct articulations with the stem nor do they, on removal, leave upon the latter well defined scars as in *Lepidodendron*, though the spiral arrangement common to both these genera might be regarded as an indication of affinity, but of very subordinate value. While the character of the fruit in *Lepidodendron* is fairly well known,[3] it is as pointed out, wholly unknown in *Lycopodites.* A distinction of this genera must for the present, therefore, be based upon the superficial structure as represented in the leaves, leaf scars and general form and aspect of the plant.

From this point of view I have carefully compared *Lycopodites milleri* with *Lepidodendron gaspianum* which Kidston regards as identical,[4] employing for this purpose specimens preserved in the same matrix, *i.e.*, sandstone shale, in order to ensure that the plants were subjected to similar conditions. I find that while in the former, the leaves closely overlap so as to render their points of inser-

[1] Jn'l. Geo. Soc. XVIII, 314; XIX, 461 Pl. XVIII, fig. 112; Can. Nat. VI, 179, fig. 10; Foss. Plants Dev. and Up. Sil., 1871, 34, 35, Pl. VII, fig. 81, and VIII, 85, 86, 87.

[2] Can. Nat. VIII, p. 383.

[3] Rept. Geol. Surv. of Canada, 1871; Dev. and Up. Sil. Plants 33, Pl. VIII., fig. 84.

[4] Brit. Mus. Cat. Pal. Plants, 232.

tion somewhat obscure and there are no leaf scars or distinct articulations and the spiral arrangement, while possible, is obscure, in the latter the leaf scars and articulations are prominent, the leaf positions distinctly separated and the arrangement strongly spiral. To this we may also add that while in *Lycopodites milleri* the habit of growth was prostrate in *Lepidodendron gaspianum* it was erect. The entire aspect of the two plants is quite distinct and they should, I think, be so considered.

The genus *Psilophyton*, as described by Sir Wm. Dawson,[1] represents again quite a distinct group of plants. Referring to the description of the plants upon which the genus was founded, I find it to indicate "Stems branching dichotomously, and covered with interrupted ridges. Leaves rudimentary or short, rigid and pointed; in barren stems, numerous and spirally arranged; in fertile stems and branchlets sparsely scattered or absent; in decorticated specimens represented by minute punctate scars. Young branches circinate; rhizomata cylindrical, covered with hairs or ramenta, and having circular areoles irregularly disposed, giving origin to slender, cylindrical rootlets. Internal structure, an axis of scalariform vessels, surrounded by a cylinder of parenchymatous cells, and by an outer cylinder of elongated woody cells. Fructification consisting of naked, oval spore cases, borne usually in pairs on slender, curved pedicels, either lateral or terminal."

By comparison with the type specimens in the Peter Redpath Museum, and both with *Lycopodites milleri*, I find that there is no ground upon which the two can be properly identified as belonging to the same genus. Indeed, the differences are even more marked than those so readily observable between *Lycopodites* and *Lepidodendron*. The interrupted ridges and circular areoles of *Psilophyton* as appear in the description above quoted, are absolutely wanting in the specimens of *Lycopodites* in my hands. Again, the greater number of specimens of *Psilophyton* show it to

[1] Rept. Geol. Surv. Can., Foss. Plants of Dev. & Up. Sil. 1871, p. 37; Jn'l. Geol. Soc. XV, 478, 479; Can. Nat. VIII, p. 379.

have been distinctly woody, while all the specimens of *Lycopodites* so far brought to my notice indicate that it was of a much more herbaceous character. To these differences we may add that the strongly recurved branchlets and the peculiar mode of ramification; also the pair of spore cases on slender, curved pedicels as found in the former,[1] are wholly wanting in the latter,[2] giving to the two plants widely different aspects.

Sir Wm. Dawson assures me that his reconstruction of *Psilophyton* was based upon laborious explorations in the beds where it was found. By systematic excavations the various parts of the plant were traced from the roots upward, and their connection thus established. In the absence of complete plants, such a method of recovery is well adapted to guarantee accuracy in the final results. I cannot but feel, therefore, that the figure of *Psilophyton princeps*[3] as the type of the genus, is correct as to the general form and habit of growth. In such case we cannot fail to see that the genus is quite different from the plants now included under *Lycopodites* as represented in the figures already given.

Lepidodendron nothum, Salter, is again distinct from *L. gaspianum*, Dn., though approaching it much nearer than it does to *Lycopodites milleri* on much the same grounds as already given. I have, however, not had access to a good type specimen of this plant, and must therefore advance an opinion with some degree of reserve.

LYCOPODITES REIDII, n. sp.

Plate I. Fig. 2.

In association with *L. milleri* from Caithness, there was obtained in Reid's collection another lycopodiaceous plant, which, however, differs from any of the above genus here-

[1] Rept. Geol. Surv Can. 1871, Dev. & Up. Sil. Plants, Plate IX, figs. 102, 103; Jn'l. Geol Soc. XV. 479, fig. li.

[2] *Ibid* XIV, Plate V, fig 8a.

[3] Jn'l. Geol. Soc. XV. 479, li; Reports. Geol. Surv. Can. Foss. Plants of Dev. & Up. Sil. Pls. IX, X, XI.

tofore described in important particulars. The specimen is a carbonized fertile stem 8 c.m. long and 6 mm. wide, showing a short branch near the base. The leaves are narrowly lanceolate, acute and somewhat spreading. The basal articulation of the scales is obscure, but among these organs, sometimes strictly basal or again scattered irregularly over the entire remains, are carbonized sporangia 1 mm. in diameter. The indications of the specimen point to a spiral arrangement of the leaves. The whole aspect of the plant is strongly suggestive of *Lycopodium selago*, both in its general form and the way the fruit is produced. (Plate I, Fig. 2.) The accompanying figure, giving an ideal

section of the fertile axis, will convey some idea of the relation of sporangia, leaves and central axis. I therefore deem it expedient to distinguish it by a separate name as *L. reidii*. The description would then be as follows:

Lycopodites reidii, n. sp.

Stems branching. Leaves disposed spirally, narrowly lanceolate, acute, 5 mm. long, 1 mm. broad at the base. Sporangia globular, 1 mm. broad.

Devonian of Scotland. Reid.

ZOSTEROPHYLLUM MYRETONIANUM, gen. et sp. nov.

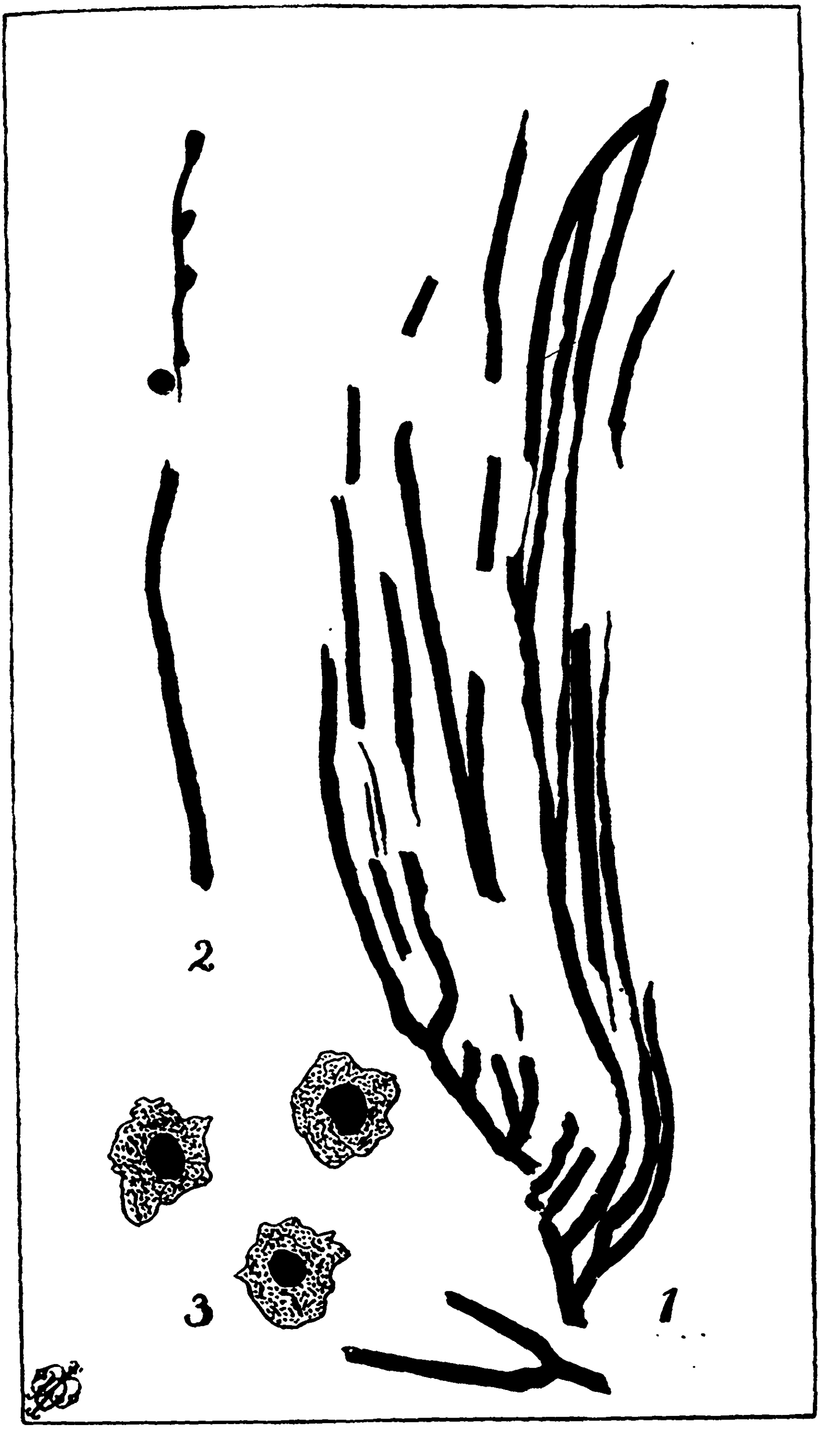
In my former paper [1] I described certain impressions in the slatey shales of Myreton as linear leaves often showing longitudinal striations like a fine parallel veining, and showed that in one specimen received from Mr. Reid from

[1] Trans. R. Soc. Can. IX, iv.

Caithness, these leaves were aggregated in the form of a tuft apparently proceeding from a common horizontal stem. Miller exactly describes their appearance [1] when he speaks of them as "ribbon-like fronds or branches which rose by dozens from a common root, like the fronds of Zostera, and somewhat resembled a scourge of cords fastened to a handle." These remains he refers to as fucoids. The peculiar appearance they present has more than once been commented upon, and in my former paper on *Parka decipiens,* I was inclined to regard them as possibly representing the leaves of *β. minor.* So far as the material then examined would enable me to judge, there was no good ground for disputing this view. The material now in hand, however, is of such a nature as to justify an entirely different view and lead me to consider them the remains of a distinct plant, which, however, is associated with leaves of *P. decipiens β. minor* and with stems of *Psilophyton*, the parts of one often bearing a somewhat strong resemblance to parts of the others, when such parts are considered separately and not in connection with the entire plant.

In a large flag from Myreton, one of these plants is found. As will be seen from the figure, it shows a central axis—probably horizontal, from which there arise simple and linear leaf-like organs, also other linear organs which repeatedly branch. (Plate II, fig. 1.) The origin of the ribbon-like leaves from a horizontal stem is very suggestive, as Miller has pointed out, of *Zostera*, but in comparing this fossil with specimens of *Zostera* in the flowering stage, I find the resemblance to be even more striking, since the simple filaments are the counterpart of the leaves of that plant and the branching filaments are strongly suggestive of the inflorescence. Indeed the suggestion is so strong that were we to take a handful of *Zostera* in the flowering state and throw it down to be afterwards covered up by mud and hardened, it would present precisely the aspect of the fossil in question. It is hardly to be supposed that flowering plants flourished at the remote period to which this fossil

[1] Testimony of the Rocks, 446.



Devonian Plants.

belongs, and there is no present evidence to show that they did, but I think the unique character of this plant will justify us in regarding it as of a new genus, for which I would suggest the name *Zosterophyllum*, to be specifically known as *myretonianum*. It must be clearly understood, however, that the application of this generic name is not intended to denote affinity with *Zostera*, but merely a general resemblance.

Closely associated with *Zosterophyllum*, I found a branch bearing rounded and ovoid sporangia like bodies (Plate I, fig. 1) which are given in the figure of natural size. It will be seen that there are two conspicuous lateral processes or branches, the uppermost of which bears a distinctly globular body or sporangium (?). Above the second sporangium there is a short fragment of stem which probably represents a continuation of the same axis. The sporangia show no subtending bracts, nor is any structure visible. They are in each case completely flattened out so that only the impression remains.

A second fruiting branch of the same nature, but with less mature fruit, is shown in the drawing of natural size (Plate II, fig. 2). This is much more intimately associated with *Zosterophyllum* than the preceding, being completely surrounded by leaves and branches from which it was at first difficult to separate it. Both agree in their essential features, but as in neither no actual connection was found to exist with *Zosterophyllum*, it is impossible to say what the precise relationship is, though from their general form and structure we might infer that these fruiting spikes were thrown up directly from the horizontal rhizome.

It is highly probable that the round, seed-like bodies (Plate II, fig. 3), which also occur abundantly, and which I was unable in my former paper,[1] to satisfactorily account for, are the same fruits in a mature condition. These bodies show a very slight carbonaceous film surrounding a mass of slaty stone as a nucleus, thus lending probability to the view that they represent sporangia, the contents of which

[1] Trans. R. Soc. Can. IX, IV, Plate I, fig. 6.

have been replaced. I think it is also safe to consider the structure figured by Salter,[1] but referred to by him as "rootlets with lateral tubercles," as of the same nature. All of the bodies may be regarded, therefore, at least provisionally, as the fruit of *Zosterophyllum.*

Finally, the remains so far submitted to us show that the plants were not strongly vascular, but that they were, on the other hand, very soft and herbaceous.

The characters of this plant, so far as at present determinable, may be stated in the following terms:

GENUS ZOSTEROPHYLLUM, n. gen.

Aquatic plants with creeping stems, from which arise narrow dichotomous branches and narrow linear leaves of the aspect of *Zostera.* Fruit, an ovoid or spherical sporangium (?), produced on short pedicels, without subtending bracts, from a single axis, the whole forming a loose spike.

Lower Devonian of Myreton, Scotland. Reid.

Z. MYRETONIANUM, n. sp. Stem and branches, 2 mm. in diameter. Leaves linear, 1.5–2 mm. wide, often showing an inconspicuous veining. Sporangia, 2.5–4 mm. broad, round or ovoid. Superficial structure, none.

In connection with the above, it may also be well to place on record the suggestion of Sir William Dawson that some of the narrow *Zostera*-like leaves described by him from Gaspé and Baie des Chaleurs, and provisionally referred to his species *Cordaites angustifolia*, may also belong to the genus *Zosterophyllum* as above described. Specimens in his collection would seem to corroborate this view.

EXPLANATION OF PLATES.

Plate I.

Fig. 1. Fertile stem of ZOSTEROPHYLLUM MYRETONIANUM, showing three fruit bodies. Natural size.

Fig. 2. Fertile branch of LYCOPODITES REIDII. Natural size.

[1] Jn'l. Geol. Soc. XIV, Pl. V, figs. 7 a, b.

Fig. 3. Branching stem of PARKA DECIPIENS β MINOR, showing at the base, a stem of PSILOPHYTON and a fragment of PARKA lying across it. Natural size.

Plate II.

Fig. 1. Plant of ZOSTEROPHYLLUM MYRETONIANUM. Natural size.

Fig. 2. Fertile stem of Z. MYRETONIANUM (?) showing immature fruit bodies. Natural size.

Fig. 3. Separate and mature fruit bodies of Z. MYRETONIANUM (?). Natural size.

SOME LAKE AND RIVER TEMPERATURES.

By A. T. DRUMMOND.

In *Nature* and this journal, I have already drawn attention to the fact that the Georgian Bay is, in its main expanse, a large body of cold water whose temperature, at its greater depths, is not much influenced by the heat of summer, whilst, on the other hand, the Central and Southern Basins of Lake Huron, although also receiving surplus waters from Lake Superior, stand in the line of inflow of the warmer waters from Lake Michigan and of their ultimate exit by way of the River St. Clair to the lower lakes, and are consequently somewhat warmer basins.

Staff-Commander Boulton, R N., has been good enough to communicate some further records of temperature made during the season of 1890 in the Georgian Bay and the channel north of the Manitoulin Islands. These, taken in connection with his former results, justify certain conclusions to which reference will be made in this paper.[1]

PARRY SOUND.

In the course of his soundings during 1890 in the deep and wide but land-locked harbor of Parry Sound, on the eastern coast of the Georgian Bay, with its fringe of islands

[1] The readings in this paper are all from Fahrenheit's scale.

and comparatively shallow waters in front, some temperatures were taken, at different periods of the summer, which establish the fact that notwithstanding the presence of islands in the sound, and of land on all sides, at no place more than two to three miles distant, the deep depressions or pools in the bottom of the sound, in some places exceeding sixty fathoms in depth, retain their cold water throughout the year. The change observed at the bottom between the beginning of May and the end of August did not exceed 3.5°, whilst in the same period the variation at the surface was 25.5°. The observations have sufficient interest to be given here:—

Time.	Depth.	Air.	Surface.	Bottom.	Sky.
May 2nd, noon....	62 fms.	48°	36.2°	35.7°	Clear
Aug. 23rd, 5 p.m..	48 "	64°	61.7°	39.2°	Some clouds
Oct. 15th, 4.10 p.m.	57 "	57°	53.5°	39°	Overcast

How far the cold waters of these deeper pools in a land-locked harbor like Parry Sound, which is largely free from the direct influence of outside currents, are subject in summer to much change, not merely in temperature but through circulation, is worth considering.

Referring to the Georgian Bay generally, Commander Boulton infers from the temperatures which he has taken that, in the early spring of the year, the whole column of water is at nearly the surface temperature, and that the effect of the summer's heat is to warm up the bottom water to about the temperature of water at its greatest density, viz., 39.2°.

INFLUENCE OF LAKE SUPERIOR WATERS ON GEORGIAN BAY TEMPERATURES.

In considering why the bottom waters in the Georgian Bay retain so low a temperature throughout the summer, regard must be had to the direction of the inflow of the waters from both Lake Superior and Lake Michigan. A reference to a chart of the Great Lakes will help to explain this. The waters of Lake Superior—always cold—find their outlet to Lake Huron through the River St. Mary. The island of St. Joseph divides the river, as it joins Lake Huron, into two channels, one of which transmits its waters partly through the Detour into the Central Basin of the lake, and partly into what might be termed the Manitoulin Basin, on the north side of the Manitoulin Islands, whilst the other channel guides its waters entirely into this latter basin. It at once suggests itself that the waters of this Manitoulin Basin must be cold, and that the flow of these colder waters, whilst in part to the Central Basin of Lake Huron by the channels between the islands, is more probably largely along the north side of these islands and into the Georgian Bay, thus continuously keeping up the supply of cold water, which is so conspicuous a feature in that bay. Commander Boulton's records seem to me to help this suggestion. Thus, in the Manitoulin Basin, north of Cockburn Island, on June 3rd, 1890, at 10.30 a.m., with a cloudy sky and the air at 54°, the surface water indicated 44.7°, whilst the temperature at 29 fathoms was 39°; and, again, at another point nearer Cockburn Island, at 8.30 a.m., on the next day, when the sky was clear and the air at 66°, the surface of the water was 46.5°, whilst the bottom at 18 fathoms indicated 39.7°.

Again, the preponderating current in the channel between La Cloche Island and the north shore of Manitoulin Island, at the point known as Little Current, is, Commander Boulton informs me, towards the Georgian Bay. As an easterly wind may reverse its direction for the time, he suggests that the easterly current might be merely surface-drift, due to the prevalence of westerly winds. My own impression is that it will be found to be a permanent, deep current, flowing towards the Georgian Bay.

It is, however, also suggestive that the cold waters from Lake Superior which do pass through the Detour, and the channels between the Manitoulin Islands into the Central Basin of Lake Huron, are not immediately incorporated with the warmer Michigan outflow, but trend in an easterly and south-easterly direction towards the Georgian Bay and

Bruce Peninsula, and constitute a barrier to the extension easterly of these warmer Michigan waters. The few surface and bottom readings obtained by the United States Lake Survey would appear to justify the suggestion, as the waters in the broad line of flow from the Straits of Mackinac to Sarnia indicated 10° warmer at the bottom and 6° to 7° at the surface than those in the Central Basin to the east of this general line.

YAMASKA RIVER.

Two or three weeks holiday, spent last August at Yamaska Mountain, on the banks of the Yamaska River, gave me the opportunity of making numerous thermometrical tests of the relations between the water and the overlying air, and, inferentially, of the influence which water in larger bodies must have on the temperature and agricultural capabilities of the neighboring land.

The river here is from 300 to 400 feet wide and from 10 to 15 feet in depth. and flows in a very serpentine course through a broad stretch of level country, the only conspicuous break immediately near being the isolated Yamaska Mountain, which, about half a mile back from the river, rises precipitously to a height of about 900 feet, and is, from summit to base, clothed with pines, spruces, maples and other trees. On the Abbotsford side, the incline is gradual, and affords both room and protection for the extensive orchards which there are laid out with a semblance of mathematical exactitude on the mountain side. Viewed from the mountain, the great plain here has been almost denuded of its woods, and, with the tracery of unsightly fences, is at every point subdivided into cultivated farms. The wind has, therefore, but little to break its force as it sweeps over the great plain and past the mountain sides. Where our headquarters were on the banks of the river, in full view of the sombre mountain which lay about half a mile away, the gales were frequent, sometimes violent. The river, however, flowed in its tortuous course between precipitous banks of from 15 to 20 feet high, and generally presented a comparatively unruffled surface, which favored the taking of temperatures.

In a shallow river like the Yamaska, whose waters are readily swollen by very heavy rains, and whose course is broken here and there by milldams, the temperature of the water is necessarily somewhat uniform, excepting so far as the surface may be influenced by the sun's rays by day or by the coolness of the night air. Thus, on days when the sky was continuously overcast, this uniformity was frequently observable, whilst in the bright sunshine of early August, the surface would indicate from 1° to 2° higher than at about four feet depth. The general temperature of the water at that depth in the earlier part of the month was about 77°, but by September 8th it had fallen gradually to 68°.

INFLUENCE OF TEMPERATURE OF WATER ON THE IMMEDIATELY OVERLYING AIR.

The temperature of the river water was about 6° to 7° higher than Lake Ontario waters at about the same depth and the same period in August would be, but the protection which the river banks afforded from the wind, and the, at oft times, comparatively unruffled surface, aided in rendering the tests made here more definite than, on the open lake, they could generally have been. The readings were taken (1) at one inch below the surface of the water, (2) in the air one inch above the surface, (3) at one foot and one foot and a-half above the surface, and (4) on the top of the bank at about sixteen feet above the river level. Cloudy days were selected, though some tests were made at sunset.

The features of interest which from the first presented themselves were, as might be expected, the much higher temperature of the surface water over the immediately overlying stratum of air, and the extreme variation in this difference of temperature. It was not uncommon to find this difference amounting to 6° @ 8°, although it sometimes was as low as half a degree, and on one occasion, at 7.45 p.m. on the 13th August, rose to nearly 18°, and was then accom-

2

panied by a light vapour over the water. In the ascent from this stratum of air directly in contact with the water, to the top of the bank, there was a constantly varying but gradually lower temperature. At one and a-half feet above the water the readings fluctuated between .5° and 3° lower than at one inch above the water, and on the top of the bank these fluctuations ranged from .5° to 4.5° lower than at one inch. In only one case was the reading on the top of the bank higher in range. Four illustrations are here given to show the relative temperatures (1) during a continuous dense fog, (2) and (3) at different hours on the same cloudy day, and (4) at sunset on a cloudy cool day:

	(1) 9 a.m. Aug. 16. dense fog.	(2) 4 p.m. Aug. 31. cloudy.	(3) 7 p.m. Aug. 31, cloudy—water absolutely calm.	(4) 7.15 p.m. Aug. 28, cloudy—cool.
Water at 3 ft..........	71.75°	68°	.....	67.2°
Water at 1 in..........	71.75°	68°	68.25°	66.5°
Air 1 in. above water..	68.5°	66°	66.25°	57°
" 1 ft. " " ..	66.75°	63.5°	61.5°	55.5°
" 8 ft. " " ..	.....	63°	.....	....
" 16 ft. " " ..	65.75°	62°	60.25°	55°

In the case of the second illustration, when the thermometer at 8 ft. up the bank was placed upon the moist ground there, the mercury rose from 63° to 64.5°. On the top of the bank, about 300 ft. inland in the fields away from the woods, it remained at 62°, but in the woods 200 ft. nearer the bank of the river it fell to 60.5°, the thermometer in each case being placed at about 18 in. above the ground.

CONCLUSIONS.

The readings are suggestive of the condition of probably most of the tributaries, from the south, of the St. Lawrence and Great Lakes during the hot months of summer. The tests were not sufficiently varied, as to place and time, to warrant definite deductions, but it may be said, in general terms, that these rivers, which in winter are paved with two or three feet of ice, have in early August a general temperture of 76° to 77°: that the air in direct contact with the warm surface of the water has, in that month, its temperature raised to from 1° to 5° above that of the air directly above but in more exposed positions: and that this increase of temperature, which is greatest at the point of contact, is, at one foot above the surface of the water, already to a considerable extent lost.

On the Collection of Samples of Water for Bacteriological Analysis.

By Wyatt Johnston, M.D., Montreal.

I have been prompted to describe my method of collecting samples of water for bacteriological examination, in the hope of its being of service to those who are anxious to do field work in this department of bacteriology.

Certain principles govern this work which cannot be neglected without introducing serious sources of error. First, the bottles in which the samples are to be taken must be sterilized by a dry heat of 150° C. and afterwards kept out of the reach of contamination from outside sources (especially from dust) until the moment when the water is collected. To this end the mouths of the bottles must be kept from contact with the fingers, and the stopper is only to be removed in the water. Second, the manipulations must be rapid enough to permit of a large number of separate samples being collected, and finally, these should be taken from such points as will ensure their affording a fair index of the body of water under examination, as the number of bacteria in samples taken at different places from the same water often varies considerably.

The method usually adopted, that of immersing the bottle at arm's length and removing the stopper under water, though fraught with much personal discomfort in cold weather, is tolerably secure from contamination at the mouth of the bottle, but it has the disadvantage of only giving the number of bacteria at the surface of the water. In the case of a rapidly flowing stream this is of little moment as the water is sure to be thoroughly mixed and the bacteria pretty evenly distributed. In standing bodies of water, such as lakes, ponds, reservoirs and wells, the bacteria for the most part sink to the bottom, so that the number of bacteria found at the surface affords no indication of their number in the deeper part, from which usually supply pipes are fed in the case of drinking waters.

In the course of a recent biological examination of the waters of the Ottawa and St. Lawrence rivers it was found necessary to take samples at some distance beneath the surface. In winter, when samples were obtained through a hole cut in ice, often from one to two feet in thickness, the water which welled up into the hole was found to be contaminated by the instruments used in cutting it. On one occasion the water in the ice hole yielded 8,000 colonies per c. cm., while a sample obtained from the running stream beneath the ice only gave 30. Lying beneath the solid ice running water there is often found a stratum of "*frazil*" ice. This consists of a dense mass of small, sharp ice fragments which have at one time been in contact with the bed of the stream and have then become contaminated from the soil. That water obtained from the midst of a bed of "*frazil*" ice is unsuitable for bacteriological examination was shown by one examination of St. Lawrence water made in mid-winter, when two samples from a bed of *frazil* yielded respectively 473 and 480 colonies per c. cm., while clear water from an adjacent spot gave only 77 and 39.

In endeavoring to obtain some apparatus suitable for obtaining deeper samples, I was surprised to find no mention of anything of the kind in any dealers' catalogues; their poverty in this particular contrasting strangely with the wealth of appliances available for other purposes.

It thus became necessary to procure some simple form of apparatus, secure from sources of extraneous contamination and rapid enough in its working to enable me to obtain a large number of individual samples.

My first attempt was made with the assistance of Dr. R. F. Ruttan. We prepared a set of wide-mouthed bottles, fitted with perforated corks in which two open glass tubes were fitted. To one of the tubes a long rubber tube was attached, the end being guarded by a stop-cock. The bottles, with their glass tubes attached, were sterilized by dry heat and the rubber tubing was steamed separately for several hours. After sinking the bottle to the required depth by attaching a weight, upon opening the stopcock the water displaced the air in the bottle. The method seemed to give accurate results, and in each case a bit of the tubing reserved for the control test of washing it out with sterilized water yielded no bacteria colonies. The sterilization seemed to be perfect, but the method was abandoned as it was found too troublesome to sterilize a separate length of tubing for each sample that was to be taken.

I had obtained by this time some collecting bottles from Messrs. Eimer & Amend of New York. These were made of very heavy glass and held about a pint, the stoppers consisting of a rubber ring fitted round to a glass rod which lay within the bottle, and was so arranged that the stopper could be pulled up against the lower part of the neck from within by means of a wire attached to the glass rod.

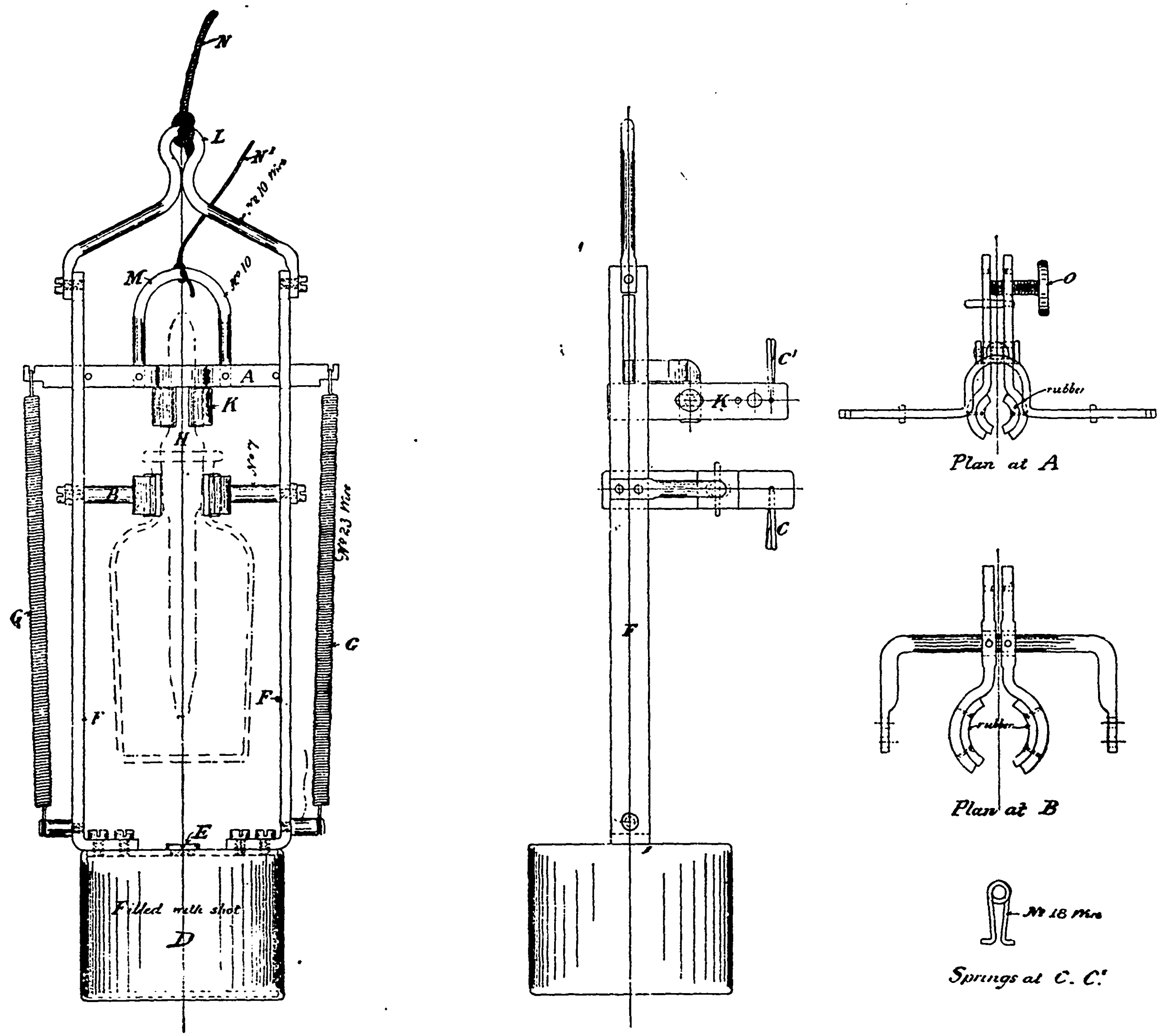
In using this bottle one line was attached to the neck of the bottle and one to the wire fastened to the rod shaped stopper. The bottles were lowered by this second line, thus holding the stopper tightly against the neck of the bottles and so preventing the water from entering, until, at the desired depth the strain was taken off the stopper by pulling in the line attached to the neck of the bottle allowing it to fill, the stopper being heavy enough to fall from its own weight. This was open to the obvious objection that the neck of the bottle above the rod shaped stopper filled with water from the surface, most of which was afterwards naturally washed into the bottle. Besides this the precautions necessary to guard against contamination of the wire while attaching the string, and the necessity of having a separate bottle for each sample collected, rendered them inconvenient for field use.

The method of using sealed tubes or flasks with a tapering end bent at right angles to be broken off under the water, has been recommended by Escherisch of Munich. This is much more free from technical sources of error than the apparatus last mentioned, but the trouble of preparing such flasks is considerable, as one has to be manufactured for every sample to be taken.

In the last edition of Rohrbeck's catalogue I find an apparatus figured for collecting bacteriological samples at different depths. From the impression conveyed by the illustration it seems too complicated to be easily handled, and the entire apparatus evidently requires to be re-sterilized before a second sample can be taken.

At this stage my attention was directed to a most ingenious apparatus invented by Prof. Ellis of Toronto University, which differed from all the others in principle. This was a device by which sterile glass stoppered bottles could be placed in a weighted frame and lowered to the required depth. By pulling a string the stopper could then be raised sufficiently to allow the water to enter. By releasing this end the stopper was instantly replaced by means of a spring. Any number of samples could be taken, as the bottles could be placed in the frame one after another with very little loss of time. The advantages of this as compared with the plans described above are very great. There is absolute certainty that no water is obtained from any except the required depth. There is no limit to the number of samples which can be taken, and all the preparation necessary is limited to sterilizing the bottles. It is also far more economical, as a single sinking frame contains in itself the attachments for opening and closing the bottles.

The instrument I am about to describe is a modification of that devised by Prof. Ellis, and I can claim no originality whatever with regard to the principle of opening



Dr. Wyatt Johnston's apparatus for collecting Samples of Water for Bacteriological Analysis.

Reduced one-half (linear).

and closing glass stoppered bottles under water. My apparatus, though a modification of Prof. Ellis', contains improvements of my own which render it specially adapted to taking large numbers of samples by making it simpler in construction and more rapid and accurate in action. All who have worked at water analysis know the great importance of making a very large number of separate observations before drawing conclusions.

My outfit consists of one collecting frame, shown (reduced to one-half its linear dimensions) in Plate III., into which the bottles can be successively fitted. It was made under my direction by Mr. O. Wendell, of 170 Coursol Street, Montreal, and cost about eight dollars. It may be briefly described as a sinking frame, to which the bottle is attached by a fixed clamp, while a movable clamp is used to raise and lower the stopper.

The frame is made of brass and has for its base a hollow cylindrical box D, 2½ inches deep and 2 inches in diameter. The box contains two pounds of shot and can be filled at a small hole E, which is closed by a screw. Attached to the top of this box are two flat brass bars F F, in the upper part of which a slot is cut allowing the movable cross bar A sufficient vertical play (1 inch) to admit of the bottle being opened beneath the water.

The neck of the bottle is grasped at B by a brass clamp, the jaws of which are lined with soft rubber, fastened on by rivets. These jaws work on pivots and are attached to the upright bars F. F. by means of a brass rod bent outward so as to bring the neck of the bottle into the line of traction. The pivots allow some lateral play. The clamp is kept closed upon the neck of the bottle by a brass spring C made of No. 18 wire.

The stopper H of the bottle is in the form of a tapering glass rod which is grasped by another clamp K and kept closed by the brass spring C. This clamp is secured to the sliding cross bar A by a horizontal pin working in slots which allow of sufficient backward and forward play to permit the stopper to adjust itself to the bottle. At the point where the pin is fastened the cross bar is bent outwards to bring the jaws of the clamps into the line of traction. The shoulder thus formed bears the entire strain in opening and closing the bottle as both ends of the clamp are balanced beneath it. It will be seen that these attachments are not rigid, thus preventing any straining or jamming of the stopper.

A loop of heavy brass wire L connects the two side bars F. F. above and another loop M is attached to the cross bar A. To these loops strings are attached enabling apparatus to be worked under water.

A pair of spiral springs G. G. made of No. 23 wire are hooked over the ends of the cross bar A above and fastened to the foot of the upright bar below. They close the bottle when it has been opened and keep it closed at other times. To place a bottle in the frame the ends of the clamps C and C are compressed between the thumb and fore-finger sufficiently to open the jaws. The frame, with bottle in position, is then lowered by means of a heavy string N attached to the loop L, when the desired depth is reached the stopper is raised by pulling a lighter string N, attached to the cross bar loop O. On releasing this again the springs close the bottle. The movement of raising the stopper can easily be felt at a depth of 15 or 20 feet.

The bottle fills in about 20 to 30 seconds and the bubbles of displaced air can usually be seen. It is better not to fill the bottles quite full, but to leave some space for subsequent shaking.

In very swift currents or when the sample is to be taken at a greater depth than 30 feet an additional weight in the form of a small bag of shot may be tied to the lower part of the frame.

To prevent any tendency of this frame to rotate while being lowered in a current, and thereby tangle the strings, I allow one string to glide in each side of my forefinger or else hold one in each hand.

Before placing a bottle in the frame it is well to ascertain that the stopper is not jammed in the neck of the bottle from unequal expansion in the hot air sterilizer.

In working at considerable depths I have found it convenient to use a screw at O. This increased pressure upon the wings of the clamps holds the stopper more firmly. At other times the screw is not needed. By substituting a wire for the string attached to the cross bar, the opening and shutting can be readily controlled at very great depth.

A bottle is removed by simply compressing the wings of the clamps and lifting it out from the jaws. The ease and rapidity with which the apparatus works will be understood from the fact that I am able to collect 10 separate samples of water at a depth of 20 feet in from 10 to 15 minutes.

The bottles made use of are those dropping bottles fitted with ground glass pipettes now in common use for holding histological reagents. Both ends of the pipettes are sealed up in a gas flame, thus converting them practically into glass rods. As these bottles are kept in stock in the laboratory, one can always be replaced if it happens to be broken. The ones I employ hold 50 c. cm., but I would have preferred 100 c. cm. bottles had they been obtainable. The method of clasping the bottle by the neck admits of various sizes being employed in the same frame as there is space to spare between the cross bars.

The differences between the model here described and the original form introduced by Dr. Ellis are that the bottle is grasped by the neck instead of being forced into a socket from above. The use of spring clamps to hold the bottle, enables bottle and stopper to be brought into position by a single act instead of taking them apart and putting them in separately. The chief advantage of using the dropping bottles described lies in its giving a long tapering stopper, the lower end of which remains in the neck of the bottle when open, and guides it back into position, and it seemed preferable to use a bottle readily obtainable rather than to order a special form, which could not be replaced if broken.

The little sinking frame I have just described was originally designed to enable a sample to be collected at any required depth with the same safety and precision as at the surface, but as it also fulfils all the precautions for collecting samples in general and saves one the necessity of repeatedly plunging one's arm into the water, I employ it whenever a sample is to be collected from an open body of water. In securing samples by hand from a stream I was previously under the necessity of either securing the services of a boat or else taking the sample from off the bank, with the great chance that in the latter case the shallow water near the shore might not be typical of the general body of the stream. But from this apparatus, which can be lowered into the water from a bridge, or by a rod, much more uniform results are obtained.

As the apparatus left little to be desired, as far as regards the rapidity and safety with which the act of collecting is performed, it only remained necessary to ensure the necks of the bottles against contamination previous to using them. Instead of using sterilized rubber caps for each bottle, a constant source of trouble and annoyance, I had a tin box made which holds forty bottles at once, each kept in position by cross partitions of tin. The bottles are numbered serially, before sterilizing, by writing in pencil upon the ground glass of the stopper, and by noting where each bottle is used the use of labels is unnecessary. Instead of a simple lid, the cover of the box is a tray four inches deep, in which a lump of ice is placed in warm weather. A small tube at one of the corners of this tray conducts the water away as fast as the ice melts. I find this keeps the temperature within the box below 8° C., even in the hottest weather. A handle across the tray serves to carry the box, and a small padlock in front guards it against an ever too inquisitive public.

Though I have not yet had cause to use it for this purpose, I think that my box, with its lump of ice on top, would form a better means of sending samples of water by express than any I have seen recommended. The temperature is kept down to a point where no increase of the bacteria can go on, and the ice could be replenished by the officials from time to time, while the padlock or a seal would prevent its being tampered with. The space occupied by this box (18″×11″×8″) admits of its being placed in a large hot-air sterilizer and heated together with its contents to 150° C. A small piece of fine string placed in the neck of each bottle permitted the escape of any moisture, so that it is unnecessary to dry the bottles thoroughly before heating them. As the box is quite dust-tight the necks of the bottles remain sterile until the time comes to use them, doing away entirely with the employment of rubber caps.

In some cases when it seemed of interest to examine great stretches of water I took my samples from off the bow of a passenger steamboat in a very simple manner. By using a stout fishing rod and about twelve feet of line a sample can be secured well outside the "wash" of the boat, even at a speed of 12 to 15 miles per hour. To ensure the bottle sinking I wrapped a piece of sheet lead round it. By making the cast well ahead the bottle usually sank 6 to 8 feet.

As these examinations were always made in duplicate the accidental encounter of any extraneous source of pollution would infallibly have been shown by an abnomal excess of growth in one of the two samples. A striking proof of the delicacy of the method is that the duplicate samples always gave practically the same number of colonies. This "fishing" was often found a convenient method of obtaining a sample from the banks of a stream.

To ensure the accuracy of the result in estimating the number of bacteria in a water it is of great importance to curtail to a minimum the time which elapses between the collection of the sample and the plating of the cultures, to guard against a possible increase of bacteria in the interval. It is also advisable to make the cultures in some flat vessel which permits of their being counted from time to time without exposing the gelatine to the danger of receiving additional bacteria from the air. Both of these objects are met by the flattened glass flasks designed by Petruschky.

These flasks contain the nutrient gelatine ready for use, so that it is only necessary to warm them gently and so melt the gelatine, drop in the proper amount of water and after shaking them gently to lay them on their side till the gelatine stiffens.

As these flasks are expensive and not always easy to obtain, it may be of interest to those who work under conditions which make it difficult to obtain apparatus to know that I have found ordinary flat sided, common, white glass vials, obtainable anywhere, answered the purpose admirably. Owing to the small size of the bottle necks I find it best to plug them by wrapping the cotton wool about the end of a wooden toothpick, which is then broken off short. By doing this the plug can be readily inserted and removed. The colonies are readily counted with a lens, and to facilitate this I rule with a writing diamond a couple of parallel scratches on the flat side of the bottle in the axis. Cross lines are not usually necessary. Any of the colonies can be fished out with as much ease as from a Petruschky flask. The only respect in which these bottles are not satisfactory is that, being made of rather thick glass, when using a low power microscope, the object appears somewhat blurred. This also could probably be obviated by using a correcting lens. They possess, however, a distinct advantage over the Petruschky flasks in being much stronger. They also pack closer, owing to their flat sides, and having flattened bottoms they can be stood up.

For summer field work I was able to pack 160 of the bottles in a small double walled tin chest or portable refrigerator, measuring 20″ × 16″ × 18″, and this included a space of 8″ × 8″ × 18″ for the ice chamber.

On The Cherts and Dolomites of The Animikie Rocks of Thunder Bay, Lake Superior.

By Elfric Drew Ingall, Ottawa, Ont.

A number of interesting features are presented by the rocks under consideration, but before dealing with their nature and structure it will be necessary to give a short explanation of their mode of occurrence for the benefit of those unfamiliar with the formation.

The Animikie or silver bearing rocks of Lake Superior occur in the vicinity of Thunder Bay. Starting from the small exposure of these rocks at the end of the peninsula between Thunder and Black Bays they form a narrow fringe along the western and northern shores of the former which connects with the main area of these rocks extending W. S. W. from Port Arthur. This area constitutes a belt from twenty to twenty-five miles wide, abutting on the west shores of Thunder Bay between Pigeon River and a point about eight miles east of Port Arthur and extending in a W. S. W. direction across the international boundary into the State of Minnesota. Along the northern fringe of the formation the rocks are found lying on the smooth surface of the Archean rocks, while in a southern direction they pass beneath the traps and conglomerates of the Keweenawan, famous for its native copper mines. The dip of the whole is at a very low angle to the S. S. E.

The Animikie formation is made up of traps, argillites and shales, cherts and dolomitic rocks. The traps present themselves as sheets at various horizons in the formation, and as more or less vertical dykes cutting the sedimentary rocks. The dykes can often be seen to connect with the sheets. In many places the sheets present unmistakeable evidence of having been intruded between the bedding planes of the sedimentary rocks showing flat under and curved upper surfaces. The stratification of the enclosing rocks being curved upwares comformably to the latter. Mr. W. S. Bailey of the Johns Hopkins University, Baltimore, U. S. A., who examined a number of thin sections of these rocks microscopically describes them as more or less altered diabases.

The sedimentary rocks may be considered under two divisions; the upper in which the argillites and shales largely preponderate, and the lower consisting almost entirely of cherts and other siliceous rocks. In both of these divisions, between which no sharp line of demarcation exists, developments of calcareous and dolomitic areas are not unfrequent. A characteristic of the upper division rocks consists in their generally carbonaceous character and the dark colour resulting therefrom.

The cherty rocks of the lower division present many interesting features. In general appearance they are extremely varied both in colour and grain, opaque browns and reds being the colours most usually presented. Milky whites and dark black also occur, and dark greens have been met with, which, when speckled with bright red spots constitute a very ornamental stone.

In grain they vary between a compact flinty presentation with conchoidal fracture, in which no trace of their original nature can be seen by the unaided eye, to distinct sandstones whose fragmental nature is plainly brought out on weathered surfaces, the grains having been weathered out leaving a projecting reticulation of harder, less alterable material. The sandy grains are rounded and measure from 0·05 inch in diameter and less. At times the above described feature is reversed. The cementing material originally surrounding the grain, apparently an earthy carbonate, is seen to have been removed by weathering, leaving the grains standing out.

Brown oxides form a very constant constituent of all these rocks, to which is doubtless due their generally red and sometimes rusty appearance. This material also occurs in the form of magnetite to such an extent at places as to almost rank the beds as iron ores. Two specimens of this variety were analysed in the laboratory of the Geological Survey, and gave respectively 39·74 per cent. and 45·57 per cent of metallic iron, titanium being absent.[1] The specimens were found to exhibit magnetic polarity in different degrees, this characteristic being also brought to light during the field surveys by the great local derangements of the magnetic needle. Small particles of pyrite are also frequently disseminated throughout these rocks.

An interesting variety is the "pitted chert." A considerable exposure will often be found pitted all over with little rounded cavities about the size of a pea. These present a rough and *hackly* inner surface, and are frequently partially filled with iron-rust. A variation of the phenomenon is presented in the occasional presence in the thin cherty layers, sometimes found interbedded in the argillites, of tubules at right angles to the surface of the layer, which, apart from the difference in shape, present much the same details of appearance as the cavities of the pitted cherts. Dr. Bell, in his report on this district, notices a very similar phenomenon. He says: "Nearly horizontal calcareous beds occur containing small coral-like siliceous concretions and vertical cylinders of chalcedony, transverse sections of which shew fine concentric rings resembling agate."[2]

Whilst calcareous matter is specially the characteristic of the upper argillites and shales, it is not entirely absent from the rocks under consideration, being present as a mineral resembling anthracite often found in the centre of vuggy cavities in the rocks.

In both upper and lower divisions calcareous and dolomitic areas are frequent, although not constituting a preponderating feature of the formation. In the argillaceous division the earthy carbonates are frequently present to such an extent as to give free effervescence with acid. In the lower siliceous division areas are frequent, made up of this calcareous and dolomitic material, which is often ferruginous, as shewn by the rusty appearances of weathered surfaces. At one place a fine-grained, grey dolomite was found to contain what appeared to be rounded pebbles of a

[1] Annual Rept. Geol. Surv. of Canada, Vol. III, p. 25 T.
[2] Report of Progress, Geological Survey of Canada, 1866-69, p. 324.

still finer grained black material, the latter standing out on weathered surfaces. Both these constituents, however, were found to be carbonates, differing only in the relative freedom of their effervescence with acids. Included in these calcareous portions there will also be seen at places nodules and inclusions of chert standing out on weathered surfaces and presenting hackly exterior surfaces. One specimen collected shewed, in a calcareous base, angular fragments of black chert, which had apparently been portions of continuous cherty layers, some cause having subsequently effected their fracture.

Before leaving the consideration of the macroscopic character of these rocks it should be stated that, whilst the variation of their characteristics is endless, the different varieties are not confined to any definite horizon in the subdivision to which they belong, and in a short distance in the same bed what will at one place be a typical flinty chert may be found to become granular or, by increasing preponderance of the earthy carbonates, to merge into a calcareous or dolomitic rock. Neither is the demarcation between the upper and lower divisions of the formation sharp, the delimitation being based upon the great preponderance of the argillaceous members in the former as contrasted with the essentially siliceous constitution of the latter. In fact, very siliceous or dolomitic portions are often found in the argillites, whilst beds of dark argillite and shale have been found amongst the lower cherty series.

Here then we have a number of rocks very dissimilar in nature, yet apparently forming interchangeable members of the series and at places merging one into the other. That they are much altered from their original condition is evident, and that they still occupy their original position as deposited, precludes the idea of any dynamic metamorphism nor do they show any signs of such action in other respects. The argillites show nothing but ordinary rock jointing apart from the bedding planes, no trace of slaty cleavage being present.

Their present condition would seem to be due to a quietly proceeding process of chemical alteration and substitution in place, producing all the varieties of product according to the original mineral composition of the material and the extent to which the process has progressed. The original condition of the rocks would seem to have been that of a series of sands and clays laid down in the basin of deposition in the order of their coarseness. The sands would naturally preponderate in the areas of shallower water, becoming gradually mixed and interspersed with clayey matter, and the latter entirely replacing the former in passing towards the areas of greater depth.

The percolation of chemical waters subsequent to the elevation of the area and the compacting of the rocks would then produce all the varied phenomena noticed. The sandy parts being easily permeable would be most changed, whilst the impermeable clays would be left in their original condition, and the sandy clays would form an intermediate product.

The original grains of the sands having a very varying composition, would by their decomposition afford all the different materials at present constituting the rocks, the ferruginous elements being supplied where basic silicates constituted the grains.

The examination of these rocks by the microscopic method further reveals the nature and extent of the process of alteration above outlined, the following descriptions of three thin sections by Mr. W. S. Bailey [1] giving a very good idea of the most noticeable characteristics.

"No. 281. R. 64. LOCATION (*Chert*).—This rock is composed in greater part of what were originally round and irregular pieces of felspar, in a ground mass of quartz. The felspar has for the most part been entirely replaced by its various decomposition products, viz., calcite, chlorite and hydrated iron oxides. That portion which has not undergone this alteration has been completely replaced by silica; so that round, cloudy areas of silica (principally in the form of chalcedony) now appear where originally

[1] Annual Reports Geological Survey, Vol. III. pp. 120 H. and 122 H.

felspar existed. These pseudomorphs are usually marked by a rim of green or red color, probably due to chlorite and iron oxide, which separated out either previous to or coincident with the silicification process. Immediately outside of these rims there is deposition of chalcedony, which forms a feathery periphery extending from all sides into the interstices between large quartz grains, which in turn form a mosaic in the centre of the spaces between the original grains of felspar.

"Scattered through the slide, both in the larger grains and also in the interstices between these, are little cloudy, almost opaque, areas, which under crossed nicols, resolve themselves into calcite. The centres of these little areas are dark and structureless, while the outer portions are composed of the perfectly crystallized mineral. This calcite has every appearance of having been enlarged, after it had once been formed, by the addition of new material around the opaque portions in a manner analogous to the enlargements of quartz grains, so distinctly shown by Profs. Irving and Van Hise, of the United States Geological Survey.

"The present condition of the rock seems to be due to a very thorough process of silicification.

"No. 303. SILVER BLUFF, (R. 61).—(*About fifty feet below contact.*) Is of the same general nature as the above. In this, however, the calcite occurs with chlorite and other alteration products of felspar to form complete pseudomorphs of this mineral. Round and angular grains consist now of chlorite and crystallized calcite, mixed with magnetite (which is usually found around the edges of the grain), and a brown earthy substance. The outlines of the original grains are well preserved by the rim of magnetite, but their material has entirely disappeared. From the large amount of magnetite and other iron minerals present in the slide it may be doubted whether the original grains were not augite or some other iron-bearing mineral.

"A few grains are composed entirely of silica, as in the case of section 281.

"No. 325. R. 93 Ridge.—(*Overlying cherty beds.*)—Is not very different from 303, except in the alteration of the rounded grains. In many cases, these consist of a very dark reddish-brown micaceous substance, mingled with a green mineral (probably of the serpentine group) and reddish-brown iron hydroxide. In some of the lighter colored grains, the remains of a colorless augite can readily be detected.

"In other cases, the entire substance of the original grain has given place to silica in the form of a fine mosaic of quartz. In these, the outline of the original grain has been rendered permanent by a line of little plates of brown mica.

"As in 303, the interstitial substance is quartz. Around the edges of the separate grains, crystals of quartz extend out on all sides, like the lining of a vein. Where the space between the fragmental grains was small, the two rows of quartz crystals mutually interfere and completely fill the spaces; where the intervening space was large, that portion in its centre between the rows of crystals is filled by a mosaic of the same mineral. Cracks which extend through the rock contain iron oxides or hydroxides."

A number of other sections examined by the writer presented in a general way the same characteristics as those above described. All without exception shewed the feathery periphry of quartz crystals, with the mosaic of larger individuals in the larger spaces. The highly ferruginous varieties, shewing magnetic polarity, were seen to be very largely composed of magnetite, generally disposed around the rim of the particles, the central parts being mostly composed of a finely crystallized quartz mass. Many particles, however, seem to be almost wholly made up of the iron minerals. By reflected light the ferruginous areas gave, in places, a dark red colour, shewing the alteration of the magnetic into ferric oxide. Although not a frequent phenomenon, the magnetite was occasionally seen to be deposited in the interstitial quartz areas. In these cases the mineral would be found to fill the centre of the space, its outlines conforming to those of the surrounding grains, transparent slides interveining to separate the two. In reflected light, too, pyrite is seen to be a not infrequent constituent.

In another section the original shape of the grains is outlined by iron hydroxide, and they have a peculiar frayed out edge, the brown material also forming a faint demarcation of the outlines of the large quartz crystals composing the interstitial mosaic.

Whilst the grains are generally rounded, there is a certain proportion of sub-angular fragments, but these would seem to result from the disintegration of the original rounded particles during the process of decomposition and solution, and often where the grain retains its primary shape numerous fissures are seen to penetrate towards its centre, which are filled with crystallized quartz similar to that surrounding it and present an incipient stage of the breaking-up process.

The mergence from the distinctly grained varieties into the compact cherts will be frequently illustrated in the same hard specimen, and examination of a thin section from such a one clearly shews the nature of the process to which the effect is due. Viewed in ordinary light, a portion of such a slide will shew distinctly marked grains with transparent quartz surrounding them. Passing towards the other edge of the section, representing the compact cherty part of the original specimens, the grains are found to shew less and less distinctly, until a portion is reached consisting apparently of nothing but transparent quartz, somewhat clouded in places, and with a few distributed areas of magnetite and iron hydroxide. An examination under polarized light, however, brings out the original structure by the contrast between the fine crystallization of the quartz replacing the original grain and that interstitially deposited.

Occasionally specimens of a pretty wavily marked variety of the cherts will be found. A section of such a one shows it to be similar in nature to the rest, except for the general parallel appearance produced by the drawing out of its constituents. The mass of the section is made up of a clouded crystalline quartz, with much red earthy material, probably iron hydroxide, which, being drawn out into long streaks, constitutes the wavy marking of the stone. The few particles left are also considerably drawn out and seem to be congregated at the apices of the bends. They are outlined by material similar to that constituting the streaks, which would appear to be long drawn out grains. Such evidences of dynamic action are, however, quite local and at some places would seem to be connected with the presence of the trap sheets and might be therefore due to the force of their intrusion.

The general appearance of these rocks under the microscope would seem to indicate that the secondary minerals at present constituting their bulk were not only supplied from the original materials of the grains, but deposited close to and around the points from which derived, long soaking in the percolating mineral waters producing all the different varieties of these rocks at present found. The extent to which the process has gone doubtless depended largely on the original constitution of the particles acted upon. These would seem mineralogically to have been largely made up of felspathic material accompanied in places by more basic silicates and just such as might have been derived from the disintegration of the Archean rocks upon whose water smoothed surface they rest. The great irregularity and indefiniteness of the distribution of the calcareous and dolomitic portions throughout the formation would also be accounted for on this supposition, and light would be thrown upon the formation of the curious spherical "bombs" which occur so frequently in the upper argillaceous division. In many places there will be seen to occur lenticules in the argillites around which the bedding is seen to bend conformably to their outline. Several specimens examined were found to effervesce more or less freely with acid, and the impression left after the study of a number of cases was that a process of dolomitization of the rock had gone on in spots, segregation of the earthy carbonates around a centre accounting for the more or less spherical shape, the bending of the surrounding stratification being due to the crystallising force. All gradations of this process could be seen from the simple lenticular thickening of a particular layer to the development of a complete spherical "bomb."

The results of the microscopic studies as given above would thus seem to give a satisfactory explanation of the at first sight so curious association of argillites, dolomites and cherts, and also furnish an interesting example of the considerable alteration of a series of rocks by chemical action alone unaccompanied by any of the more powerful forces usually resorted to in explanation of the metamorphism of rocks.

Supplemental Notes on the Flora of Cap-a-L'Aigle.

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

In the Record of Science, Vol. IV., No. 1, pp. 54–68, appeared a catalogue of the plants found up to that date, during the months of July and August, in successive years. The following species were discovered in the same district in the summer of 1891:—

Exogens.

Caryophyllaceæ:

Arenaria peploides, L., Port au Persil, near the shore.

Malvaceæ:

Malva crispa, L., in two places, apparently escaped from gardens.

Hypericaceæ:

Hypericum ellipticum, Hook., on the banks of the Trou River.

Hypericum canadense, L., near the Loutre River.

Leguminosæ:

Trifolium hybridum, L., near the River Port au Salmon.

Trifolium agrarium, L., in the same locality as above.

Vicia caroliniana, Watt., near the cemetery, banks of Murray River.

ROSACEÆ:

Prunus virginiana, L., road to the Trou.

Genus strictum, Ait., everywhere (omitted accidentally from former catalogue).

Potentilla pennsylvanica, L., near Ste. Fidele.

Cratægus tomentosa, L., road to Loutre.

SAXIFRAGACEÆ:

Mitella nuda, L., east bank of the Loutre.

UMBELLIFERÆ

Osmorrhiza longistylis, D. C., woods on high ridge near Cap-a-l'Aigle wharf.

COMPOSITÆ.

Solidago virga-aurea, L., banks of a mountain stream.

Solidago ohioensis, Riddell, woods near Fraser Falls.

Solidago nemoralis, Ait., in the same locality as above.

Aster puniceus, L., near the Trou.

Aster ptarmicoides, Torr. and Gray, at the Upper Fraser Falls.

Ambrosia artemisiæfolia L., in one spot, come in within two years.

Bidens frondosa, L., on road to Port au Persil.

Hieracium marianum, var. *Spathulatum*, Gray, two specimens on Perrault's Hill.

ERICACEÆ:

Vaccinium canadense, Fraser River Road.

Chimaphila umbellata, Nutt., woody heights near Loutre.

Moneses grandiflora, Salis., one specimen near Port au Salmon River.

PRIMULACEÆ:

Glaux maritima, L., sandy shore near mouth of Murray River.

BORRAGINACEÆ:

Mertensia maritima, Don., in same situation as last above.

SCROPHULARIACEÆ:

Pedicularis palustris, L., marsh near mouth of Murray River.

LABIATÆ:

Lycopus virginicus, L., above Ste. Fidele village.

POLYGONACEÆ:

Polygonum lapathifolium, var. *incarnatum*, Watson, near Loutre.

ELÆAGNACEÆ:

Shepherdia canadensis, Nutt., two specimens about half a mile apart, near Cap-a-l'Aigle P. O.

ENDOGENS.

ORCHIDACEÆ:

Microstylis ophioglossoides, Nutt., near Cap-à-l'Aigle P. O. and at the Trou.

Habenaria hyperborea, R. Br., mouth of Murray River.

ALISMACEÆ:

Alisma plantago, L., mouth of Murray River.

GRAMINEÆ:

Elymus canadensis, L., beyond the Loutre.

FILICES:

Osmunda claytoniana, L., in great abundance beyond the Loutre.

Osmunda cinnamomea, L., in the same localities as above.

OPHIOGLOSSACEÆ:

Botrychium virginianum, Swartz., one specimen near Upper Fraser Falls.

Three mistakes were inadvertently made in the former catalogue:—

Physalis viscosa should have read *Physalis grandiflora*.

Euphorbia platyphylla should have read *Euphorbia helioscopia*.

Arundinaria macrosperma should have read *Cinna arundinacea*, var. *pendula*.

A List of Coleoptera Collected in the Vicinity of St. Jérome, Que.

By J. F. Hausen.

CICINDELIDÆ.

Cicindela, Linn.

1. *longilabris*, Say.
2. 6–*guttata*, Fab.
3. *purpurea*, Oliv.
4. *vulgaris*, Say.
5. *repanda*, Dej.
6. 12–*guttata*, Dej.

CARABIDÆ.

Carabus, Linn.

7. *serratus*, Say.

Calosoma, Web.

8. *frigidum*, Kirby.
9. *calidum*, Fab.

Elaphrus, Fab.

10. *riparius*, Linn.
11. *ruscarius*, Say.

Bembidium, Lat.

12. *carinulum*, Chd.
13. *inæquale*, Say.
14. *chalceum*, Dej.
15. *concolor*, Kirby.
16. *lucidum*, Lec.
17. *variegatum*, Say.
18. *versicolor*, Lec.
19. *quadrimaculatum*, Linn.

Pterostichus, Bon.

20. *adoxus*, Say.
21. *honestus*, Say.
22. *lachrymosus*, Newm.
23. *coracinus*, Newm.
24. *stygicus*, Say.
25. *lucublandus*, Say.
26. *caudicalis*, Say.
27. *luctuosus*, Dej.
28. *corvinus*, Dej.
29. *mutus*, Say.
30. *orinomum*, Leach.
31. *desidiosus*, Lec.

Amara, Bon.

32. *exarata*, Dej.
33. *angustata*, Say.
34. *impuncticollis*, Say.
35. *fallax*, Lec.
36. *interstitialis*, Dej.
37. *obesa*, Say.

Diplochila, Brullé

38. *laticollis*, Lec.

BADISTER, Clairv.

39. *pulchellus*, Lec.

CALATHUS, Bon.

40. *gregarius*, Say.

PLATYNUS, Bon.

41. *brunneomarginatus*, Mann.
42. *extensicollis*, Say.
43. *pusillus*, Lec.
44. *errans*, Say.
45. *melanarius*, Dej.
46. *affinis*, Kirby.
47. *metallescens*, Lec.
48. *cupripennis*, Say.
49. *placidus*, Say.
50. *obsoletus*, Say.

LEBIA, Lat.

51. *viridis*, Say.
52. *pumila*, Dej.

CYMINDIS, Lat.

53. *cribricollis*, Dej.
54. *borealis*, Lec.

BRACHYNUS, Web.

55. *fumans*, Fab.
56. *cordicollis*, Dej.

CHLÆNIUS, Bon.

57. *sericeus*, Forst.
58. *leucoscelis*, Chev.
59. *tricolor*. Dej.
60. *pennsylvanicus*, Say.
61. *impunctifrous*, Say.
62. *toment sus*, Say.

ANOMOGLOSSUS, Chd.

63. *emarginatus*, Say.

BRACHYLOBUS, Chd.

64. *lithophilus*, Say.

AGONODERUS, Dej.

65. *lineola*, Fab.
66. *pallipes*, Fab.

HARPALUS, Lat.

67. *viridiæneus*, Beauv.
68. *caliginosus*, Fab.
69. *pennsylvanicus*, De G.
70. *herbivagus*, Say.
71. *clandestinus*, Lec. (?)

STENOLOPHUS, Dej.

72. *fuliginosus*, Dej.
73. *conjunctus*, Say.

BRADYCELLUS, Er.

74. *cognatus*, Gyll.
75. *rupestris*, Say.

ANISODACTYLUS, Dej.

76. *rusticus*, Dej.
77. *agricola*, Say.
78. *discoideus*, Dej.
79. *baltimorensis*, Say.

HALIPLIDÆ.

HALIPLUS, Lat.

80. *triopsis*, Aubé.

CNEMIDOTUS, Er.

81. 12—*punctatus*, Say.

DYTISCIDÆ.

LACCOPHILUS, Leach.

82. *masculosus*, Germ.

ILBIUS, Er.

83. *biguttalus*, Germ.

COPTOTOMUS, Say.

84. *interrogatus*, Fab.

AGABUS, Leach.

85. *obtusatus*, Say.

COLYMBETES, Clairv.

86. *sculptilis*, Harr.

DYTISCUS, Linn.

87. *fasciventris*, Say.
88. *sublimbatus*, Lec.
89. *Harrisii*, Kirby.

ACILIUS, Leach.

90. *fraternus*, Harr.

GYRINIDÆ.

GYRINUS, Linn.

91. *ventralis*, Kirby.

DINEUTES, MacL.

92. *discolor*, Aubé.

HYDROPHILIDÆ.

HELOPHORUS, Fab.

93. *lacustris*, Lec.
94. *tuberculatus*, Gyll.

HYDRÆNA, Kug.

95. *pennsylvanica*, Kies.

HYDROPHILUS, Geoff.

96. *triangularis*, Say.
97. *glaber*, Hbst.

HYDROCHARIS, Lat.

98. *obtusatus*, Say.

BEROSUS, Leach.

99. *peregrinus*, Hbst.
100. *striatus*, Say.

HYDROBIUS, Leach.

101. *globosus*, Say.
102 *fuscipes*, Linn.

CERCYON, Leach.

103. *unipunctatum*, Linn.
104. *posticatum*, Mann.

CRYPTOPLEURUM, Mul.

105. *vagans*, Lec.

SILPHIDÆ.

NECROPHORUS, Fab.

106. *orbicollis*, Say.
107. *marginatus*, Fab.
108. *vespilloides*, Hbst.
109. *tomentosus*, Web.

SILPHA, Linn.

110. *surinamensis*, Fab.
111. *lapponica*, Hbst.
112. *inæqualis*, Fab.
113. *noveboracensis*, Forst.
114. *americana*, Linn.

STAPHYLINIDÆ.

FALAGRIA, Mann.

115. *bilobata*, Say. (?)

HOMALOTA, Mann.

5 species undetermined.

ALEOCHARA, Grav.

121. *lata*, Grav.
122. *bimaculata*, Grav.

GYROPHÆNA, Mann.

123. *vinula*, Er.
124. *socia*, Er.

HETEROTHOPS, Steph.

125. *fumigatus*, Lec.

QUEDIUS, Steph.

126. *lævigatus*, Gyll.

LISTOTROPHUS, Perty.

127. *cingulatus*, Grav.

CREOPHILUS, Kirby.

128. *villosus*, Grav.

STAPHYLINUS, Linn.

129. *badipes*, Lec.
130. *cinnamopterus*, Grav.
131. *violaceus*, Grav.
132. *viridanus*, Fauvel.

OCYPUS, Kirby.

133. *ater*, Grav.

PHILONTHUS, Curt.

134. *æneus*, Rossi.
135 *lætulus*, Say.
136. *lomatus*, Er.
137. *blandus*, Grav.
138. *cyanipennis*, Fab.
139. *sordidus*, Grav.
140. *stictus*, Hausen.
141. *ventralis*, Grav.

XANTHOLINUS, Serv.

142. *cephalus*, Say.
143. *obsidianus*, Melsh.
144. *obscurus*, Er.
145. *hamatus*, Say.

BAPTOLINUS, Kraatz.

146. *macrocephalus*, Nord.

STENUS, Lat.

147. *femoratus*, Say.
148. *annularis*, Er.

CRYPTOBIUM, Mann.

149. *bicolor*, Grav.
150. *pallipes*, Grav.

LATHROBIUM, Grav.

151. *grande*, Lec.
152. *punctulatum*, Lec.
153. *nigrum*, Lec.
154. *dimidiatum*, Say.

SCOPÆUS, Er.

155 *exiguus*, Er.

LITHOCHARIS, Say.

156. *confluens*, Say.

PÆDERUS, Grav.

157. *littorarius*, Grav.

SUNIUS, Steph.

158. *longiusculis*, Mann.

TACHINUS, Grav.

159. *flavipennis*, Dej.
160. *luridus*, Er.
161. *canadensis*, Horn.
162. *fimbriatus*, Grav.

TACHYPARUS, Grav.

163. *jocosus*, Say.

ERCHOMUS, Mots.

164. *ventriculus*, Say.

CONOSOMA, Kraatz.

165. *crassum*, Grav.
166. *basale*, Er.

BOLETOBIUS, Leach.

167. *cincticollis*, Say.
168. *cinctus*, Grav.

OXYPORUS, Fab.

169. *stygicus*, Say.
170. *vittatus*, Grav.

PLATYSTETHUS, Mann.

171. *americanus*, Er.

OXYTELUS, Grav.

172. *sculptus*, Grav.

SCAPHIIDIDÆ.

SCAPHIDIUM, Oliv.

173. *guadriguttatum*, Say.

PHALACRIDÆ.

OLIBRUS, Er.

174. *pallipes*, Say.
175. *nitidus*, Melsh.

COCCINELLIDÆ.

ANISOSTICTA, Dup.

176. *strigata*, Thumb.

HIPPODAMIA, Muls.

177. 13—*punctata*. Linn.
178. *parenthesis*, Say.

COCCINELLA, Linn.

179. *trifasciata*, Linn.
180. 9—*notata*, Hbst.
181. *transversoguttata*, Fab.
182. *sanguinea*, Linn.

ADALIA, Muls.

183. *frigida*, Schn.
184. *bipunctata*, Linn.

HARMONIA. Muls.

185. *picta*, Rand.

ANATIS, Muls.

186. 15—*punctata*, Oliv. (= *canadensis*, Prov.)

PSYLLOBORA, Muls.

187. 20—*maculata*, Say.

CHILOCORUS, Leach.

188. *bivulnerus*, Muls.

BRACHYACANTHA, Chev.

189. *ursina*, Fab. 190. var. 10—*pustulata*, Melsh.

HYPERASPIS, Chev.

191. *signata*, Oliv.

SCYMNUS, Kug.

192. *caudalis*, Lec.

ENDOMYCHIDÆ.

PHYMAPHORA. Newm.

193. *pulchella*, Newm.

ENDOMYCHUS, Panz.

194. *biguttatus*, Say.

EROTYLIDÆ.

TRITOMA, Fab.

195. *thoracica*, Say.

CUCUJIDÆ.

SILVANUS, Lat.

196. *planatus*, Germ.

NAUSIBIUS, Redt.

197. *dentatus*, Marsh.

PEDIACUS. Shuck.

198. *fuscus*, Er.

LÆMOPHLÆUS. Lap.

199. *biguttatus*, Say. 200. *fasciatus*, Melsh.

BRONTES, Fab.

201. *dubuis*, Fab.

CRYPTOPHAGIDÆ.

ANTHEROPHAGUS, Lat.

202. *ochraceus*, Melsh.

CRYPTOPHAGUS, Hbst.

203. *cellaris*, Scop.

MYCETOPHAGIDÆ.

MYCETOPHAGUS, Hellw.

204. *punctatus*, Say.
205. *flexuosus*, Say.

DERMESTIDÆ.

BYTURUS, Lat.

206. *unicolor*, Say.

DERMESTES, Linn.

207. *lardarius*, Linn.

ATTAGENUS, Lat.

208 *megaloma*.
209. *pellio*, Linn.

ANTHRENUS, Fab.

210. *musæorum*, Linn.

ORPHILUS, Er.

211. *glabratus*, Fab.

HISTERIDÆ.

HISTER, LINN.

212. *interruptus*, Beauv.
213. *abbreviatus*, Fab.
214. *merdarius*, Hoffm.
215. *americanus*, Payk.

NITIDULIDÆ.

CERCUS, Lat.

216. *pennatus*, Murr.

CARPOPHILUS, Steph.

217. *niger*, Say.

COLASTUS, Er.

218. *truncatus*, Rand.

CONOTELUS, Er.

219. *obscurus*, Er.

EPURÆA, Er.

220. *rufa*, Say.
221. *avara*, Rand.

NITIDULA, Fab.

222. *bipustulata*, Linn.
223. *rufipes*, Linn.

STELIDOTA, Er.

224. 8—*maculata*, Say.

PROMETOPIA, Er.

225. *sexmaculata*, Say.

PHENOLIA, Fab.

226. *grossa*, Fab.

OMOSITA, Er.

227. *colon*, Linn.
228. *discoidea*, Linn.

CRYPTARCHA, Shuck.

229. *ampla*, Er.

IPS, Fab.

230. *fasciatus*, Oliv.
geminatus, Melsh.
231. *confluentus*. Say.
232. *sanguinolentus*, Oliv.

LATRIDIIDÆ.

CORTICARIA, Marsh.

233. *grossa*, Lec.
234. *pusilla*, Mann.
235. *cavicollis*, Mann.

TROGOSITIDÆ.

TENEBRIOIDES, Pall.

236. *intermedia*, Horn.
237. *dubia*, Harss.

PELTIS, Ill.

238. *ferruginea*, Linn.

GRYNOCHARIS, Thom.

239. *quadrilineata*, Melsh.

BYRRHIDÆ.

CYTILUS, Er.

240. *trivittatus*, Melsh.

BYRRHUS, Linns.

241. *americanus*, Lec.

PARNIDÆ.

DRYOPS, Oliv.

242. *fastigiatus*, Say.

HETEROCERUS, Fab.

243. *mollinus*, Kies.

DASCYLLIDÆ.

ANCHYTARSUS, Gecér.

244. *bicolor*, Melsh.

SCIRTES, Ill.

245. *titialis*, Guér.

CYPHON, Payk.

246. *variabilis*, Thunb.

ELATERIDÆ.

ADELOCERA, Lat.

247. *marmorata*, Fab.
248. *brevicornis*, Lec.

ALAUS, Esch.

249. *oculatus*, Linn.

CARDIOPHORUS, Esch.

250 *convexulus*, Lec.

CRYPTOHYPNUS, Esch.

251. *grandicollis*, Lec.
252. *abbreviatus*, Say.
253. *pectoralis*, Say.

MONOCREPIDIUS, Esch.

254. *auritus*, Hbst.

ELATER, Linn.

255. *nigricollis*, Hbst.
256. *linteus*, Say.
257. *semicinctus*, Rand.
258. *rubricus*, Say.
259. *apicatus*, Say.
260. *obliquus*, Say.

AGRIOTES, Esch.

261. *mancus*, Say.
262. *pubescens*, Melsh.

DOLOPIUS, Esch.

263. *lateralis*, Esch.

MELANOTUS, E ch.

264. *Leonardi*, Lec.
265. *fissilis*, Say.
266. *mmunis*, Gyll.

LIMONIUS, Esch.

267. *aurifer*, Lec.
268. *stigma*, Hbst.
269. *confusus*, Lec.
270. *quercinus*, Say.
271. *basillaris*, Say.
272. Sp. undetermined.

PITYOBIUS, Lec.

273. *anguinus*, Lec.

ATHOUS, Esch.

274. *Brightwelli*, Kby.
275. *rufifrons*, Rand.

ŒSTODES, Lec.

276. *tenuicollis*, Rand.

SERICOSOMUS, Steph.

277. *incongruus*, Lec.
278. *silaceus*, Say.

CORYMBITES, Lat.

279. *virens*, Schr.
280. *vernalis*, Hentz.
281. *cylindriformis*, Hbst.
282. *tarsalis*, Melsh.
283. *falsificus*, Lec.
284. *sulcicollis*, Say.
285. *hamatus*, Say.
286. *hieroglyphicus*, Say.
287. *cruciatus*, Linn.
288. *æripennis*, Kby.

ASAPHES, Kutz.

289. *decoloratus*, Say.
290. *memnonius*, Hbst.

BUPRESTIDÆ.

CALCOPHARA, Sol.

291. *virginiensis*, Drury

DICERCA, Esch.

292. *prolongata*, Lec.
203. *divaricata*.
294. *lurida*, Fab.
295. *tenebrosa*.

BUPRESTIS, Linn.

296. *lineata*, Fab.
297. *maculiventris*, Say.
298. *fasciata*, Fab.
299. *striata*, Fab.

MELANOPHILA, Esch.

300. *longipes*, Say.
301. *fulvoguttata*.

CHRYSOBOTHRIS, Esch.

302. *femorata*, Fab.
303. 4—*impressa*, Lap. & Gory.
304. *dentipes*, Germ.
305. *scabripennis*, Lap. & Gory.

EUPRISTOCERUS, Deyr.

306. *cogitans*, Web.

AGRILUS, Steph.

307. *arcuatus*, Say.
308. *ruficollis*, Fab.
309. *otiosus*, Say.
310. *torpidus*, Lec.
311. *egenus*, Gory.

BRACHYS, Sol.

312. *ovata*, Web.
313. *ærosa*, Melsh.

LAMPYRIDÆ.

CALOPTERON, Guér.

314. *terminale*, Say.

CELETES, Newm.

315. *basalis*, Lec.

EROS, Newm.

316. *aurora*, Hbst.
coccinatus, Say.
317. *humeralis*, Fab.

LUCIDOTA, Lap.

318. *atra*, Fab.

ELLYCHNIA, Lec.

319. *corrusca*, Lec.
320. var. *lacustris*, Melsh.

PYROPYA, Mots.

321. *nigricans*, Say.
322. *decipiens*, Harr.

PYRACTOMENA, Lec.

323. *angulata*, Say.

PHOTINUS, Lap.

324. *ardens*, Lec.
325. *scintillans*, Say.

PHOTURIS, Lec.

326. *pennsylvanica*, De G.

CHAULIOGNATHUS, Hentz.

327. *pennsylvanicus*, De G.

PODABRUS, Westw.

328. *tricostatus*, Say.
329. *rugulosus*, Lec.
330. *modestus*, Say.
331. *simplex*, Couper.

SILIS, Lat.

332. *percomis*, Say.

TELEPHORUS, Schäff.

333. *excavatus*, Lec.
334. *fraxini*, Say.
335. *carolinus*, Fab.
336. *tuberculatus*, Lec.
337. *bilineatus*, Say.

CLERIDÆ.

TRICHODES, Hbst.

338. *Nuttalli*, Kby.

CLERUS, Geoff.

339. *quadriguttatus*, Oliv.
340. *thoracicus*, Oliv.

THANASIMUS, Lat.

341. *dubius*, Fab.
342. *nubilus*, Kl.

THANEROCLERUS, Spin.

343. *sanguineus*, Say.

HYDNOCERA, Newm.

344. *cyanescens*, Lec.

NECROBIA, Lat.

345. *rufipes*, Fab.
346. *ruficollis*, Fab.
347. *violaceus*, Linn.

PTINIDÆ.

PTINUS, Linn.

348. *fur*, Linn.
349. *brunneus*, Duft.

EUCRADA, Lec.

350. *humeralis*, Melsh.

HADROBREGMUS, Thom.

351. *errans*, Melsh.

TRYPOPITYS, Redt.

352. *sericeus*, Say.

CIOIDÆ.

CIS, Lat.

353. *fuscipes*, Mellié.

ENNEARTHRON, Mellié.

254. *thoracicorne*.

LUCANIDÆ.

PLATYCERUS, Geoff.

355. *quercus*, Web.
356. *depressus*, Lec.

SCARABÆIDÆ.

ONTHOPHAGUS, Lat.

357. *Hecate*, Panz.

APHODIUS, Ill.

358. *fossor*, Linn.
359. *fimetarius*, Linn.
360. *ruricola*, Melsh.
361. *femoralis*, Say.
362. *granarius*, Linn.
363. *vittatus*, Say.
364. *inquinatus*, Hbst.

GEOTRUPES, Lat,

365. *splendidus*, Fab.
366. *Blackburnii*, Fab.

HOPLIA, Ill.

367. *trifasciata*, Say.

DICHELONYCHA, Kirby.

368. *elongata*, Fab.
369. *albicollis*, Burm.

SERICA, MacL.

370. *vespertina*, Gyll.
371. *sericea*, Ill.

LACHNOSTERA, Hope.

372. *fusca*, Fröh.
373. *hirticula*, Knoch.

LIGYRUS, Burm.

374. *relictus*, Say.

OSMODERMA, Lep.

375. *eremicola*, Knoch.
376. *scabra*, Beauv.

TRICHIUS, Fab.

377. *affinis*, Gory.

SPONDYLIDÆ

PARANDRA, Lat.

378. *brunnea*. Fab.

CERAMBYCIDÆ.

ORTHOSOMA, Serv.

379. *brunneum*, Forst.

ASEMUM, Esch.

380. *atrum*, Esch.

CRIOCEPHALUS, Muls.

381. *agrestis*, Kirby.

TETROPIUM, Kirby.

382. *cinnamopterum*, Kirby.

GONOCALLUS, Lec.

383. *collaris*, Kirby.

RHOPALOPUS, Muls.

384. *sanguinicollis*, Horn.

HYLOTRUPES, Serv.

385. *ligneus*, Fab.

PHYMATODES, Muls.

386. *amœnus*, Say.
387. *dimidiatus*, Kirby.

CALLIDIUM, Fab.

388. *antennatum*, Newm.
389. *janthinum*, Lec.

ELAPHIDION, Serv.

390. *parallelum*, Newm.

MOLORCHUS, Fab.

391. *bimaculatus*, Say.

CYLLENE, Newm.

392. *robiniæ*, Forst.

PLAGIONOTUS, Muls.

393. *speciosus*, Say.

ARHOPALUS, Serv.

394. *fulminans*, Fab.

XYLOTRECHUS, Chev.

395. *colonus*, Fab.
396. *sagittatus*, Germ.
397. *undulatus*, Say.
398. var. *fuscus*, Kirby.

PLAGITHMYSUS, Motsch.

399. *muricatulus*, Kirby.

CLYTANTHUS, Thom.

400. *ruricola*, Oliv.

CYRTOPHORUS, Lec.

401. *verrucosus*, Oliv.

EUDERCES, Lec.

402. *picipes*, Fab.

DESMOCERUS, Serv.

403. *palliatus*, Forst.

RHAGIUM, Fab.

404. *lineatum*, Oliv.

PACHYTA, Serv.

405. *monticola*, Rand.
496. *rugipennis*, Newm.

ACMÆOPS, Lec.

407. *proteus*, Kirby.
408. *pratensis*, Laich.

GAUROTES, Lec.

409. *cyanipennis*, Say.

BELLAMIRA, Lec.

410. *scalaris*, Say.

TYPOCERUS, Lec.

411. *badius*, Newm.
412. *velutinus*, Oliv.
413. *sinuatus*, Newm.

LEPTURA, Serv.

414. *subhamata*, Rand.
415. *elegans*, Lec.
416. *capitata*, Newm.
417. *subargentata*, Kirby.
var. *ruficeps*, Lec.
418. *nigrella*, Say.
419. *canadensis*, Fab.
420. *vagans*, Oliv.
421. *chrysocoma*, Kirby.
422. *proxima*, Say.
423. *vittata*, Germ.
424. *pubera*, Say.
425. *ruficollis*, Say.
426. *mutabilis*, Newm.

PSÉNOCERUS, Lec.

427. *supernotatus*, Say.

MONOHAMMUS, Serv.

428. *scutellatus*, Say.
429. *confusor*, Kirby.
430. *marmorator*, Kirby.

HYPERPLATYS, Bates.

431. *aspersus*, Say.

UROGRAPHIS, Horn.

432. *fasciatus*, De G.

POGONOCHERUS, Lat.

433. *mixtus*, Hald.

SAPERDA, Fab.

434. *calcarata*, Say.
435. *candida*, Fab.
436. *tridentata*, Oliv.
437. *vestita*, Say.

OBEREA, Muls.

438. *ruficollis*, Fab.

TETRAOPES, Serv.

439. *tetraophthalmus*, Forst.

CHRYSOMELIDÆ.

DONACIA, Fab.

440. *palmata*, Oliv.
441. *magnifica*, Lec.
442. *subtilis*, Kuntz.
443. *cuprea*, Kirby.

ORSODACHNA, Lat.

444. *atra*, Ahr.
var. *childreni*, Kirby.

SYNETA, Esch.

445. *ferruginea*, Germ.

LEMA, Fab.

446. *trilineata*, Oliv.

BASSAREUS, Hald.

447. *congestus*, Fab.
448. *mammifer*, Newm.
449. var. *luteipennis*. Melsh.

CRYPTOCEPHALUS, Geoff.

450. 4—*maculatus*, Say.
451. *venustus*, Fab.

MONACHUS, Chev.

452. *ater*, Hald.

XANTHONIA, Baly.

453. 10—*notata*, Say.

ADOXUS, Kirby.

454. *vitis*, Linn.

CHRYSOCHUS, Chev.

455. *auratus*, Fab.

PARIA, Lec.

456 6.—*notata*. Say.
457. *aterrima*, Oliv.

PRASOCURIS, Lat.

458. *varipes*, Lec.

DORYPHORA, Ill.

459. *clivicollis*. Kirby.
460. 10—*lineata*, Say.

CHRYSOMELA, Linn.

461. *elegans*, Oliv.
462. *scalaris*, Lec.
463. *philadelphica*,, Linn,
var. *spiræa*, Say.
464. *multipunctata*, Say.
var. *Bigsbyana*, Kirby.

PLAGIODERA, Redt.

465. *viridis*, Melsh.

GASTROIDEA, Hope.

466. *polygoni*, Linn.

LINA, Meg.

467. *scripta*, Fab.
468, var. *morula*, Hausen.

PHYLLODECTA, Kirby.

468. *vulgatissima*, Linn.

DIOBROTICA, Chev.

469. 12—*punctata*, Oliv.
470. *vittata*, Fab.

TRIRHABDA, Lec.

471. *tomentosa*, Linn.
472. var. *virgata*, Lec.
473. var. *canadensis*, Kirby.

ADIMONIA, Leach.

474. *rufosanguinea*, Say.

GALERUCA, Geoff.

475. *sagittariæ*, Gyll.

ŒDIONYCHIS, Lat.

476. *quercata*, Fab.

DISONYCHA, Chev.

477. *alternata*, Ill.
478. *collaris*, Fab.

HALTICA, Geoff.

479. *bimarginata*, Say.
480. *carinata*, Germ.
481. *ignita*, Ill-

CREPIDODERA, Chev.

482. *Helxines*, Linn.
483. *cucumeris*, Harr.

SYSTENA, Chev.

484. *hudsonias*, Forst.
485. *frontalis*, Fab.

PHYLLOTRETA, Foud.

486. *vittata*, Fab.

ODONTOTA, Chev.

487. *nervosa*, Panz.

COPTOCYCLA, Chev.

488. *aurichalcea*, Fab.

BRUCHIDÆ.

BRUCHUS, Linn.

489. *pisi*, Linn.

TENEBRIONIDÆ.

PHELLOPSIS, Lec.

490. *obcordata*, Kirby.

NYCTOBATES, Guér.

491. *pennsylvanica*, De G.

IPTHIMUS, Truq.

492. *serratus*, Mann.

UPIS, Fab.

493. *ceramboides*, Linn.

SCOTOBATES, Horn.

494. *calcaratus*, Fab.

XYLOPINUS, Lec.

495. *saperdioides*, Oliv.

TENEBRIO, Linn.

496. *molitor*, Linn.
497. *tenebrioides*, Beauv.

DIAPERIS, Geoff.

497. *hydni*, Fab.

HOPLOCEPHALA, Lap.

498. *bicornis*, Oliv.

PLATYDEMA, Lap.

499. *ruficorne*, Sturm.
opaculum, Casey.
500. *subcostatum*, Lat.

BOLETOTHERUS, Cand.

501. *bifurcus*, Fab.

CISTELIDÆ.

ISOMIRA, Muls.

502. *quadristriata*, Couper.

ANDROCHIRUS, Lec.

503. *erythropus*, Kirby, (= *luteipes*, Lec.)

MELANDRYIDÆ.

PENTHE, Newm.

504. *obliquata*, Fab.

MELANDRYA, Fab.

505. *striata*, Say.

SERROPALPUS. Hellw.

506. *barbatus*, Schall. (= *striatus*, Hellw.)

PYTHIDÆ.

BOROS, Hbst.

507. *unicolor*, Say.

ŒDEMERIDÆ.

DITYLUS, Fisch.

508. *cœruleus*. Rand.

NACERDES. Schm.

509. *melanura*. Linn.

ASCLERA, Schm.

510. *ruficollis*. Say.

MORDELLIDÆ.

ANASPIS, Geoff.

511. *flavipennis*. Hald.

MORDELLA. Linn.

512. *melæna*. Germ.

MORDELLISTENA. Costa.

513. *scapularis*. Say.

ANTHICIDÆ.

CORPHYRA, Say.

514. *fulvipes*. Newm.

515. *lugubris*. Say.

NOTOXUS. Geoff.

516. *anchora*. Hentz.

ANTHICUS, Payk.

517. *formicarius*, Laf.

PYROCHROIDÆ.

SCHIZOTUS, Newm.

518. *cervicalis*, Newm.

DENDROIDES, Lat.

519. *canadensis*, Lat.

MELOIDÆ.

MELOE, Linn.

520. *niger*, Kirby.
521. *angusticollis*, Say.
522. *americanus*, Leach.

MACROBASIS, Lec.

523. *unicolor*, Kirby.

EPICAUTA, Redt.

524. *pennsylvanica*, De G.

ATTELABIDÆ.

ATTELABUS, Linn.

525. *rhois*, Boh.

OTIORHYNCHIDÆ.

PHYXELIS, Sch.

526. *rigidus*, Say.

OTIORHYNCHUS, Germ.

527. *sulcatus*, Fab.
528. *ovatus*, Linn. (=*ligneus*, ‡‡ Lec.)

CURCULIONIDÆ.

SITONES, Sch.

529. *lineellus*, Gyll.
530. *tibialis*, Hbst.

ITHYCERUS, Sch.

531. *noveboracensis*, Forst.

PHYTONOMUS, Sch.

532. *nigrirostris*, Fab.

LEPYRUS, Sch.

533. *colon*, Linn.

LISTRONOTUS, Jek.

534. *appendiculatus*, Boh.

PISSODES, Germ.

535. *strobi*, Peck.

HYLÓBIUS, Germ.

536. *pales*, Hbst.

ERYCUS, Tourn.

537. *puncticollis*, Lec.

MAGDALIS, Germ.

538. *armicollis*, Say.

ANTHONOMUS, Germ.

539. *quadrigibbus*, Say. 540. *signatus*, Say.

ORCHESTES, Ill.

541. *ephippiatus*, Say.

GYMNETERON, Sch.

542. *teter*, Fab.

CONOTRACHELUS, Sch.

543. *nenuphar*, Hbst. 544. *posticatus*, Boh.

CRYPTORHYNCHUS, Ill.

545. *parochus*, Hbst.

MONONYCHUS, Germ.

546. *vulpeculus*, Fab.

BALANINUS, Germ.

547. *nasicus*, Say.

BRENTHIDÆ.

Eupsalis, Lec.

548. *minuta*, Drury.

CALANDRIDÆ.

Sphenophorus, Sch.

549. *pertinax*, Oliv.
550. *sculptilis*, Uhler.

Calandra, Clairv.

551. *granaria*, Linn.

Cossonus, Clairv.

552. *platalea*. Say.

SCOLYTIDÆ.

Xyleborus, Eich.

553. *pyri*, Peck.

Tomicus, Lat.

554. *pini*, Say.
555. *calligraphus*, Germ.

Dendroctonus, Er.

556. *terebrans*, Oliv.

Hylurgops, Lec.

557. *pinifex*, Fitch.

ANTHRIBIDÆ.

Cratoparis, Sch.

558. *lunatus*, Fab.

Proceedings of the Natural History Society.

The regular monthly meeting was held on Monday evening, November 30th, Hon. Senator Murphy, Vice-President, in the chair.

The minutes of meeting of October 26th were read and approved.

Minutes of council meeting of the 23d instant were also read.

The Librarian reported the gift of a copy of Dana's Manual of Mineralogy from Mr. Horace T. Martin. On motion of Mr. J. Stevenson Brown, seconded by Mr. F. B. Caulfield, the thanks of the society were tendered to Mr. Martin.

It was moved by Mr. J. S. Shearer, seconded by Mr. J. S. Brown, that the by-laws be suspended, and that the Hon. J. K. Ward be elected a member of the society. Carried. Mr. Ward was then elected by acclamation.

Sir William Dawson read a very interesting paper on "Trees cultivated on McGill College Grounds."

After a lengthy discussion of the paper, a vote of thanks to Sir William Dawson was moved by the Rev. Dr. Smyth, seconded by Mr. Edgar Judge. Carried.

Mr. Horace T. Martin communicated some notes on old engravings of the beaver.

The meeting then adjourned.

Proceedings of the Microscopical Society.

The regular monthly meeting of the above society was held on Monday evening, Dec. 14th, the lecturer being Sir Wm. Dawson, who chose for his subject "The use of the Microscope in the Study of Fossils." The lecture was most interesting, owing to the fact that Sir William gave, in clear, concise terms, the accumulated results of years of continuous research, and at the same time demonstrated some of the difficulties that the early investigators had to contend with, owing to the poor instruments at their command. He exhibited a "prehistoric" microscope, of date 1834, and also a number of single lenses, with a magnifying power of about 200, by the aid of which all his early work had been accomplished. He laughingly remarked "that if in the dawn of microscopy the instruments were poor, the observers had to make up for it by looking harder." Certainly nothing can mark more clearly the advance made in optical instruments, in response to the demands of science, than a comparison between the instrument of 1834 and that of to-day. Sir William demonstrated that our Montreal limestone is composed almost entirely of organic remains. He also exhibited a specimen of clay from McGill College grounds, and shewed that it contained a large number of foraminifera. Fossil sponges were treated of, and a large number of specimens, prepared by the lecturer, were examined with much interest by the members.

A vote of thanks was tendered Sir William for his courtesy in preparing so interesting a lecture and demonstration for the society.

Letters of regret at being absent were read from His Excellency the Governor-General and others.

The next meeting of the society will be held on January 11th, when Prof. Cox of McGill College will lecture on "Polarised Light, its usefulness in indicating structure," with lantern illustrations.

Notices of Books and Papers.

Manganese, its Uses, Ores and Deposits, by R. A. F. Penrose, 642 pp., Little Rock, Ark., 1891, being Volume I. of the Annual Report of the Arkansas State Geological Survey, 1890, J. C. Branner, State Geologist.

In 1889 Dr. R. A. F. Penrose, jr., assistant geologist for the Geological Survey of Arkansas, U.S., began the thorough reexamination and study of the manganese deposits of that State, and his official report, now published, proves how very complete and exhaustive have been his labors and researches, for not only has he examined personally the deposits in Arkansas, but he has visited every known manganese region in the United States and Canada, investigating the modes of occurrence of the ore and the mining and commercial history of this important product. In this very valuable monograph are discussed (1) the uses of manganese together with the history and statistics of the manganese industry, (2) the ores of manganese and (3) the nature of manganese deposits, and to this we will be indebted for the substance of this article.

Manganese is now used for many different purposes in the arts, but by far the greater part of the ore mined is converted into the alloys of manganese and iron, spiegeleisen and ferro-manganese, which in turn play such a vital part in steel making. As an oxidizer this ore is used extensively in the manufacture of chlorine, bromine oxygen and disinfectants, and for discolorizing glass, and as a coloring material in coloring glass, pottery and tiles, calico printing and dyeing and paints.

But it is in the production of steel that manganese plays such a prominent and valuable part. In 1839, Heath, an East Indian ironmonger, patented his process by which the introduction of the carburet of manganese into steel making was made with such marvellous success that the price of steel was reduced $150 to $200 per ton. This revolution in the manufacture of steel was still further hastened by Bessemer, in 1858, introducing his perfected process in which manganese is used with great effect in his converter, leading to the great reduction in the cost of steel with the consequent vast increase in its production and consumption. Of these alloys, spiegeleisen contains less than 20 per cent. of manganese, ferro-manganese 20 per cent. and more, and their effects in steel-making are various. In the first place their presence in the converter, after the iron has lost all its carbon, and hence been reduced to wrought iron, serves to restore the proper amount of carbon to "re-carburize," or convert this wrought iron into steel. Again, manganese reduces the small but harmful quantities of iron oxide in the steel during the final melting; then passes into the slag, making it more fluid.

This metal tends to overcome to a large extent in steel-making the evil influences of sulphur and phosphorus, and when present, even in small quantities, in steel, it increases the hardness, toughness, malleability and elasticity, and when the amount reaches 8 per cent. it not only makes the steel astonishingly ductile, but also very hard.

The production of spiegeleisen and ferro-manganese in the United States is increasing very rapidly, but the supply of domestic ores is far from sufficient for the demand. In 1889, 99,481 tons were imported and 85,823 tons produced, and though in the census year ending June 30th, 1890, the home production had greatly increased, the market is still open for large quantities of foreign ores.

Manganese is a very valuable metal in some very useful alloys, such as manganese bronze, from which the propeller screws of the largest ocean steamships are made, an alloy of remarkable strength, hardness and toughness; and silver bronze, now very largely used as a substitute for German silver, a small percentage of aluminium present greatly enhancing its value.

In its chief ores, manganese exists mostly as a carbonate or an oxide, but though true manganese ores are mined, manganiferous ores of other metals are more abundant, and in reality there is no sharp line between manganese ore proper and manganiferous iron ores which are very highly valued and readily marketable. All of the many manganese minerals on exposure to decomposition from surface influences are generally converted into oxides, and these oxyd minerals are thus more abundant, forming the greater part of American ores, and are known as pyrolusite, psilomelane, braunite, manganite and wad or bog manganese.

In Canada manganese ores have been found in many parts, but the most valuable deposits are in New Brunswick and Nova Scotia, those near the Bay of Fundy and Chignecto Bay having been the most extensively worked. Manganese was mined in Hants Co., N.S., as early as 1861, but the first real work was done at the Tenny Cape in that county in 1862 by John Brown. In 1864 the mine at Markhamville, N.B., was opened by Major A. Markham, and has been worked continuously ever since, producing up to 1890, 40,000 tons, or by far the greater part of Canada's total yield, which has been estimated at over 50,000 tons.

The most important deposits occur in the lower carboniferous limestone or the associated strata, and the ore is mostly found as an oxide, as pyrolusite, manganite and psilomelane, and especially as wad.

Nearly all our Canadian ore is shipped to the United States, where it is used in glass-making, electric batteries, as a dryer in varnishes, but very little for spiegeleisen or ferro-manganese, as it is too pure and high grade, and thus more valuable for other industrial purposes, particularly glass-making, where its freedom from iron is a very necessary quality. The Canadian deposits are such that the ore cannot be extensively mined as for spiegeleisen, but for chemical purposes its value of $40 to $100 per ton make it profitable, as at the most only $15 can be got for low grade mineral. The ore is found in the limestone in interbedded lenticular layers, nests or pockets, carrying from a few pounds to several tons, also in considerable quantities in the clays overlying the decayed surface of the limestone. Much of the ore is concentrated before shipping, by crushing, washing and sizing in screens, or else shipped *en masse* as "furnace ore," to be manufactured into alloys for steel-making.

In Canada the production from 1873-1886 of manganese ore was 16,039 tons, worth $344,440, while in 1890 it was 1,455 tons, worth $32,737. In 1888 the United States produced 291,330 tons of ore, valued at $1,454,416. The demand for manganese ores is ever increasing, and it is to be hoped that new deposits will be opened up in Canada, leading to mining on a more extensive and productive scale, and adding materially to the wealth and prosperity of our Dominion.

W. A. CARLYLE, M.E.

ON THE NICKEL AND COPPER DEPOSITS OF SUDBURY, ONT., by Alfred E. Barlow, M.A. (of the Geological Survey Department).

This timely paper which appears in the June number of the *Ottawa Naturalist*, deals in general with the discovery, geological relations, mode of occurrence and composition of the nickel and copper ores in the Districts of Algoma and Nipissing, together with their preliminary metallurgical treatment as carried on in this district. The discovery of nickel in Canada dates back to 1846, when its existence in workable quantities at the Wallace mine, on Lake Huron, was made known. In 1856 Dr. T. Sterry Hunt, in his analyses of some trap collected by Mr. Alex. Murray, of the Geological Survey, from the north-western corner of the Township of Waters, showed that small quantities of nickel and copper were present. These deposits are composed of chalcopyrite very intimately mixed with nickeliferous pyrrhotite. The detection at some of the openings of polydymite, ferriferous sulphide of nickel, as well as a few undoubted crystals of millerite, seems to justify the assumption that in the more highly nickeliferous deposits, at least, the nickel is also present as a sulphide, disseminated through the ore mass like the iron and copper. These sulphides may be said to occur in three distinct ways. 1st, As contact deposits of pyrrhotite and chalcopyrite, situated between the clastic rocks, such as felsites, quartzites, and intrusive diabase or gabbro, or between these latter and granite or micropegmatite. 2nd, As impregnations of these minerals through the diabase or gabbro, which are sometimes so rich and considerable as to form workable deposits. These sulphides are in no case found dissemmated through the clastic rocks at any great distance from the diabase or gabbro, which seems clear evidence that they have been brought up by the latter. 3rd, As segregated veins which may have been filled subsequently to the intrusion which brought up the more massive deposits. These veins are not very common, although certain portions of the more massive deposits may have been dissolved out and redeposited along certain faults and fissures.

Assays made for the Canadian Copper Company, by Mr. F. L. Sperry, the chemist, show a range in the percentage of nickel from 1.12 to 4.21 per cent., with an average of 2.38 per cent., while the copper varied from 4.03 to 9.98 per cent., with an average of 6.44 per cent. Mr. Hoffmann, of the Geological Survey, assayed four samples which showed the nickel contents to vary from 1.95 to 3.10 per cent., with an average of 2.25 per cent. The metallurgical treatment commences at the roast, where the ore is piled in rectangular heaps on previously laid cordwood and roasted for fifty to seventy days, and when thoroughly done should contain about 7 or 8 per cent. of sulphur. It is then smelted in a very perfect water-jacketed furnace, the resulting product, or "matte," containing about 27 per cent, copper and 14 per cent. nickel. This is then packed in barrels and shipped to various refiners in the United States or Europe, according to their respective bids.

The paper in question is the most succinct and best report we have as yet seen upon the ores and geology of the region about Sudbury, and no one interested in the geological and mineralogical problems involved, as well as the metallurgical points with which it deals, should be without it.

H. M. Ami.

Erosion in the Desert of the Little Colorado.

In No. 3 of "North American Fauna," recently published by the United States Department of Agriculture (1890–1), Dr. C. Hart Merriam, in addition to an immense amount of most valuable information on the botany and zoology of Arizona and Idaho, gives a graphic description of the peculiar erosion topography of the Desert area, as well as an account of several cloud-bursts which he witnessed while travelling in that almost unknown region. As these cloud-bursts, although having a very remarkable effect on the character of the erosion, occur but rarely and have been but very seldom described by competent observers, the following extracts from Dr. Merriam's reports, which are of especial interest, are here reproduced: . . .

The Desert of the Little Colorado, sometimes known as the "Painted Desert," is a great basin about 1,000 meters (3,300 feet) in depth, situated on the top of the plateau. It was excavated, as its name indicates, by the drainage system of the Little Colorado River—the Colorado Chiquito of the Mexicans—and consequently is lowest at the north, its slope being *away* from the southern edge of the plateau. The river has cut its bed down to about 820 meters (2,700 feet) at the point where it empties into the Grand Cañon of the Colorado, and throughout the lower part of its course it flows through a cañon considerably below the level of the desert proper, the lowest part of which is but little less than 1,200 meters (approximately 4,000 feet) in altitude. Its upper limit may be set at 1,800 meters (6,000 feet). The term Painted Desert should be restricted, it seems to me, to that part of the basin which is below 1,500 metres (approximately 5,000 feet).[1]

The geology of the region is simple. The lowest stratum which comes to the surface is carboniferous limestone; above this is red sandstone, which in turn is overlaid by the so-called variegated marls or argillaceous clays, sometimes capped by a thin layer of impure coal or lignite. The limestone appears on the west side of the river only (?), where it is soon buried under the ancient lava floods from San Francisco Mountain and neighboring craters. The red sandstone is encountered everywhere, sometimes as surface rock, sometimes as high cliffs forming the escarpments of broad mesas, and sometimes as curiously sculptured tablets standing on the plain. The marls are widely distributed, and in many places, particularly south of the lower part of Moencopie Wash,[2] rise from the surface level in the form of strangely eroded hills and ranges of stratified cliffs, whose odd shapes and remarkable combinations of colors—red, white, blue, brown, yellow, purple and green—have given the area in which they occur the name "Painted Desert." There are hundreds of smoothly rounded, dome-shaped hills of bluish clay, utterly devoid of vegetation, and almost identical in appearance with the "gumbo hills," of the Bad Lands bordering the Little Missouri in North Dakota. Both the hills and the naked clayey flats between them abound in alkali vents—miniature craterlets—where the alkali effloresces, crusting over the surface in patches which resemble newly fallen snow. Many of the hills are capped with fossil wood, and many of the flats and lower levels east of the Little Colorado River are strewn with chips and pieces which have tumbled down during the wearing away of the hillsides. Logs 30 to 50 centimeters (roughly, a foot or a foot and a half) in diameter and 9 to 12 meters (30 or 40 feet) in length are

[1] The area below 1,370 meters (4,500 feet) is about 120 kilometers (75 miles) in length, and that below 1,500 meters (5,000 feet), 200 kilometers (125 miles). The long axis of the desert, slightly crescentic in form, and curving from near the mouth of the Little Colorado in the northwest to New Mexico in the southeast, is 320 kilometers (200 miles) in length, with a transverse diameter of about 110 kilometers (70 miles) along the middle portion, and a total area of 29,800 square kilometers (11,500 square miles). Its eastern edge penetrates the boundary of New Mexico in two arms, following the usually dry courses of the Zuni and the Carrizo, and nearly reaches the boundary along the Rio Puerco, the largest tributary of the Colorado Chiquito.

[2] The terms "wash" and "arroyo" are applied to the deep channels or ravines so common in arid regions. "These arroyos are natural consequences of the unequal manner in which the rain falls throughout the year. Sometimes not a drop falls for several months; again, it pours down in a perfect deluge, washing deep beds in the unresisting soil, leaving behind the appearance of the deserted bed of a great river."—Emory, Mexican Boundary Survey, I, 1857, p. 57.

still common, and several sections were found, possibly from the same tree, which measured about 150 centimeters (5 feet) in diameter. There are pebbled beds miles in extent, made up of agate, moss-agate, chalcedony, jasper, obsidian and fossil wood, with not so much as a spear of grass or bit of cactus between them. On the other hand, many of the mesas and plains are covered with sand and decomposed marls, which support a scanty growth of cactus, yucca, grease-wood and a few other forms of vegetation characteristic of arid regions.

The bed of the Little Colorado River contains the only running water in this part of Arizona, and it "goes dry" a large part of the year, a little water remaining in scattered pools, which are strongly alkaline. Some of the salt and alkali flats on the river-bottom support a luxuriant growth of a singular fleshy plant belonging to the genus *Salicornia*, which at a little distance looks like a leafless bush with green stems. During the rainy season, and whenever the river "runs," the liquid which flows down its course is red alkaline mud, about the consistency of ordinary sirup. This is the case also with its tributaries, of which Moencopie Wash and Tenebito Wash are the only ones which cross the Painted Desert proper.

The physical and climatic features of the Painted Desert are peculiar and striking, and result in the production of an environment hostile alike to diurnal forms of animal life and to the person who traverses it. The explorer is impressed with the unusual aspects of nature—the strange forms of the hills, the long ranges of red and yellow cliffs, the curiously buttressed and turreted buttes and mesas, the fantastic shapes of the rocks carved by the sand-blast, and rendered still more weird by the hazy atmosphere and steady glare of the southern sun, the sand-whirls moving swiftly across the desert, the extraordinary combination of colors exposed by erosion, the broad clayey flats whitened by patches of alkali and bare of vegetation, the abundance of fossil-wood, the extensive beds of shining pebbles, the unnatural appearance of the distant mountains sharply outlined against the yellow sky, the vast stretches of burning sand, the total absence of trees, the scarcity of water, the alluring mirage, the dearth of animal life, and the intense heat, from which there is no escape.

The Plateau region of the interior of North America is noted for its scanty rain-fall, and the same may be said of Arizona as a whole. The annual precipitation and mean humidity are greatest on the high mountains and least on the low plains and deserts. The San Francisco Mountain has many times the rain-fall of the Little Colorado Desert, near by, and the quantity of aqueous vapor in the air is correspondingly higher. Evaporation is retarded by the clouds which frequently rest upon the summit, and by the dense spruce forests which protect the soil from the direct rays of the sun, enabling it to retain enough moisture to permit the growth of plants requiring a humid atmosphere for their existence.

There are two rainy seasons on the San Francisco Mountain plateau: one in summer, usually in July or August, the other in mid-winter. The summer rainy season is characterized by daily thunder-showers. As a rule, several such showers occur each day, and not infrequently several may be seen at the same time from any of the volcanic cones. The area covered by each is very small, its diameter rarely exceeding half, or even a quarter of a mile;

and its duration is brief, though the rain-fall may be considerable. The accompanying thunder is often terrific, and the lightning vivid and destructive. Tall pines are shattered on every hand, and cattle are frequently killed; three were killed by one stroke near our camp about the middle of August. The showers almost always take place in the day-time, and are most common at mid-day and in the early afternoon. In fact, it is a common saying in this region that it never rains at night. Two partial exceptions to this rule occurred during our stay, one in which an unusually severe and protracted rain lasted from about 3 o'clock in the afternoon until 9 or 10 in the evening; the other, a light shower which actually took place in the night. During the latter part of the rainy season the showers became less frequent, but extended over a larger area and lasted longer. The axis of abundance seems to be between San Francisco and Kendrick Peaks, but the greatest precipitation occurs on San Francisco Mountain, as would be expected from its great altitude. The summit of the mountain is so cold that it is occasionally whitened with snow while rain falls at its base; and hail-storms are frequent both on the mountain itself and throughout the plateau region, many sudden storms taking this form.

Over much of the pine plateau the soil consists of decomposed lava, and is so porous that the rain sinks out of sight as it falls, and the atmosphere is so dry and evaporation so rapid that a few minutes after a shower no traces of it are visible.

On the arid desert of the Little Colorado rains are infrequent, but usually of great violence, producing torrents which cut deep washes or "arroyos" in the sun-baked sand and clay. Sometimes cloud-bursts deluge large areas, flooding the valleys and destroying multitudes of the smaller mammals. Three storms of this character were witnessed, two of moderate size, the third of great dimensions, and striking evidences of a fourth were everywhere noticeable when we reached the region. This latter almost inundated the town of Flagstaff and several other places along the line of the Atlantic & Pacific Railway, and left unmistakable evidences of its volume and force in various directions, the most impressive, perhaps, being the overflow of a crater lake and adjoining craterlet just east of Kendrick Peak. The track of the torrent that rushed down the sides of this crater, and for a distance through the pine forest beyond, suggested a veritable volcanic eruption.

While following the course of Tenebito Wash across the Painted Desert, we saw a heavy rain-storm raging over the high mesas to the north and east during the entire afternoon of August 14, though not a cloud came between us and the parching sun. Before dark a furious wind—the vehicle of a sand-blast—swept down the wash between the rows of cliffs which mark its course, abating as night came on. About 10 o'clock we were startled by a loud roaring in the north, which at first gave the impression that a severe storm was advancing upon us, but not a cloud could be seen, and the stars shone brightly in every direction. The roaring increased and came nearer until it was evident that something was coming down the bed of the wash; and in a moment a great wave of thick mud rushed past with a tremendous roar, accompanied by a fetid stench. The first wave was about 1½ metres (5 feet) high, but it soon rose to 2½ meters (8 feet), where it remained for an hour, and then slowly subsided. After 3½ hours it was still about 1½ meters (5 feet) deep and running swiftly, and it had not entirely ceased three days later.

Two days afterward (August 16), when at the Moki Pueblo of Oraibi, a furious rain set in about 4 p.m., and lasted more than an hour, flooding the house-tops and streets and parts of the valley below. And yet the desert was as parched next day as if it had never been wet.

The heaviest and most extended rain-fall observed by us occurred September 20, on which date Mr. Bailey and I set out from Little Spring for Moencopie. Heavy laden clouds began scurrying over the mountain toward the northeast early in the morning, and by noon the entire sky was overcast and had a most ominous appearance. Soon the rain began falling in torrents, and the storm moved steadily eastward from the edge of the lava-beds to the Little Colorado, and thence across the desert to the high mesas beyond. Such a deluge I never saw, and we afterwards learned that it extended 160 kilometers (nearly 100 miles) to the south. The gulch in the edge of the lava-beds, about 2½ kilometers (1½ miles) east of Black Tank, was full to overflowing; the flat upon which it empties was 1½ meters (5 feet) under water; great lakes appeared in various parts of the desert, and the Little Colorado bottom was completely flooded. And yet all this vast volume of water disappeared in a few hours. A red, sirupy, alkaline mud filled the bed of the Little Colorado for a few days, and pools of similar mud were occasionally found in depressions in the sand-rock all the way to Moencopie. The whole desert, from the San Francisco lava-beds on the west to Echo Cliffs on the east, showed that it had been recently deluged, as if by the breakage of some mighty dam, but the water had disappeared.

From the scanty data available, and from the experience of residents of the region, it is safe to infer that the rain-fall was unusually heavy in the Plateau region during the summer of 1889.

In No. 5 of the "North American Fauna," Dr. Merriam also makes the following observations on the effects of water-courses on the geographic distribution of species:

Mountain streams, in passing down into the plains, exert a two-fold influence on the distribution of animals and plants. By their constant efforts to reach base level, these streams are continually cutting down and lengthening the valleys in such a way as to produce gradually sloping bottom lands, which penetrate the highlands from the plain below, carrying with them narrow prolongations or tongues of the fauna and flora of lower levels, which follow the the contour lines in a general way.

The second effect mentioned is of an exactly opposite character. The low temperature of the water, coming from melting snow-banks or cold springs in the mountains, lowers the temperature of the soil supporting the vegetation on its immediate banks, while the evaporation from its surface cools the air to which the foliage of such vegetation is exposed, thus bringing the northern or higher fauna and flora down along the immediate course of the stream.

The length of the stream and steepness of the slope determine whether the first or second effect is most pronounced. Rivers having long courses over the plains, such as the Missouri and

Platte, become so thoroughly warmed during their long journey that the second effect is inappreciable, while the first is very strongly marked, southern forms of life ascending these valleys a hundred kilometers or more beyond the usual limit. Short streams, on the other hand, and particularly those that head in mountains and have rapid courses, carry northern forms many kilometers below their normal limit, but do not afford the same facility for the northward extension of southern forms. Streams of intermediate character (in the respects indicated) present intermediate conditions, and where the two types balance, the northward (or upward and southward (or downward) extensions of the life zones are of equal length, the latter inclosing the former like the involuted finger of a glove.

THE BIRDS OF MANITOBA. By Ernest E. Thompson, Toronto, Canada. Proc. U. S. National Museum, Vol. XIII, 1890.

In this pamphlet of 643 pages, the author gives the results of three years' field studies of the birds of Manitoba, supplemented by numerous quotations from previous writers and unpublished manuscripts, notably the unpublished "Observations on Hudson's Bay," by Thos. Hutchins, for twenty-five years prior to 1782 an agent of the Hudson's Bay Company. Mr. Thompson has also availed himself of a number of reports communicated to the A. O. U. Committee on Bird Migration, bringing together a large amount of information respecting the ornithology of a district of which previously but comparatively little was known. The author's own field notes are very full, particularly with regard to the nesting habits and singing powers of many species, and bring vividly before us charming pictures of bird life, amidst the whispering woods and on the breezy prairies. The work consists of five parts, (1) an introduction giving the boundaries and physical features of the province; (2) an "Annotated list of the birds," numbering 266 species and subspecies; (3) "A chronological list of the principal books and articles consulted;" (4) "A list of the manuscripts used in completing the foregoing notes;" (5) index. The paper is accompanied by a map showing the distribution of the prairies, sand dunes and marshes and the deciduous and coniferous forests, the whole forming a very important addition to the literature of Canadian ornithology. It is to be regretted that the mechanical portion of the undertaking is not equally praiseworthy, the presswork being very poor indeed, and typographical errors by no means infrequent.

F. B. CAULFEILD.

TAXIDERMY AND ZOOLOGICAL COLLECTING. By William T. Hornaday. New York, Charles Scribner's Sons, 1891.

To the enthusiastic boy naturalist, waging a losing battle with the mangled remains of what once was a bird or small mammal, this book will be a revelation and a delight, telling him plainly and pleasantly everything necessary to enable him to skin, preserve and set up his bird or squirrel.

To the advanced worker it will be equally welcome, giving the latest and most approved methods of work, with a copiousness of detail and wealth of illustration exceedingly gratifying when compared with previous works. In truth, however, the plan of Mr. Hornaday's book is so comprehensive and so ably carried out, that it cannot fairly be compared with any of its predecessors, many of the methods and appliances described being either the author's own inventions or improvements upon those already in use, especially with respect to mounting the larger mammals and scaled fishes. Stress is laid upon the necessity of taking a full series of measurements and outline drawings, and the importance of accurate notes of all specimens, with sketches, so as to trust nothing to memory. Sound advice that, if followed, would save endless trouble. While preferring the clay-covered manikin for mounting mammals larger than a squirrel, the author describes the method of mounting with a soft body, as practised by the French taxidermists, viz., filling around a central support with tow or similar material. For the smaller mammals the writer prefers using a hard body, similar to that described for mounting birds, exactly copying the natural body as to size and form. For absorbing moisture or grease the writer much prefers fine sawdust to either plaster of Paris or cornmeal, the former covering everything with a fine film of dust, and when mixed with liquified grease forming a gummy cement very difficult to get rid of, while the latter is too hard to absorb moisture quickly. The book is divided into six parts: (1) Collecting and preserving. (2) Taxidermy. (3) Making casts. (4) Osteology. (5) The collection and preservation of insects (by Rev. W. J. Holland). (6) General information. Each subject is exhaustively treated, leaving little or nothing to be desired, every page bearing witness that it is written by one who loved his work and spared no pains to make himself master of it. It is illustrated by twenty-four plates and eighty-five cuts in the text.

F. B. CAULFEILD.

ABSTRACT FOR THE MONTH OF OCTOBER, 1891.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	* BAROMETER. Mean.	§ Max.	§ Min.	Range.	† Mean pressure of vapour	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	52.33	63.8	41.3	22.5	30.4177	30.513	30.315	.198	.2820	73.8	43.3	S.	5.4	4.8	10	0	85	....	....	....	1
2	60.17	70.5	47.0	23.5	30.2117	30.316	30.114	.202	.3990	76.0	52.5	S.W.	12.7	8.0	10	0	59	....	....	....	2
3	71.10	80.1	61.1	19.0	29.9547	30.101	29.846	.255	.5608	74.0	62.2	S.W.	22.1	0.0	0	0	92	....	....	....	3
SUNDAY.........4	.....	72.9	64.1	8.8	....	......	.....	....	.....	....	....	S.W.	10.8	....	..	..	50	....	....	....	4 ....SUNDAY
5	57.55	69.7	48.4	21.3	29.7290	29.938	29.596	.342	.3863	78.5	50.8	S.W.	15.8	6.3	10	0	19	0.06	....	0.06	5
6	44 37	50.2	39.5	10.7	30.0012	30.235	30.050	.185	.1858	64.2	32 7	W.	13.1	2.2	7	0	96	....	....	....	6
7	45.73	50 8	39.8	11.0	30.1757	30.265	30.029	.236	.2230	73.5	37 0	E.	6.8	9.7	10	8	00	0.15	....	0.15	7
8	43.55	46.0	41.2	4.8	29.8585	29.972	29.755	.217	.2523	89.2	40.3	N.E.	9.9	6.7	10	0	00	0.78	....	0.78	8
9	45.67	55.7	36.3	19.4	30.0160	30.066	29.976	.090	.2313	76.8	37.8	S.W.	10.5	3.3	10	0	00	....	....	....	9
10	51.28	59.7	42.5	17.2	30.0493	30.120	30.020	.100	.2915	77.5	44 2	S.W.	14.0	3.8	10	0	70	...	....	....	10
SUNDAY......11	.....	48.4	32.9	15.5	....	......	....	....	.....	....	....	N.	21.9	....	..	..	93	0.02	1.00	0.12	11 ....SUNDAY
12	37.47	44.8	30.2	14.6	30.6860	30.762	30.589	.173	.1465	66.3	27.0	N.E.	8.9	0.0	0	0	94	....	..	....	12
13	40.10	47.2	32.7	14.5	30.3657	30.531	30.183	.348	.1863	75.3	32.8	N.E.	9.0	7.7	10	0	00	....	....	....	13
14	45.78	54.6	37.7	16.9	29.9318	30.088	29.816	.272	.2437	79.3	39.7	N.E.	10.0	6.0	10	0	18	Inap.	....	Inap.	14
15	49 10	60.0	45.2	14.8	29.8070	29.829	29.781	.048	.2858	82.7	43.7	S.W.	14.4	5.5	10	0	00	0.06	....	0.06	15
16	46.97	53.6	42.4	11.2	30 0240	30.234	29.870	.364	.2483	77.2	40.0	W.	17.5	9.2	10	5	62	Inap.	....	Inap.	16
17	43.92	48.2	40.5	7.7	30.3168	30.383	30.243	.140	.2325	81.2	38.3	S.W.	5.7	4.2	10	0	32	....	....	....	17
SUNDAY.......18	.....	57.5	40.0	17.5	....	......	......	....	.....	...	....	S.E.	17.0	....	..	..	94	....	....	....	18 ....SUNDAY
19	45.43	53.8	37.4	16.4	30.0942	30.158	30.020	.138	.2438	80.5	39.5	N.E.	10.2	2.5	9	0	84	....	....	....	19
20	43 52	47.3	39 0	8.3	29.8442	30.008	29 622	.386	.2610	91.8	41.3	N.E	15.5	10.0	10	10	00	0.93	...	0.93	20
21	44.65	48.0	42.0	6.0	29.6838	29.812	29.593	.219	2585	87.3	40.8	W.	13.0	6.7	10	0	03	0.04	....	0.04	21
22	38.13	42.0	35.1	6.9	29.9080	29.951	29.852	.099	.1688	73.3	30.2	W.	14.9	8.2	10	0	15	....	Inap.	Inap.	22
23	34 63	39 0	30.1	8.9	29.8297	29.945	29.732	.213	.1448	72.3	26.7	W.	13.4	7.5	10	2	25	....	....	....	23
24	35.00	40.5	34.6	5.9	29.7833	29.902	29.716	.186	.1300	64.2	24.2	W.	19.7	6.7	10	0	03	....	....	....	24
SUNDAY......25	.....	37.7	26.0	11.7	......	.....	......	....	.....	....	....	W.	10.7	....	..	..	86	....	....	....	25 ....SUNDAY
26	42.55	50.5	37.2	13.3	29.6702	29.765	29.624	.141	.2222	81.2	37.0	S.W.	7.0	10.0	10	10	42	0.16	....	0.16	26
27	36.40	41.7	31.5	10 2	29.8712	30.127	29.676	.451	.1870	86.3	32.7	N.W.	16.5	10.0	10	10	00	0.13	0.50	0.18	27
28	30.38	33.7	24.5	9.2	30.2898	30.342	30.208	.134	.1203	70 8	22.3	N.W.	9.5	4.2	10	0	84	....	....	....	28
29	33.70	39.3	27.0	12.3	30.3165	30.375	30.238	.137	.1575	81.0	28.3	S.E.	12.0	4.3	10	0	07	....	....	....	29
30	44.50	55 0	33.2	21.8	30.0627	30.188	29.958	.230	.2168	74.2	36.5	S.	14 2	3.8	10	0	68	0.01	....	0.01	30
31	54.07	61.6	46.5	15.1	29.7518	29.942	29.550	.392	.2578	60.7	40.7	S.W.	20.1	9.8	10	9	16	0.04	....	0.04	31
............Means	45.14	52.33	38.93	13.45	30.0241	....	......	.218	.2416	76.63	37.87	W. 22¾° S.	13.0	6.0	....	....	41.9	2.38	1.50	2.53	Sums ....
17 Years means for and including this month......	45.06	52.03	38.39	13.64	30.0036	.....	......	.210	.2411	76.35	....	....	....	6.47	....	....	¶40.6	3.32	1.57	3.48	17 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction....	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles...........	748	1201	342	662	922	2888	2114	781	
Duration in hrs..	48	112	43	53	84	187	148	63	6
Mean velocity....	15 6	10.7	8 0	12.5	11.0	15 4	14.4	12.4	

Greatest mileage in one hour was 30 on the 11th.

Greatest velocity in gusts, 36 miles per hour on the 11th.

Resultant mileage, 3308.

Resultant direction, W. 22¾° S.

Total mileage, 9658.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 10 years only.

The greatest heat was 80.1 on the 3rd; the greates cold was 24.5 on the 28th, giving a range of temperature of 55.6 degrees. Warmest day was the 3rd. Coldest day was the 28th. Highest barometer reading was 30.762 on the 12th; lowest barometer was 29.550 on the 31st, giving a range of 1.212 inches. Maximum relative humidity was 98 on the 21st. Minimum relative humidity was 42 on the 9th.

Rain fell on 13 days.

Snow fell on 3 days.

Rain or Snow fell on 14 days.

Hoar frost on 2 days.

Lunar corona on the 16th.

Fog on 2 days.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1891.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	* BAROMETER. Mean.	§ Max.	§ Min.	Range.	† Mean pressure of vapour	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........1	.....	52.5	28.6	23.9	....	......	......	....	.....	..	....	W.	27.9	....		..	15	0.13	....	0.13	1 ....SUNDAY
2	29.88	34.0	26.3	7.7	30.2485	30.350	30.155	.195	.1100	66.8	20.3	W.	16.5	6.7	10	0	42	....	....	....	2
3	29.42	35.3	26.5	8.8	30.3740	30.420	30.336	.084	1020	62.7	18.8	W.	10 3	2.3	8	0	76	....	....	....	3
4	28.20	33.6	21.2	12.4	30.2517	30.342	30.164	.178	.1183	77.5	21.8	S.W.	3 0	4.7	10	0	73	....	....	....	4
5	29.82	36.8	23.0	13.8	30.1567	30.183	30.122	.061	1320	80.3	24.3	E.	6.4	5.0	10	0	33	....	....	....	5
6	32 58	40.0	26.5	13.5	30.2177	30.262	30.159	.103	.1273	69.7	23.7	N.E.	4.4	0.0	0	0	94	...	....	....	6
7	34.80	42.0	25.8	16.2	30.1303	30.199	30.078	.121	.1480	74.5	27.0	N.E.	8.0	7.3	10	0	83	....	....	....	7
SUNDAY 8	.....	47.2	32.0	15.2	....	......	......	....	.....	....	....	N.E.	11.2	.. ..	..	.	88	.. ..	....	....	8 ....SUNDAY
9	44.62	55.7	32.7	23.0	30.0130	30.061	29.977	.084	.2002	69.3	34.5	S.E.	15.1	4.7	10	0	71	....	....	....	9
10	49.77	54 7	41.6	13.1	29.9843	30.044	29.903	.141	.2657	74.5	41.8	S.E.	20.7	5.5	10	0	[illegible]	....	....	....	10
11	49.72	55.4	40.5	14.9	29.8012	29.867	29.749	.118	.2973	82.5	44.7	S.W.	18.8	5.0	10	[illegible]	85	0.52	....	0.52	11
12	43.20	49.5	37.3	12.2	29.9252	30.019	29.874	.145	.2332	83.5	38.7	S.W.	16.1	8.7	[illegible]	2	00	0.15	....	0.15	12
13	38.42	42.0	35.4	6.6	30.1778	30.236	30.058	.178	.1718	73.7	30.7	S.W.	12.7	8.2	10	0	00	Inap.	....	Inap.	13
14	33.68	39 4	28.5	10.9	30.3935	30.533	30.247	.286	.1177	61.0	21.5	W.	14.4	7.3	10	0	69	Inap.	Inap.	Inap.	14
SUNDAY ... 15	.....	32.8	24.4	8.4	....	......	....	....	.....	....	.. ..	N.W.	7.2	....	..	..	94	....	....	....	15 ....SUNDAY
16	42.72	49.5	27.8	21.7	30.1028	30.362	29.884	.478	2315	81.7	37.5	S.E.	23.6	10.0	10	10	00	0.20	0.60	0.26	16
17	45.95	60.4	30.7	29.7	29.5285	29.739	29.302	.437	.2685	79.0	39.7	S.W.	30.4	10.0	10	9	00	0.49	.	0.49	17
18	21.82	31.0	17.0	14.0	30.2740	30.549	29.907	.642	.0832	70.0	13.8	N.W.	22.5	6.0	10	0	65	....	Inap.	Inap.	18
19	27 57	36.4	16.0	20.4	30.5317	30.620	30.440	.180	.1033	69.3	19.0	S.	16.1	7.7	10	0	13	....	....	.. .	19
20	35 83	39.5	29.3	10.2	30.4722	30.507	30.442	.065	.1465	69.8	26.8	S.	13.6	10.0	10	10	00	....	....	....	20
21	43.07	49.2	36.4	12.8	30.2908	30.467	30.134	.333	1957	70.0	33.7	S.E.	18 1	10.0	10	10	00	0.06	...	0.06	21
SUNDAY 22	.....	51.7	44.3	7.4	.. ....	......	......	....	.	....	....	S.	21.1	....	..	.	00	0.36	....	0.36	22 .... SUNDAY
23	52.80	56.7	49.0	7.7	29.4160	29.715	29.013	.702	.3453	86 7	48.7	S.E.	22.4	10.0	10	10	00	0.35	....	0.35	23
24	40.30	52.0	36.5	15.5	29.2660	29.538	29.041	.497	.2092	82.3	35.3	S.W.	35.7	10.0	10	10	00	0.38	....	0.38	24
25	33 40	37.3	29 5	7.8	29.7718	29.894	29.706	.188	.1478	77.2	26.8	S.W.	20.7	8.3	10	0	09	...	0.70	0.07	25
26	30.98	37.0	22.5	14.5	29.8953	30.063	29.638	.425	.1363	78.7	25.0	S.E.	16.2	8.3	10	0	49	Inap.	....	Inap.	26
27	31.97	39.2	25.0	14.2	29.5778	29.723	29.395	.328	.1528	83.2	27.7	W.	18.3	10.0	10	10	21	0.07	0.10	0.08	27
28	14.82	26.6	5.2	21.4	29.9440	30.195	29.765	.430	.0693	78.0	9.3	N.	12.8	6.7	10	0	00	....	2.00	0.20	28
SUNDAY........29	.....	7.5	0.0	7.5	....	....	......	....	...	....	....	W.	10.9	....	..	..	91	....	....	..	29 ....SUNDAY
30	12.68	27 3	2.4	24.9	30.2708	30.400	30.177	.223	.0702	84.2	8.8	S.W.	12.9	7.2	10	0	07	....	0.10	0.01	30
....Means	35.10	50.09	32.88	17.21	30.0406	....	......	.265	.1673	74.4	28 0	S. 24½° W.	16.3	7.2	...	...	35.9	2.71	3.50	3.06	Sums ....
17 Years means for and including this month......	32.23	38.81	26.38	12.42	30.0111	.....	......	.262	.1551	79.4	....	....	....	7.3	...	...	¶30.4	2.43	12.8	3.72	17 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles............	260	526	184	2812	1695	3812	1709	711	
Duration in hrs..	32	63	28	144	102	193	108	44	6
Mean velocity....	8.4	8.3	6.6	19.5	16.6	19.7	15.8	16.2	

Greatest mileage in one hour was 53 on the 17th.
Greatest velocity in gusts, 64 miles per hour on the 17th.

Resultant mileage, 5750.
Resultant direction, S. 24½° W.
Total mileage, 11709.

* Barometer readings reduced to sea-level and temperature of 32° Fahrenheit.
§ Observed.
† Pressure of vapour in inches of mercury.
‡ Humidity relative, saturation being 100.
¶ 10 years only.

The greatest heat was 60.4 on the 17th; the greatest cold was zero on the 29th, giving a range of temperature of 60.4 degrees. Warmest day was the 23rd. Coldest day was the 30th. Highest barometer reading was 30.612 on the 19th; lowest barometer was 29.013 on the 23rd, giving a range of 1.599 inches. Maximum relative humidity was 100 on the 1st. Minimum relative humidity was 46 on the [illegible]th and 20th.

Rain fell on 13 days.
Snow fell on 7 days.
Hail fell on 2 days.
Rain or Snow fell on 17 days.
Lunar halo on 15th.
Lunar corona on the 14th.

ABSTRACT FOR THE MONTH OF DECEMBER, 1891.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	* BAROMETER. Mean.	§ Max.	§ Min.	Range.	† Mean pressure of vapour	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	30.88	36.7	27.3	9.4	30.1150	30.197	30.003	0.194	.1385	79.7	25.5	S.W.	21.8	7.8	10	0	55	....	....	....	1
2	37.20	43.7	27.8	15.9	29.9647	30.042	29.910	0.132	1580	71.3	28.5	S.W.	24.5	6.0	10	0	73	....	....	....	2
3	38.63	44.0	36.0	8.0	30.2260	30.258	30.157	0.101	.1897	81.5	33.3	S.W.	12.7	2.7	10	0	53	....	....	...	3
4	41.90	52.5	32.7	19.8	29.7815	30.144	29.428	0 716	.2067	76.8	35.2	S.E.	25.6	7.5	10	0	28	0.50	0.5	0.55	4
5	42.95	46.2	34.3	11.9	29.6572	29.702	29.616	0 086	1510	54.7	27.7	S.W.	36.7	4.8	10	0	68	0.02	...	0.02	5
SUNDAY......6	.....	43.7	31.6	12.1	......	......	.....	.....	.....	....	....	S.W.	23.0	....	..		76	....	Inap.	0.00	6 ....SUNDAY
7	26.27	32.5	22.5	10 0	29.7363	29.910	29.610	0.300	.1187	84.8	22 0	N.W.	19.9	8.0	10	0	00	....	2.6	0.26	7
8	28.08	34.8	19.2	15.6	30.0070	30.078	29.924	0 154	.1158	75.2	21.2	S.W.	23.8	4.7	10	0	82	...	...	....	8
9	39.50	41.8	30.8	11.0	29.9388	30.054	29.866	0 188	.1562	64.2	28.3	S.W.	37.2	5.5	10	0	62	....	....	....	9
10	40.47	44.8	36.8	[illegible]	29.9578	30.047	29.887	0 160	.1593	62.8	28.7	S.W.	26.6	6.2	10	0	62	....	....	....	10
11	35.52	42.2	28.0	14.2	30.1597	30.313	30.034	0.279	.1470	69.8	26.5	W.	22.8	2.8	10	0	81	....	....	....	11
12	31.02	39.0	23.5	15.5	30.1037	30.229	29.978	0 351	.1352	76.5	24.5	S.W.	12.5	7.7	10	0	23	....	....	....	12
SUNDAY......13	.....	45.0	36.4	8.6	......	.....	.	.....	.....	....	....	S.W.	28.5	....	..	..	88	....	....	...	13 ..... SUNDAY
14	27.95	38.3	19.3	19.0	30.1952	30.412	29.992	0.420	.1107	69.2	19.7	N.W.	20.0	7.8	10	0	01	....	.	....	14
15	22.63	34.8	18.0	16.8	29.9507	30.406	29.375	1.031	.1115	87.7	19.8	E.	18.1	8.3	10	0	00	0.14	6.0	0.74	15
16	19.55	35.3	4.5	30.8	29.4788	29.728	29.272	0.456	.0913	77.2	13 5	S.W.	23.5	10.0	10	10	00	0.15	1 6	0.31	16
17	3.47	11.0	−4.0	15.0	30.0727	30.382	29.856	0 526	.0385	75 0	−3.0	S.W.	27.3	3.3	10	0	00	....	Inap.	0.00	17
18	16.78	26.5	7.4	19.1	30.4435	30.525	30.350	0 175	.0783	80.7	11.7	S.W.	25.0	6.7	10	0	65	....	Inap.	0.00	18
19	29.28	33.0	26.3	6.7	30.3927	30.425	30.351	0 074	1375	85 2	25.3	S.W.	16.0	5.8	10	0	68	....	Inap.	0.00	19
SUNDAY......20	.....	29.5	20.2	9.3	....	......	......	....	.	....	.	S.W.	5.5	....	..		01	....	....	....	20 ....SUNDAY
21	26.53	33.6	18.6	15.0	30.3023	30.348	30.236	0.112	.1275	87.5	23.3	S.	14.3	5.0	10	0	31	....	....	....	21
22	35.22	43.8	22.3	21.5	30.0248	30.188	29.939	0 249	.1788	85.0	31.2	S.	23.0	9.2	10	5	00	0.03	...	0.03	22
23	39 28	45.6	34.4	11.2	29.9680	30.019	29.864	0.155	.2292	95.0	36.8	S.W.	12.9	10.0	10	10	00	0.46	....	0.46	23
24	32.57	37 0	31.0	6.0	30.1375	30.187	30.096	0.091	.1763	95.5	31.3	N.E.	10.0	8.3	10	0	00	0.02	0.3	0.05	24
25	33.42	35.2	32.3	2.9	30.0667	30.128	29.977	0 151	1855	97.0	32 7	N.E.	8.3	10.0	10	10	00	0.02	....	0.02	25
26	40.08	46.8	32.5	14.3	29.5493	29.837	29 335	0.502	.2150	85.0	35.8	S.	26.2	10.0	10	10	00	0.23	....	0.23	26
SUNDAY......27	.....	33.5	21.0	12.5	....	......	......	.....	.....	....	....	S.W.	25 7	....	..	.	57	....	Inap.	0.00	27 ....SUNDAY
28	16.60	21.7	12.3	9.4	30.2928	30.352	30.203	0.149	.0737	80.7	11.7	N.E.	7.3	1.8	10	0	68	. .	....	..	28
29	34.87	39.2	16.8	22.4	29.8692	30.142	29.629	0.513	.1612	78.7	28.7	S.E.	22.2	10.0	10	0	03	0.36	....	0.36	29
30	24.82	38.5	7 0	31.5	29.9413	30.373	29.649	0 724	.1163	77.0	18.7	W.	27 5	5.0	10	0	32	0.21	1.0	0.31	30
31	6.63	12.6	−1.3	13.9	30.6518	30.725	30.545	0.180	.0375	63.8	−3 5	W.	18.5	0.0	0	0	91	...	....	....	31
............Means	29.71	36.87	22.76	14.11	30.0365	.....	......	0.303	1387	78.4	23 5		20.9	6.48	....	....	37.7	2.14	12.0	3.34	Sums ....
17 Years means for and including this month.......	18.96	26.03	11.62	14.41	30.0205	.....	......	0.293	0988	82.1	....	....	....	7.08	....	....	¶29.3	1.39	23.7	3.73	17 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles..............	384	721	429	1245	1251	9845	1530	126	
Duration in hrs.	26	58	27	64	63	418	74	10	4
Mean velocity....	14.8	12.4	15.9	19.5	19.9	23.6	20.7	12.6	

Greatest mileage in one hour was 52 on the 26th.

Greatest velocity in gusts, 65 miles per hour on the 26th.

Resultant mileage, 10,550.

Resultant direction, S. 40° W.

Total mileage, 15,531.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 10 years only.

The greatest heat was 52°.5 on the 4th; the greatest cold was 4°.0 below zero on the 17th, giving a range of temperature of 56.5 degrees. Warmest day was the 5th. Coldest day was the 17th. Highest barometer reading was 30.725 on the 31st; lowest barometer was 29.272 on the 16th, giving a range of 1.453 inches. Maximum relative humidity was 98 on 3 days. Minimum relative humidity was 47 on the 5th.

Rain fell on 11 days.

Snow fell on 11 days.

Rain or Snow fell on 17 days.

Hoar frost on 6 days.

Fog on 5 days.

Coloured solar halos of 22° and 46° with contact arcs and parhelia on the 6th.

NOTE.—The mean temperature of this month was 10.°7 above the normal and is the highest for December in the Seventeen Years over which the present series of observations extends.

METEOROLOGICAL ABSTRACT FOR THE YEAR 1891.

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

C. H. McLEOD, *Superintendent.*

Month.	Thermometer. Mean.	Thermometer. ¶ Deviation from 17 year means.	Thermometer. Max.	Thermometer. Min.	Thermometer. Mean daily range.	* Barometer. Mean.	* Barometer. Max.	* Barometer. Min.	* Barometer. Mean daily range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Mean dew point.
January	15 38	+ 3.38	38.5	— 15.0	13.88	30.0308	30.719	28.874	.307	.0826	81.8	10.7
February	17.36	+ 1.77	45.2	— 13.0	19.11	29.9984	30.725	29.225	373	.0886	77.7	11.4
March	25.94	+ 1.95	49.0	— 2.1	14.18	30.1157	30.659	29.118	.243	.1098	72.1	18.0
April	42.19	+ 2.43	72.0	21.8	18.19	29.9198	30.538	29.441	.214	.1862	67.3	31.5
May	52.36	— 2.09	80.0	31.7	20.84	29.9845	30.312	29.608	.162	.2513	61.7	38.5
June	65.17	+ 0.67	90.0	40.4	19.98	29.9192	30.246	29.620	.114	.4052	63.6	51.6
July	66.33	— 2.50	86 8	45.6	17.00	29.9401	30.357	29.568	.131	.4564	70.9	55.9
August	63.65	— 0.30	90.2	50.6	17.40	29.9122	30.283	29.469	.140	.4751	73.0	57.0
September	62 29	+ 3.56	83.5	42.5	17.12	30.0870	30.473	29.732	.167	.4285	74.9	53.9
October	45.14	+ 0.08	80.1	24.5	13.45	30.0241	30.762	29.550	.218	.2416	76.6	37.9
November	35.10	+ 2 87	60.4	0.0	17.21	30.0406	30.620	29.013	.265	.1673	74.4	28.0
December	29.71	+10.75	52.5	— 4.0	14 11	30.0365	30.725	29.272	.303	.1387	78.4	23.5
Sums for 1891	.	....	....	....	....		....	....	....	....		....
Means for 1891	43.63	+ 1.88	....	....	16 87	30 0032	....	....	.220	.2523	72.7	34.8
Means for 17 years ending Dec. 31, 1891.	41.75	....	...	....	...	29.9781	....	....	....	.2495	74.3	....

Month.	Wind. Resultant direction.	Wind. Mean velocity in miles per hour.	Sky clouded per cent.	Per cent. possible bright sunshine	Inches of rain.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain *and* snow fell.	No. of days on which rain or snow fell.	Month.
January	N. 43° W.	15.6	74.8	29.0	1.29	6	21 0	23	3.30	5	24	January
February	S. 32° W.	17.3	66 8	38.7	1.62	8	18.7	15	3.14	5	18	February
March	S. 87½° W.	15.6	54.6	54.7	2.65	9	16.3	8	3.92	2	15	March
April	S. 72° W.	16.2	68.1	41.5	2.38	12	7.1	6	3.26	2	16	April
May	S. 58½° W.	14.7	59.9	55.3	1.71	12	...	1	1.71	1	12	May
June	S. 72½° W.	15.0	58.6	58.4	1.75	8	....	..	1.75	..	8	June
July	S. 34° W.	13.0	57.1	52.9	4.80	20	....	..	4.80	..	20	July
August	S. 44½° W.	10.8	53 0	58.4	3.70	14		..	3.70	.	14	August
September	S. 71° W.	11.6	44.0	62.7	1.03	14	....	..	1.03	.	14	September
October	S. 67° W.	13.0	60 0	41.9	2.38	13	1.5	3	2.53	2	14	October
November	S. 24½° W.	16.3	72.0	35.9	2.71	13	3 5	7	3.06	3	17	November
December	S. 40° W.	20.9	64 8	37.7	2.14	11	12.0	11	2.34	5	17	December
Sums for 1891		....	....	....	28.16	140	80.1	74	35 54	25	189	Sums for 1891
Means for 1891	S. 52° W.	14.99	61.1	47.3	....	....	....	....	2.98	..	16	Means for 1891
Means for 17 years ending Dec. 31, 1891.	....	* 15 27	61.4	§ 46.2	28.13	134	122.0	83	39.97	16	201	Means for 17 years ending Dec. 31, 1891.

* Barometer readings reduced to 32° Fah., and to sea level. † Inches of mercury. ‡ Saturation, 100. § For 10 years only. * For 5 years only. ¶ "+" indicates that the temperature has been *higher;* "—" that it has been *lower* than the average for 17 years, inclusive of 1891. The monthly means are derived from readings taken every 4th hour, beginning with 3h. 0m, Eastern Standard time. The anemometer and wind vane are on the summit of Mount Royal, 57 feet above the ground, and 810 feet above sea level.

The greatest heat was 90.0 on June 16th; greatest cold 15.0 below zero on January 17th; extreme range of temperature was therefore 105°.0. Greatest range of the thermometer in one day was 40.9 on Jan. 1st; least range was 4°.1 on Aug. 21st. The warmest day was July 13th, when the mean temperature was 77 22. The coldest day was Jan. 16th, when the mean temperature was [illegible] 7 below zero. The highest barometer reading was 30.725 on Feb. 14th and Dec. 31st; the lowest was 28 874 on Jan. 12th, giving a range of 1.851 for the year. The lowest relative humidity was 25 on May 13th and June 7th. The greatest mileage of wind recorded in one hour was 59 on Mar. 3rd, and the greatest velocity in gusts was at the rate of 72 m. p. h. The total mileage of wind was 131,316. The resultant direction of the wind for the year was S. 52° W., and the resultant mileage 51,200. Auroras were observed on 12 nights. Fogs on 26 days. Hoar-frost on 17 days. Thunder storms on 18 days. Lunar halos on 8 nights. Lunar coronas on 4 nights. Solar halos on 3 days and on Dec 6th, coloured halos of 22° and 46° with contact arcs and parhelia. The sleighing of the winter closed, in the city, on March 27th, and snow all gone on open ground on April 10th. The first snowfall of the autumn was on October 11th. The first sleighing of the winter was on December 7th.

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