Technical and Bibliographic Nctes / 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
- [x] Bound with other material/ Relié avec d'autres documents
- [x] 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
- [x] Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- [ ] Pages detached/ Pages détachées
- [x] 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
- [x] 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	12X	14X	16X	18X	20X	22X	24X	26X	28X	30X	32X
					✓						

THE CANADIAN

RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF

THE NATURAL HISTORY SOCIETY OF MONTREAL,

AND REPLACING

THE CANADIAN NATURALIST.

VOL. VI. (1894-1895.)

MONTREAL:

PUBLISHED BY THE NATURAL HISTORY SOCIETY.

1896.

CONTENTS OF VOLUME VI.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. VI. JANUARY, 1894. NO. 1.

PRELIMINARY NOTE ON RECENT DISCOVERIES OF BATRACHIANS AND OTHER AIR-BREATHERS IN THE COAL-FORMATION OF NOVA SCOTIA.

By Sir J. WILLIAM DAWSON.

This note is intended to record the fact of the discovery, in 1893, of erect trees containing remains of land animals at two horizons in the coal-formation of the South Joggins, in addition to that in which such remains were found by Sir C. Lyell and the writer in 1851, and from which so many additional trees of this character have been extracted in subsequent years. Details as to the species in the recently discovered trees will be published when their contents have been worked out and studied.

The remarkable section of coal-formation rocks at the South Joggins, in Cumberland County, Nova Scotia, has long been known as one of the most instructive in the world; exhibiting as it does a thickness of 5,000 feet of strata of the coal-formation in a cliff of considerable height, kept clean by the tides and waves, and in the reefs extending from this to the shore, which at low tide expose the beds very perfectly. It was first described in detail by the late Sir W. E. Logan,[1] and afterwards the middle portion of it was examined in greater detail by the author, more especially in connection with the fossil remains characteristic of the several beds, and the vegetable constituents and accompaniments of the numerous seams of coal.[2] It was on occasion of a visit of the author, in company with Sir Chas. Lyell, and in the pursuit of these investigations, that one of the most remarkable features of the section was disclosed in 1851. This is the occurrence, in the trunks of certain trees imbedded in an erect position in the sandstones of Coal-mine Point, of remains of small reptiles, which, with one exception, a specimen from the Pictou coal-field, were the first ever discovered in the Carboniferous rocks of the American continent, and are still the most perfect examples known of a most interesting family of coal-formation animals, intermediate in some respects between reptiles proper and batrachians, and known as Microsauria. With these were found the first known Carboniferous land-snails and millipedes. Very complete collections of these remains have been placed by the auther with his other specimens in the Peter Redpath Museum of McGill University. The manner in which these remains were entombed may be stated as follows:

A forest or grove of the large ribbed trees known as Sigillariæ was either submerged by subsidence, or, growing on low ground, was invaded with the muddy waters of an inundation, or successive inundations, so that the trunks were buried to the depth of several feet. The projecting tops having been removed by subaerial decay, the buried stumps became hollow, while their hard outer bark remained intact. They thus became hollow cylinders in a vertical position and open at top. The surface having then become dry land, covered with vegetation, was haunted by small quadrupeds and other land animals, which from time to time fell into the open holes, in some cases nine feet deep,

[1] "Report Geol. Survey of Canada," 1844.

[2] "Journal London Geological Society," vol. x., pp. 1 et seq., 1853; "Acadian Geology," pp. 156 et seq.

and could not extricate themselves. On their death, and the decomposition of their soft parts, their bones and other hard portions remained in the bottom of the tree, intermixed with any vegetable *débris* or soil washed in by rain, and which formed thin layers separating successive animal deposits from each other. Finally the area was again submerged, or overflowed with water bearing sand and mud. The hollow trees were filled to the top and their animal contents thus sealed up. At length the material filling the trees was by pressure and the access of cementing matter hardened into stone, not infrequently harder than that of the containing beds, and the whole being tilted to an angle of 20°, and elevated into land exposed to the action of the tides and waves, these singular coffins present themselves as stony cylinders projecting from the cliff or reef, and can be extracted and their contents studied.

The singular combination of accidents above detailed was, of course, of very rare occurrence, and in point of fact until the year 1893 these conditions were known to occur in only one set of beds: under the thick-bedded sandstone in Division 4, Section XV. Coal-group 15, of my section of the South Joggins.[1]

In the spring of 1893, however, Mr. P. W. McNaughton, of the Joggins Coal Mine, who had been so kind as to watch the exposures of trees in the cliff at my request, was so fortunate as to find two productive trees in beds considerably below that which had afforded the previous discoveries. According to Mr. McNaughton's observations, the lowest of these trees is in Division 4, Section XII., Coal-group 26, of my section, or 414 feet lower in the series than the original bed, and about 1,617 feet distant from it along the shore. The intervening beds, besides sandstones, shales and underclays, include fifteen small seams of coal and five beds of bituminous limestone and calcareo-bituminous shale, so that they must represent a considerable lapse of time. The tree was rooted in a shaly underclay, with coaly streaks and

[1] "Acadian Geology."

stigmaria roots. It was one 1 foot 11 inches in diameter near the base. Below this, as is often the case with erect sigillariæ, there was a slight swelling or bulb. The lower part is imbedded in gray sandstone and shale for 5 feet 2 inches. Above this are 2 feet 6 inches of gray shale. Above this is a sandstone 12 feet thick, but the tree penetrates this only about 8 inches, when it is broken off. Thus the total remaining height is 8 feet 4 inches. The tree was probably a ribbed Sigillaria, and the bark at the base is unusually thick and rugged for trees of this kind. The remains of woody matter contained in it have not yet been examined microscopically. In the figure the tree is represented in its original vertical position, without reference to the dip (Fig. 1.)

Five feet of the lower part of this tree are filled with matter which must have been introduced into it while it remained an open pit, accessible to land animals. This material; while all probably introduced by rain-wash or accidental falling from the surface, is of varied character. At the bottom there is a layer of mineral charcoal about an inch in thickness, and immediately above this is a black shaly layer, with bones of small batrachians, remains of millipedes and coprolitic matter. Above this is a hard material, composed partly of indurated calcareous clay and partly of vegetable fragments arranged in very irregular layers, which have usually a shallow basin shape, being hollowed toward the centre. This is partly an effect of compression of the vegetable matter, and is partly caused by the greater thickness of the earthy beds toward the sides, a consequence of rain-wash from the surface. Here and there, throughout this part of the stem, there are thin, black, coaly or shaly bands marking surfaces of some duration. Toward the upper part of the productive five feet, sandstone predominates, but there are still occasional dark beds. Throughout all these layers there are animal remains, which are, however, more abundant in the dark and laminated beds. There is, more especially in the lower part of the tree, much coprolitic matter, sometimes in dis-

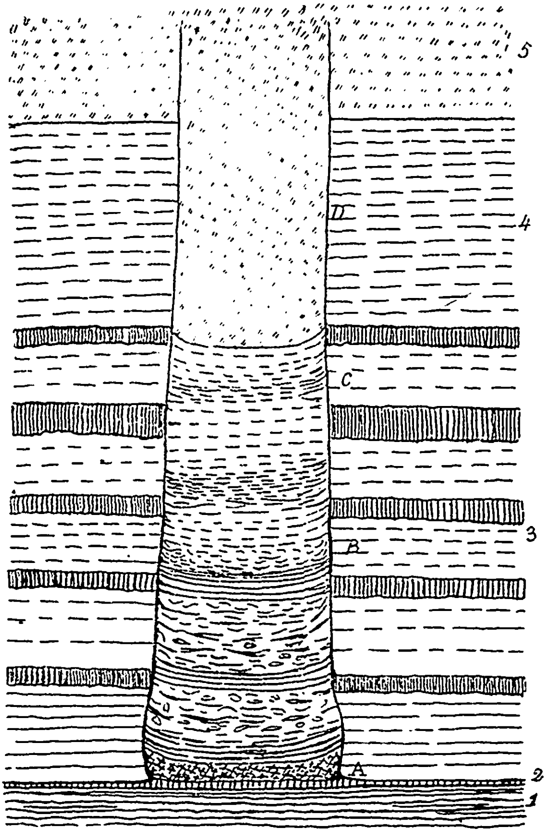

Fig. 1.—Section of tree No. 1, Division 4, Section XII., Coal-group 26, of South Joggins section; as observed *in situ* by Mr. P. W. McNaughton. (Scale 2 feet to an inch.)

Enclosing Beds.—(1) Underclay; (2) coaly layer; (4) alternations of shale and sandstone, 5 feet 2 inches; (4) shale, 2 feet 6 inhes; (5) sandstone, 12 feet.

Filling of Trunk.—(*A*) Mineral charcoal and thin carbonaceous laminæ. (*B*) Arenaceous and argillaceous matter, irregularly bedded and with many vegetable fragments. (*C*) Sandy layers, depressed in centre, with occasional shaly bands and vegetable fragments; remains of land animals up to top of *C*. (*D*) Barren sandstone, same with overlying bed.

tinct layers, and rich in phosphate of calcium. Under the lens it is seen to contain fragments of bones of small reptiles and of chitinous matter of millipedes or insects. It is in short in some places a very fine bone-breccia and in others an indurated guano.

The whole of the material of this tree was carefully taken out by Mr. McNaughton, with the aid of Mr. J. Devine, and packed in boxes, keeping separate the lower, middle and upper portions, and is now in process of being split up and examined—a work requiring much time and labour. So far as yet observed, the species represented are *Dendrerpeton Acadianum* and *D. Oweni* and *Hylonomus Lyelli*, which, as in all trees hitherto examined, predominate in numbers. *Hylerpeton Dawsoni* and *H. longidentatum* also occur, and there are bones which probably indicate two new species. *Pupa vetusta* also occurs, though rarely, and there are numerons fragmentary specimens of millipedes of the genera *Xylobias* and *Archiulus.* This tree is remarkable above all others hitherto found for the great thickness of the productive layers and the abundance of coprolitic matter, which probably indicate that it remained open a long time, and that some of the animals continued to live and subsist on their feebler companions for some time after they fell into it. It results, however, from this that the bones of the smaller species are much scattered. The devourers of these smaller animals would seem to have been the species of Dendrerpeton whose bones are least scattered, and in some ceses associated with carbonised cuticle. One specimen of *Dendrerpeton Acadianum* is the largest yet found, the skull being 4 inches in length. It may have been nearly 3 feet long, and could not therefore extend itself within its prison.

The second tree found by Mr. McNaughton is in Division 4, Section XIII, Group 20, of the Section. It is thus 203 feet 7 inches below the original bed at Coal-Mine Point, and is about half way between this and the new tree in Group 26. It is remarkable as standing on a bituminous shale, one of the few beds of this kind which have been elevated to constitute forest soils. It is 22 inches in diameter, and is about seven in height; but only about 18 inches of the lower part are productive, and are largely composed of a dark-coloured laminated material, much damaged by the percolation of ferruginous water. The enclosing beds are, in ascending order, coarse shale and sandstone 3 feet, sandstone 4 feet, and beds of coal with shaly partings 2 feet. The contents of this tree have as yet been only cursorily examined, and though it contains many small bones, these are for the most part not in so good preservation as in the other tree. They include specimens of *Dendrerpeton* and *Hylonomus*.

It is probable that at least twenty batrachians found a grave in the first mentioned tree. Among the vegetable matter mixed with the bones, I have noticed fragments of *Lepidodendron* and *Calamites*, and leaves of *Cordaites* and ferns, and stems with numbers of ærial roots of the type of *Psaronius*; but most are mere scraps of bark and decayed wood, such as might drop in, or be washed in from the surface by rain.

On the whole the preliminary examination of these trees does not indicate material change of fauna during the deposition of fifteen successive coal-beds and their accompaniments. It would also seem to show that the trees previously extracted, about thirty in number, have nearly exhausted the terrestrial vertebrate fauna of the locality.

For descriptions of the species hitherto discovered in these singular repositories; reference may be made to the author's "Geology of Nova Scotia, New Brunswick and Prince Edward Island," chapter xviii., to his "Air-breathers of the Coal Period," and to his paper on "Erect Trees containing Animal Remains" in the Transactions of the Royal Society of London, Part II., 1882, and for a summary of the facts to "Salient Points in the Science of the Earth," chapter x. More detailed notices of the fossils found in the trees recently discovered will appear in the future.

Our Record of Canadian Earthquakes.

By Sir J. William Dawson.

In the "Canadian Naturalist," 1st series, vol. v., on occasion of the earthquake of October 17, 1860, an account was given by the writer of this article of all previously recorded Canadian earthquakes, with remarks on their periodicity, local peculiarities and probable causes. In the same periodical, new series, vol. i., the record was kept up to 1864. In vol. v. of the same series it was continued to the earthquake of October 20, 1870; and in vol. viii. to that of November 4, 1877, which was the most considerable since that of May, 1871. The severity of the shock of Nov. 27th, 1893, has again attracted public attention to the subject, and furnishes a suitable occasion for continuing the record.

Subsequently to 1877, the following earthquakes have been noted at Montreal, but have not been recorded in this journal. They are given as reported in the newspapers of the time, and the dates are of course very imperfect:

1879—April 7—St. Paul's Bay, at midnight, slight and local.
June 11—Montreal and elsewhere in the Province of Quebec; smart shock with rumbling noise.
Aug. 21—Various places in Ontario; slight shock (in the morning.)

1880—Feb. 8—Ottawa, slight shock.
April 3—Quebec and Ottawa, 10 p.m., slight.
Nov. 24—Quebec, 11.45, smart shock.
Nov. 29—Bay St. Paul, smart shock.
Dec. 30—Cap des Monts, smart shock.

1881—May 31—Lower St. Lawrence, at L'Islet, 4.30 a.m.; Murray Bay, 3.30 a.m.

1882—Oct. 10—Montreal, at daybreak, slight.
Dec. 4—Various places in Ontario and Eastern Townships of Quebec, smart shock; at Welland, 6.30 p.m.

1883—Jan. 1—Various places in the Maritime Provinces. At St. John, four minutes before 10 a.m., slight.

March 11—10h. 57m. and 11h. 7m.—Two distinct shocks at Waterloo, P.Q., St. Johns and Cowansville (R).[1]

March 23—21h. 25m., at Huntington, P.Q., slight (R).

April 1—Hamilton, Ont., smart shock at 1h.

Oct. 15, Nov. 5, Nov. 22, Dec. 32—Slight shocks at Point des Monts, P.Q.

1884—Jan. 29—Three light shocks at Rothesay, near St. John, N.B. (R).

Feb. 16—Very slight, Point des Monts, P.Q.

March 18—South-eastern Newfoundland (R).

Aug. 10—Strong in New England and Middle States, light in Canada (R).

Sept. 16—Moderate in Ohio and neighbouring States; felt slightly in Western Ontario (R).

Oct. 24, 0h. 14m.—Huntington, P.Q., slight.

1885—March 11, 10h. 57m.—Two very light shocks; 11h. 7m., a third at St. Johns and Waterloo, P.Q., in a severe snowstorm.

March 18, 19h. 45m.—Very light, at Point des Monts, P.Q.

March 23—Very light and rumbling noise, various places, P.Q.

April 16, 9h.—Light, St. Fidèle and Murray Bay, P.Q.

1886—This was a remarkable year for earthquakes and volcanic eruptions. In June occurred the terrible eruptions at Mount Taracuera, in New Zealand. On July 23 there was a violent eruption of Cotopaxi, in the Andes. On August 28 began the great series of earthquakes so destructive at Zante and elsewhere in Greece, and which were felt throughout the Mediterranean region. On August 31 and following days occurred the severe earthquakes which, centering at Charleston, South Carolina, extended over a great part of the United States, and were felt slightly even in the Lake region of Canada. From the observations of Prof. McLeod, of McGill

[1] Those marked thus (R) are from the printed Reports of Prof. Rockwood, of Princeton.

University, it would appear that on August 31 earthquake shocks were felt at Toronto, London, St. Catharines and Petrolia, but none were recorded in Eastern Canada; nor does the year 1886 appear to have been one of unusual seismic activity in Canada. At Montreal it would appear that no earthquake shock was observed in 1886. For the other slight shocks experienced in Canada in 1886 reference is made to the report of Prof. McLeod, appended.

1887—Murray Bay and elsewhere in the Lower St. Lawrence, several slight shocks at different dates.

1888—Jany. 11—Ottawa Valley, several smart shocks.

Feby—Slight shock at Ottawa.

July 1—Montreal, slight shock.

Nov.—Lower St. Lawrence, several shocks at different dates.

1890—Sept. 26—Montreal, 2.45 a.m., perceptible shock and rumbling noise.

1892—July 26—10 p.m., observed by Dr. Ells between Petite Nation and Lievre River, a smart shock.

1893—Nov. 27—Montreal (McGill College), 11.47 a. m. Ottawa, as observed at Geological Survey, began 11 47′ 05″ continued 15 seconds, ended 11 47′ 20″. Several observers report it as double, the second being most severe. Quebec, 11.47 a.m. At all the above places the shock was a smart one, shaking buildings and causing some alarm and displacing unstable objects. As observed by Prof. McLeod at the Observatory, McGill College, the barometer stood at 30 in. 15 and falling, the thermometer 24° 5′, the wind was from the north-east and the sky overcast. The vibration seemed to be propagated from the N. E. This was a shock sufficiently violent and widely extended to excite much public attention.

The following extracts from the newspapers show the effects which the earthquake produced, as noticed at the time in the public press. At 11.47 o'clock this forenoon, the city and the country generally round about felt the most severe shock of earthquake that has visited this part of the continent for several yeasr. Buildings rocked and trembled as if about to be thrown down by the percussion of an explosion. At first came a heaving sensation like that of a ship rising over a heavy dead swell; the buildings creaked as if every joint and fastening was being tested by some invisible force, and then a dull, muffled deep-toned sound like that of a subterranean explosion. The shock was felt from foundation to turret of the most substantially built edifice in the city, and then came the settling back, and for an instant it felt as if everything was going down—then a moment of suspense and the earthquake had passed. Prof. McLeod, of McGill Observatory, noted the time; it was just thirteen minutes to twelve o'clock, and the shock apparently came from the north-east and moved towards the south-west. It was distinctly felt in the Observatory and all through the College buildings, but not so severely as in the lower part of the city. Perhaps that part of the city situated along the brow of the hill between Dorchester and St. Antoine street felt the shock most distinctly, and there the people were the most frightened. Many offices and public buildings were rapidly emptied of their occupants, and in others persons ran into the corridors, but had not time to get farther before the shock was over. As usual in such cases, animals were much frightened, and some horses on the cab stands ran away.—(Montreal Evening Papers, Nov. 27.)

ORMSTOWN—About this place the earthquake shock on Monday appears to have been most severely felt. The foundation and brick work of the school were cracked. The iron bridge rattled and some stones fell out of the abutments. John Ligget's brick house was cracked in three places. Cattle huddled together in great fright. Wells were disturbed, some chimneys toppled over, and window glass was broken. In Mr. Dewar's drug shop some bottles were upset and broken. Those who were in the woods state that the ground had a waving motion for about a minute. It was the heaviest earthquake for thirty-five years.

VAUDREUIL, P.Q.—Several chimneys were thrown down and the walls of houses were cracked. The people were much excited.

The earthquake seems to have been felt throughout Quebec and Ontario and in the New England States and New York. So far as appears from the newspaper accounts it seems to have been most severe in Western Quebec and Eastern Ontario.

In Montreal it was sufficiently violent to cause a perceptible movement in buildings, enough in many cases to produces a panic among the inmates, the effect being described as resembling that of a violent explosion within the building, or the fall of some heavy object from the ceiling. The higher buildings in the lower part of the city were naturally the most affected, but no serious damage is recorded except in one instance, from the fall of planks from a scaffolding. In a few instances cracks were produced in the walls of buildings.

Dec. 1—Another shock was felt at several places on the Lower St. Lawrence. Moisie, Labrador, 5 a.m.; Seven Islands, Saguenay, 5.30 a.m. The shock is said to have been strong.

The following hints as to recording the intensity of earthquake shocks, based upon the Rossi-Forel scale, adopted by the Italian and Swiss seismologists, are taken from Prof. Rockwood, for the benefit of future observers, (*American Journal of Science*, July, 1886):

General Designation.	*More Particular Classification.*
Microseismic shock	I. Recorded by a single seismograph or by seismographs of the same model, but not putting in motion seismographs of different patterns; reported by experienced observers only.
Very light..........	II. Shock recorded by several seismographs of different patterns; reported by a small number of persons at rest.
	III. Shock reported by a number of persons at rest; duration or direction noted.

Light	IV. Shock reported by persons in motion; shaking of movable objects, doors and windows; cracking of ceilings.
Moderate	V. Shock felt generally by every one. furniture shaken; some bells rung; VI. General awakening of sleepers; general ringing of bells; swinging of chandeliers; stopping of clocks; visible swaying of trees; some persons run out of buildings.
Strong	VII. Overturning of loose objects; fall of plaster; striking of church bells; general fright, without damage to buildings.
Severe	VIII. Fall of chimneys; cracks in the walls of buildings.
Destructive	IX. Partial or total destruction of some buildings. X. Great disasters; overturning of rocks; fissures in the surface of the earth; mountain slides.

To these may be added the following questions addressed to the public, on behalf of the Geological Survey of the United States, on occasion of the Charleston earthquake of 1886 (*Science*, Sept. 10, 1886):

"1. At what hour, minute and second of standard time was it felt? When this can be accurately given, it is of the very greatest importance. Be particularly careful to state whether it is standard (railway) time or local time; whether the watch or clock was compared with some standard clock at a railway station or elsewhere, how soon, what the error was, and whether you corrected your observation by this comparison or not.

"2. How long did its perceptible motion continue?

"3. Was it accompanied by any unusual noise? If so, describe it.

"4. Was there more than one shock felt? If so, how many? When several were felt, give accurately, or even roughly, the number, duration and character of each, and the interval between them.

"5. Which of the following measures of intensity would best describe what happened in your vicinity?—No. 1. Very light; noticed by a few persons; not generally felt. No. 2. Light; felt by the majority of persons; rattling of windows and crockery. No. 3. Moderate; sufficient to set suspended objects, chandeliers, etc., swinging, or to overthrow light objects. No. 4. Strong; sufficient to crack the plaster in houses or to throw down some bricks from chimneys. No. 5. Severe; overthrowing chimneys and injuring the walls of houses.

"6. Do you know of any other cause for what happened than an earthquake? Give also any further particulars of interest, stating whether they are from observation or hearsay: for instance, whether the shock seemed like a tremor or jar, or an undulatory movement; and whether it seemed to come horizontally or vertically; whether any idea of direction of shock was formed, and if people agreed in their idea as to such direction. Mention any unusual condition of the atmosphere; any strange effects on animals (it is often said that they will feel the first tremors of a shock before people notice it at all); character of damage to buildings; general direction in which walls, chimneys, etc., were overthrown. Springs, rivers and wells are often noticeably affected by even slight shocks, and such facts are especially interesting. If a clock was stopped, give the time it indicated, and some idea as to how fast or how slow it was, its position, the direction in which it was standing or facing, and the approximate weight and length of the pendulum. If a chandelier was noticed to swing decidedly, describe it and state direction of swing. If pictures swung, state direction of wall, and whether pictures on the wall at right angles to it were also put in motion. If doors were closed or opened, state the direction of the wall in whi h they were set. All such little facts, if noticed, remembered and recorded, are of great value."

By attending to these directions, persons of ordinary observation, and without the aid of instruments, may contribute valuable information, which, if sent to the editors of this journal, or to the Meteorological Office at Toronto or the Geological Survey, Ottawa, would probably be recorded. Even if published in any local newspaper, it will be likely to reach persons interested in the subject.

As to the causes and general phenomena of earthquakes, and the best methods of observing them, reference may be made to the excellent little work of Milne on "Earthquakes and other Earth-movements," (International Scientific Series.)

The following record, consisting largely of reports to the Meteorological office, Toronto, kindly furnished by Prof. McLeod, of McGill College Observatory, is appended, as containing many additional notices of slight and local shocks between 1883 and 1894.

STATEMENT OF EARTHQUAKE SHOCKS FELT IN CANADA.

YEAR.	MONTH & DAY.	PLACE.
1884.	March 18.	St. John, Nfld., Trinity Bay, Harbor Grace, Heart's Content, Bay Robert and Holywood at 1.30 to 1.45 p.m, movement north to south.
	Feby. 16.	Point des Monts, 9 a.m.
	Sept. 19.	London, Ont., 3.21 p.m.
	"	Dresden, Ont., 3.20 p m.
	Oct. 24.	Huntingdon, Que., 9 a.m.
	Nov. 21.	Point des Monts, two shocks, 6.30 p.m. and during night.
	" 22.	Shock felt between St. Flavie and Gaspé last night, lasting 45 to 50 seconds.
1885.	April 26.	Point des Monts, 5.30 a.m.
	Feby. 3.	Huntingdon, 0.20 a.m.
	" 25.	do 0.30 p.m.
1886.	Feby. 13.	Port Hope, Ont.
	March 16.	Victoria, B.C., 0.35 p.m.
	" 21.	Point des Monts, 5 p.m.
	May 16.	do 10.25 a.m.
	" 18.	do 2.30 p.m., strong.
	Aug. 12.	St. Marguerite, St. Adele, St. Sauveur, shock early in morning, lasting over six minutes.
	" 19.	Cooksville, Ont., 3 a.m., shock felt along banks of Credit River.
	" 31.	Toronto, London, St. Catharines, and Petrolia, shocks felt at 9.45 a.m.
	Oct. 14.	Sydney, N.S., 10.30 p.m., lasting ten seconds.
	" 27.	Point des Monts, slight shock.
	Sept. 2.	St. Catharines, Petrolia, Ont. [1]

[1] There is no record of a shock at Montreal in 1886.

EARTHQUAKE SHOCKS FELT IN CANADA.—Continued.

YEAR.	MONTH & DAY.	PLACE.
1887.	Jany. 7.	Point des Monts, 6.40 a.m.
	" 21.	do 2.47 p.m.
	Feby. 15	St. Anne des Monts, 1.30 p.m., N.W. to S.E.
	" 16.	Point des Monts, 2.08 p.m.
	" 22.	do 5.59 p.m., strong.
	" 19.	Joly, Parry Sound, Ont., 11.45 p.m., W. to E.
	March 19.	do do 10.50 p.m., slight.
	June 30.	Point des Monts, 10.20 p m.
1888.	Jany. 6.	Huntingdon, 2.30 p.m., slight.
	" 11.	Pembroke, Ont., 4 a.m.
	Feby. 5.	Ottawa, early morning.
	March 2.	Huntingdon, 4.30 p.m., slight.
	April 19.	River du Loup, 0.40 a.m., N. to S., 3 to 4 secs.
	" 19.	St. Paul's Bay, 0.30 a.m., strong, 3 mins. (?)
	July 1.	Montreal, slight shock, 4.00 to 4.01 p.m.
	July 10.	Shock felt in district between Belleville and Kingston, 11 p.m. Felt at Tamworth 11.15 p.m.; also at Newburgh, Moscow, Yarker and Napanee.
	Dec. 7.	Father Point, 9.26 a.m.
		St. Flavie, 9.25 a.m., strong, 30 secs.
		Trois Pistoles, 9.35 a.m.; also at Rimouski.
1889.	None.	
1890.	May 17.	Point des Monts, 8.30 p.m.
	Sep. 26.	Montreal, slight shock at 3.3 a.m.
	Oct. 29.	Meach Lake, 12 miles from Hull, Q., 5.30 p.m.
1891.	Sept. 21.	Esquimalt, B.C., two distinct shocks, 3.30 p.m., N. to S.; 3.50 p.m., E. to W.
	Nov. 29.	Esquimalt, B.C., 3.20 p.m.
1893.	July 30.	Carmanah, 3.15 p.m., two shocks.
	Nov. 12.	Masset, Queen Charlotte Island, sharp shock at daybreak.
	" 27.	Alexandria, Ont., 11.49 a.m., sharp.
		Montreal at 11.47, sharp shock.
1894.	Jany. 11.	Godbout, Point des Monts, Pentecost, Seven Islands and Moise, P.Q., between 4.07 and 4.30 a.m., lasting 10 seconds.
	Feby. 23.	Toronto, 11 p.m., felt in eastern part.

CHECK-LIST OF EUROPEAN AND NORTH AMERICAN MOSSES (Bryineæ).

By N. CONR. KINDBERG, Ph. D.

While at work on my Catalogue of Canadian Plants, I met with great difficulty in getting my collections of mosses correctly named. After submitting them to various specialists for a series of years, I saw that as species multiplied the confusion became greater, many diverse forms were being placed together, and often no two bryologists agreed as to what certain specimens should be called. In fact, they neither had time nor inclination to work up my material, and so gave names without sufficient examination. In the winter of 1886 Dr. Kindberg, of Linkœping, Sweden, took the matter up and entered heartily into the work of making careful examination of all my Canadian collections of Mosses. Since then he has been able to bring comparative order out of chaos. Part VI. of my Catalogue of Canadian Plants, containing the Musci and including over two hundred descriptions of new species, was in great part his work. Since the publication of Part VI. he has been continuously engaged on a synopsis of the moss flora of North America, and has one section—the Pleurocarpous Mosses—written. The list now published is the outcome of that work and is intended to show the mosses of both Europe and America in a tabulated form.

As this list adds many names to my catalogue and alters others and includes many species collected since its publication, I propose following the list with a series of papers on Canadian Musci, which will include, besides Dr. Kindberg's work, that of Mrs. E. G. Britton of Columbia College, New York, and the revisions of M. Jules Cardot of Stenay, France, and others engaged in special work. The intention of the writer is to see that Canadian Bryology will be kept abreast of the times, although other duties cause him to pass the microscopic work of examination into the hands of specialist who are more competent to do the work.

JOHN MACOUN.

Ottawa, March 12th, 1894.

Series I. PLEUROCARPOUS.

Tribe 1. HAPLOLEGRIDEOUS.

Endostome without longitudinal line or wanting.

Fam. 1. CRYPHÆACEÆ.

1. *Hedwigia*, Ehrh.

ciliata (Brid.), Ehrh.
**subnuda*, Kindb.—America.
imberbis (Nees et Hsch.), Spruce. —Europe.
alopecura (Brid.), Kindb.—Europe.
californica (Lesq.), Kindb.—America.

2. *Leucodon*, Schwægr.

sciuroides (L.), Schw.
**morensis*, Schw.—Europe.
brachypus, Brid.—America.
julaceus (L.), Sulliv.—America.

3. *Lasia*, Brid.

trichomitria (H.), Brid.—America.
floridana (Lindb.), Kindb.—America.
immersa (Mohr), Kindb.—America.
ohioensis (Sulliv.), C. M.—America.
nitida (Lindb.), Kindb.—America
Ravenellii (Aust.), Kindb.—America.

4. *Cryphæa*, Mohr.

arborea (L.), Lindb.—Europe.
**Lamyi*, Montagne.—Europe.
pendula, Lesq. et Jam.—America.
glomerata, Schimp.—America.
nervosa (Hook. et Wilf.), Schimp. —America.

5. *Antitrichia*, Brid.

curtipendula (L.), Brid.
gigantea (Sull. et Lesq.), Kindb. —America.
tenella, Kindb.—America.
pseudo-californica (Hook. et Arn.), Kindb.—America.

Fam. 2. ANOMODONTACEÆ.

6. *Anomodon*, Hook. et. Tayl.

nervosus (Brid.), Hueben.
Moseri, Kindb.—America.
heteroideus, Kindb.—America.
tectorum (Al. Braun), Kindb.
rostratus (H.), Schimp.
rigidulus, Kindb.—Europe.
californicus, Lesq.—America.
longifolius, C. J. Harton.—Europe.
attenuatus (Schreb.), Hueben.
viticulosus (L.), Hook. et Tayl.
apiculatus, Schimp.
platyphyllus, Kindb.—America.
obtusifolius, Schimp.—America.

Fam. 3. FABRONIACEÆ.

7. *Fabronia*, Raddi.

pusilla, Raddi.
gymnostoma, Sull. et Lesq.—America.
octablepharis (Schleich.), Schw.
Wrightii, Sulliv.—America.
Ravenellii, Sulliv.—America.

8. *Clasmatodon*, Hook. et Wils.

parvulus (Hampe), Sull.
rupestris (Sulliv. et Lesq.), Kindb.—America.

9. *Habrodon*, Schimp.

perpusillus (De Not.), Lindb.

Fam. 4. LEPTODONTACEÆ.

10. *Leptodon*, Mohr.

Smithii (Dicks.), Mohr.—Europe.

Tribe 2. DIPLOLEPIDEOUS.

Endostome with longitudinal line.

Fam. 5. CLIMACIACEÆ.

11. *Porotrichum*, Brid.

Bigelowii (Sell.), Kindb.—America.

12. *Taxithelium*, Mitt.

planum (Brid.), Mitt.—America.

13. *Thamnium*, Schimp.

Toccoæ (Sull. et Lesq.), Kindb.—America.
circinnatum(Brid.),Kindb.—Europe.
alopecurum (L.), Schimp.—Europe.
alleghaniense (C. M.), Schimp.—America.
Leibergii, Britton.—America.
angustifolium, Holt.
micro-alopecurum, Kindb.—America.

14. *Pleurozium* (Sull.), Kindb., n. g.

umbratum (Ehrh.)
pyrenacium (Spruce).
flagellare (Dicks.).—Europe.
brevirostre (Ehrh.)
calvescens (Wils.).—Europe.
Schreberi (Willd.)
purum (L.)—Europe.
megaptilum (Sull.)—America.
striatum (Schreb.)—Europe.
meridionale (De Not.)—Europe.

15. *Pleuroziopsis*, Kindb, n. g.

prolifera (L.)
alaskana (James).
ruthenica (Weinm.)—America.
triquetra (L.)

16. *Alsia*, Sulliv.

abietina(Hook.),Sull.—America.
longipes, Sull. et Lq.—America.

17. *Climacium*, Web. et Mohr.

dendroides (L.), W. M.
americanum, Brid.—America.

18. *Isothecium*, Brid.

myurum (Poll.), Brid.—Europe.
circinnans(Schimp.), Sant.—Europe.
aplocladum, Mitt.—America.
brachycladon,Kindb.—America.
obtusatulum, Kindb.—America.
Breweri (Lesq.), Kindb.—America.
**Howei*, Kindb.—America.
myurellum, Kindb.—America.
pleurozioides, Kindb.—America.
aggregatum, Mitt.—America.
myosuroides (L.), Brid.
tenuinerve, Kindb.
Holtii, Kindb.—Europe.
striatulum (Spruce), Kindb.—Europe.
stoloniferum (Hook.), Brid.—America.
spiculiferum, Mitt.—America.
Cardoti, Kindb.—America.

19. *Pterogonium*, Swartz.

ornithopodioides(Huds.), Lindb.

20. *Pterobryum*, Hornsch.

cymbifolium (Sull.), Mitt.—America.
Ludoviciæ (C. M.), Kindb.—America.

Fam. 6. HOOKERIACEÆ.

21. *Hookeria*, Tayl.

lætevirens, Tayl.—Europe.
varians, Sull.—America.

22. *Pterygophyllum*, Brid.

lucens, (L.), Brid.
Sullivantii, C. M.—America.

23. *Daltonia*, Tayl.

splachnoides, Hook. et Tayl.—Europe.

Fam. 7. METEORIACÆ.

24. *Callicostella*, C. M.

cruceana, (Dubq.), Sauerb. et Jaq.—America.

25. *Papillaria*, C. M.

nigrescens (Sw.), Sb. et Jaq.—America.
**Donnellii*(Aust.),Kindb.—America.
floridana (Aust.), Kindb.—America.

26. *Meteorium*, Brid.

pendulum, Sull.—America.

Fam. 8. LESKEACEÆ.

27. *Thelia*, Sulliv.

hirtella (H.), Sull.—America.
compacta, Kindb.—America.

robusta, Dubq.—America.
asprella (Schimp.), Sull.—America.
Lescurii, Sull.—America.

28. *Myurella*, Bruch et Schimp.

julacea (Vill.), Br. eur.
*gracillima, Kindb.—Europe.
apiculata (Hueben.), Br. eur.
gracilis (Weinm.), Lindb.

29. *Pterygynandrum*, Hedw.

filiforme, Hedw.
*decipiens, W. M.—Europe.
*papillosulum, C. M. et Kindb.

30. *Leskea*, Hedw.

rivalis (Schimp.), Kindb.—Europe.
polycarpa, Ehrh.
obscura, H.—America.
cardoti, Kindb.—America.
subobtusifolia, C. M. et Kindb.—
brachyptera, (Mitt.), Kindb.—America.

31. *Heterocladium*, Schimp.

procurrens (Mitt.), Kindb.—America.
aberrans, Ren. et Card.—America.
dimorphum (Brid.), Br. eur.
Austini (Sull.), Kindb.—America.
triste (Cesati), Kindb.
frullaniopsis, C M. et Kindb.—America.

32. *Thuidium*, Schimp.

a. Claopodium.

crispifolium, (Hook.), Kindb.—America.
leuconeuron (Sull. et Lq.), Lesq.—America.
Whipplei (Sull.), Kindb.—America.
laxifolium (Schw.), Kindb.—America.
pseudo-pygmæum (Schimp.), Kindb.—America.

b. Micro-Thuidium.

minutulum (H.), Br. eur.
erectum, Dubq.—America.
scitum (P. B.), Aust.—America.
gracile, Br. et Schimp.—America.
*pallens, Lindb.—Europe.
*calyptratum, Sull.—America.
lignicola, Kindb.—America.
punctulatum, De Not.—Europe.

c. Eu-Thuidium.

tamariscinum, (H.), Br. eur.—Europe.
delicatulum (H.), Lindb.
recognitum (H.), Lindb.
Alleni, Aust.—America.

d. Elodium.

abietinum (L.), Br. eur.
*pachycladon, Kindb.-America.
Blandowii, Web. et Mohr.
paludosum (Sulliv.), Kindb.—America.
pseudo-abietinum, Kindb.—America.

33. *Pseudoleskea*, Br. eur.

rupestris (Bergyr.), Kindb.—Europe.
denticulata (Sull.), Kindb.—America.
occidentalis (Sull.), Kindb.—America.
heteroptera (Bruch.), Schimp.
vancouveriensis, Kindb.—America.
papillosa (Lindb.), Schimp.—Europe.
Wollei (Aust.), Kindb.—America.
catenulata (Brid.), Br. eur.—Europe.
*laxifolia, Kindb.—Europe.
malacoclada, C. M. et Kindb.
pulchella (De Not.), Kindb.—Europe.
atrovirens (Dicks.), Br. eur.—Europe.
*filamentosa (Dichf.), Kindb.—Europe.
ticinensis, Bottini.—Europe.
patens (Lindb.), Kindb.—Europe.
brachyclados (Schwægr.), Kindb.—Europe.
*borealis, Kindb.—Europe.
rigescens (Wilf.), Lindb.—America.
atricha, Kindb.—America.
falcicuspis, C. M. et Kindb.—America.
oligoclada, Kindb.—America.
sciuroides, Kindb.—America.
*denudata, Kindb.—America.

stenophylla, Ren. et Card.—America.
algamica (Schimp.), Kindb.—Europe.

Fam. 9. NECKERACEÆ.

34. *Hypnella*, C. M.

Wrightii (Sulliv.), Sb. et Jog.—America.

35. *Neckera*, Hedw.

Menziesii, Drumm.—America.
**amblyclada*, Kindb.—America.
turgida, Yur.—Europe.
Douglasii, Hook.—America.
crispa (L.), Hedw.—Europe.
pennata (L.), Hedw.
oligocarpa, Bruch.
pterantha, C. M. et Kindb.—America.
pumila, Hedw.
complanata (L.), Hueben.
tenella, Kindb.—Europe.
gracilis (Jam.), Kindb.—America.
Besseri (Lobarz.), Zur.—Europe.

36. *Homalia*, Brid.

lusitanica, Schimp.—Europe.
trichomanoides (Schreb.), Brid. Europe.
Jamesii, Schimp.—America.
Macounii, C. M. et Kindb.—America.

37. *Neckeropsis*, Reichardt.

undulata (H.), Reichdt.—America.
disticha (H.), Kindb.—America.

Fam. 10. HYPNACEÆ.

38. *Orthothecium*, Schimp.

chryseum (Schwægr.), Br. eur.
rufescens (Dichf.), Schimp.
**complanatum*, Kindb.-Europe.
rubellum (Mitt.), Kindb.—Europe.
**strictum*, Lor.
intricatum, C. J. Hartin.

39. *Macouniella*, Kindb., n.g.

californica (Sull.), Kindb.

40 *Myrinia* Schimp.

pulvinata (Wahlenb.), Schimp.
corticola Kindb.—America.
Dieckii Ren et Card.—America.
subcapillata (H.), Kindb.—America.

41 *Entodon* C.M.

orthocarpus (Dela Pgt.), Lindb.
Drummondii (Br. et Sch.), Kindb.—America.
Macounii C. M. et Kindb.—America.
acicularis C. M. et Kindb. America.
cladorhizans (Hidw.), C. M.—America.
**minutipes* Kindb.—America.
Schleicheri (Schimp), Kindb.—America.
**transsilvanicus* Demeter.—Europe.
compressus (H.), C.M.—America.
brevisetum (Hook et Wig.), Kindb.—America.
seductrix (H.), C. M.—America.
Sullivantii C. M.—America.
subflaceus C. M. et Kindb.—America.

42 *Platygyrum* Schimp.

repens (Bird.),—Schimp.
brachycladon (Bird.),—Kindb.—America.

43 *Pylaisia* Schimp.

intricata C. M. et Kindb.—America.
ontariensis C. M. et Kindb.—America.
Selwynii Kindb.—America.
heteromalla Br. et Sch.—America.
pseudo-platygyrium Kindb.—America.
filari-acuminata C. M. et Kind.—America.
polyanthos (Schreb.), Schimp.
suecica (Schimp), Lindb.—Europe.
**alpina* Kindb.—Europe.
alpicola (Lindb.), Kindb.—Europe.

44 *Pylaisiella* Kindb., n. g.

velutina (Schimp.), Kindb.—America.

subdenticulata (Schimp), Kindb. --America.

45 *Tripterocladium* C. M.

compressulum C. M.—America.
leucocladulum C. M.—America.
rupestre Kindb.—America.

46 *Lescurea* Schimp.

striata (Schw.), Sch.—Europe.
*saxicola Molendo, - Europe.
imperfecta C. M. et Kindb.

47 *Platyloma* Kindb., n. g.

Lescurii (Sull.), Kindb.- America.

48 *Amblystegium* Schimp.

compactum C. M.—America.
subcompactum C. M. et Kindb. —America.
dissitifolium Kindb.—America.
varium (H.), Lindb.—
*orthocladon (P. B.), Kindb.- America.
*radicale (P. B.), Br. eur. - Europe.
*porphyrhizum Lindb.
*Yuratzkæ Shimp.
*leptophyllum Schimp.-Europe.
serpens (L.), Br. eur.
*Columbiæ Kindb.—America.
speirophyllum Kindb. -America
distantifolium Kindb.—Kindb. America.
fenestratum Kindb. --America.
Sprucei Bruch.
*minutissimum Sull. et Lg.
subtile (H) Br. eur.
tenuissimum Guemb.—Europe.
confervoides (Brod.), Br. eur.
pseudo-confervoides Kindb.—America.
adnatum(H.), Kindb.—America.
hispidulum (Brid.), Kindb.
Sommerfeltii (Myrin), Kindb.
*byssirameum C.M. et Kindb.- America.

49 *Eurhynchium* Schimp.

a. Stokesiella.

prolongum (L.), Schimp.
*abbreviatum Schimp.-Europe.
*hians (Hedw.), Lindb.
pumilum (Wilf.), Schimp.—Europe.
ticinense Kindb.—Europe.
Bolanderi (Lesq.), Kindb.—America.
Stokesii (Turn.), Br. eur.
*pseudo-speciosum Kindb. America.
oreganum (Sull.), Kindb.—America.
speciosum (Brid.), Br. eur.—Europe.
Dawsoni Kindb. - America.
velutinoides (Bruch),—Europe.
*Villardi Ren. et Card.—America.

b. Pseudo-Rhynchostegium.

rotundifolium (Scop.), Milde.—Europe.
styriacum (Limpr. et Bricol.), Kindb.—Europe.
murale (Nesk.), Milde.--Europe.
confectum (Dichf.), Milde.--Europe.
rusciforme (Weis.), Milde.
subintegrifolium Kindb.—America.
megapolitanum (Bland.), Milde. —Europe.
serrulatum (H.), Kindb. America.
*eriense Kindb.—America.
*hispidifolium Kindb.—America.
revelstokiense Kindb.- America.

c. Leiopodium.

collinum (Schleitz.), Kindb.
Bryhnii (Kaur.), Kindb.—Europe.
pseudo-collinum Kindb.—America
utahense(Yam.), Kindb.—America.
Krausei (C. M.), Kindb.—America.
strigosum (Hoffm.), Br. eur.
*præcox (H.), Kindb.
*diversifolium Br. eur.
substrigosum Kindb.—America.

d. Illecebrina.

cæspitosum (Wilf.), Kindb.
Macounii Kindb.—America.
illecebrum (P. B.), Kindb.
obtusifolium (Drum.), Kindb.—

e. Scabridaria.

Sullivantii (Spruce), Kindb.—America.

subscabridum Kindb.—America
scabridum Lindb.—Europe.
chloropterum C. M. et Kindb.- America.
Novæ-Angliæ (Sull. et Lesq.), Kindb.—America.

f. Starkeella.

reflexum (Starke), Kindb.
Starkei (Brid.), Kindb.
oedipodium (Mitt.), Kindb.
glaciale (C. Harton), Kindb.
Roellii Ren. et Card.—America.
scleropus Schimp.—Europe.
pseudo-serrulatum Kindb.—America.
lentum (Mitt.), Kindb.—America.

g. Brachythesiopsis.

populeum (H.), Kindb.
**nanopes* C. M. et Kindb.—America.
erythrorhizon (Harton), Kindb.
**Thedenii* (Harton), Kindb.
harpidioides C. M. et Kindb.—America.
semiasperum C. M. et Kindb.—America.

50 Rhynchostegium Schimp.

depressum Bruch.—Europe.
geophilum Aust.—America.
deplanatum (Schimp), Kindb.—
membranosum Kindb.—America.
pratense (Koch), Kindb.
pseudo-pratense Kindb.—America.

CONTRIBUTIONS TO CANADIAN BOTANY.

By JAS. M. MACOUN.

I.

Since the publication in 1890 of Part V. of Prof. John Macoun's Catalogue of Canadian Plants the geographical range of many species has been extended, many additional species have been added to the Flora of Canada and not a few species and varieties have been discovered that have proved new to science.

A record of these later discoveries has been kept by the writer and it is proposed in these papers to publish such notes as it is thought will prove of general interest to botanists.

This plan will exclude such facts as are of local interest only. That a plant common in various parts of Ontario, for example, should have been found in another part in which it was not known to grow, will not be considered of sufficient general interest to be recorded here but when the plant is quite new to the country, of extreme rarity, or of very restricted distribution new stations for it will be considered worthy of record and when possible its habitat, mode of growth etc., will also be given.

Descriptions of new species will also be published, and where recent revisions of genera or orders have made noteworthy changes in the nomenclature of Canadian plants, corrections will be made in the work already done.

ACONITUM COLUMBIANUM, Nutt.

This beautiful aconite was first collected in Canada by Mr. Jas. McEvoy between Stump and Chaperon Lakes South of Kamloops, B. C. Mr. McEvoy describes it as growing in rich soil in open spaces between thickets and as being frequently found three feet in height. It was afterwards noted by Mr. McEvoy in several localities between the Spullamacheen or Shuswap River and where it was first found by him.

BRASSENIA PELTATA, Pursh.

Common in Eastern Canada; collected in Langford Lake, Vancouver Island and in 1893 in Stanley Park, Vancouver, B. C., not before recorded from Western Canada.

CARDAMINE BELLIDIFOLIA, Linn.

Until 1890 this little cress had not been collected in Canada since the time of Franklin's Second Journey when it was found in the Rocky Mountains by Drummond and the arctic regions by Dr. Richardson. In 1890 it was discovered by the writer on Avalanche Mt. near Roger's Pass in the Selkirk Mountains, B. C., at 7,500 ft. altitude. But five specimens in all were found, none of them exceeding an inch in height. They were growing in mud close to a rock over which water continually trickled. A few specimens of this species were also found by Prof. Macoun on Mt. Aylmer, Devil's Lake, Rocky Mts. in 1891, alt. 8000 ft.

LEPEDIUM OXYCARPUM, T. & G.

Specimens of a reduced form of this plant were collected in 1893 by Prof. Macoun at Cadboro Bay near Victoria Van. Island. New to Canada.

THYSANOCARPUS PUSILLUS, Hook.

Common in parts of Vancouver Island but not found in Brit. Columbia until 1890 when it was collected at Sproat on the Columbia River by Prof. Macoun.

CLAYTONIA CORDIFOLIA, Wat.

Found by Prof. Macoun at an attitude of 5000 ft. on the mountains near Warm Springs, Kootanie Lake, B. C. New to Canada.

ELATINE AMERICANA, Arn.

In his catalogue of Canadian Plants Prof. Macoun gives but one station for this species--Long Lake in Assinaboia. During the past four years it has been found in widly separated localities so that we may now safely say that though of local occurrence it ranges in Canada from the Atlantic to the Pacific. New stations for this species are Tadousac Lake, Que. (*Geo. G. Kennedy.*) Hull, Que., and Alberni, Vancouver Island. (*John Macoun.*) Port Sandfield, Muskoka, Ont. (*Dr. and Mrs. Britton and Miss Timmerman.*)

ASTRAGALUS LEUCOPSIS, Torr.

One clump of this plant was found by Prof. Macoun near Nanaimo, Van. Island in 1893. The seed was doubtless brought from California in ballast.

LUDWIGIA ALTERNIFOLIA, L.

Collected by Mr. Alex. Wherry of Windsor, Ont. in 1893. Mr. Wherry writes:—" It is found in low rich, swampy ground generally meadows and pastures, about 2 miles west of Sandwich, Ont.; also within half mile of Windsor, Ont. Quite common in these places but not met with elsewhere by me."

This species is credited to Canada in Torrey & Gray's Flora and in Hooker's Flora but no localities are mentioned. Both this and the next species are common in Michigan and that they have been so recently found on the Canadian side of the Detroit River in a region that has been well botanized may go to show that they are extending their limits.

LUDWIGIA POLYCARPA, Short & Peter.

Found by Prof. Macoun in 1891, growing in ditches and along the railway track near Amherstburg, Ont.

GRINDELIA SQUARROSA, Duval.

This common prairie plant has become naturalized in the vicinity of Skead's Mills near Ottawa, Ont., where it was found by Mr. Wm. Scott in 1890, the seed having been doubtless brought from the west either in grain or attached to cars of the Canadian Pacific Railway.

APLOPAPPUS LYALLII, Gray.

This plant is probably to be found on most of the higher mountains in British Columbia but was overlooked until 1890, when it was collected in the Gold Range by Mr. Jas. McEvoy and by the writer on a high mountain near Kicking Horse Lake in the Rocky Mountains.

That it was not collected before, is I believe to be attributed to its close resemblance to a form of *Solidago multiradiata var. scopulorum, Gray*, Common on all the mountains in British Columbia with which it was growing when found by me. With it *Aplopappus Brandegei* also grew and it was while collecting specimens of this plant that I noticed what appeared to be two forms of the *Solidago* referred to, but one of which proved on examination to be *A. Lyallii*.

This species was again found by Prof. Macoun in August, 1891, in abundance on the mountains around Lake Agnes, near Laggan, Rocky Mountains.

ASTER STENOMERES, Gray.

Until 1890 confined, so far as known, to Idaho and Montana. In that year young plants were found by Prof. Macoun on a mountain near the Columbia River at Sproat, B. C., they were brought to camp, placed in water and at the end of a week were in full bloom.

ARNICA PARRYI, Gray.

Collected first at Kicking Horse Lake in the Rocky Mountains by Prof. Macoun in 1885, but referred to *A. foliosa*. Again collected at the same place in 1890, and correctly determined and afterwards in 1891 at Lake Agnes and Lake Louise near Laggan, Rocky Mountains. New to Canada.

HEMICARPHA SUBSQUARROSA, Nees.

This minute sedge was found in 1891 by Prof. Macoun growing in damp sandy soil near Amherstburg, Ont. New to Canada.

THE COMPOSITION OF LIMESTONES AND DOLOMITES FROM A NUMBER OF GEOLOGICAL HORIZONS IN CANADA.

By B. J. HARRINGTON, B.A., Ph. D.

The following analyses of limestones and dolomites from various localities in Canada have been brought together in the hope that they may be of interest to students of geology or of value for technical purposes. Some of them have appeared in previous papers or reports by the writer, but others are now published for the first time. In some cases they are incomplete, the main object as a rule having been to ascertain the proportions of calcium and magnesium carbonates. They are arranged in the order of the geological formations from which they are supposed to have been derived.

CAMBRIAN ?

1. From about six miles above Yale on the Fraser River, British Columbia. The limestone at this locality is white and crystalline, and occurs interstratified with grey gneiss. A specimen collected by the writer was found to contain:

Calcium carbonate	91.55
Magnesium "	1.43
Ferrous "	0.16
Alumina	0.27
Insoluble matter	5.62
	99.03

A small quantity of the stone has been used for making lime.

LEVIS FORMATION. (*Siluro-Cambrian.*)

2. From Little Metis Bay on the Lower St. Lawrence, where thin bands of impure rusty-weathering dolomite are interstratified with black shales. A specimen from one of these bands gave on analysis:

Calcium carbonate	35.46
Magnesium "	26.40
Ferrous "	4.67
Insoluble matter	32.19
	98.72

It was in the black shales of this locality that the fossil sponges described by Sir William Dawson and Dr. Hinde were discovered.

3. From the third range of Wickham, in the Eastern Townships. A blackish-grey limestone with somewhat conchoidal fracture. The dark colour is due to the presence of a little carbonaceous matter, which, however, burns away during calcination, leaving a buff-coloured lime from which gelatinous silica separates on treatment with hydrochloric acid. Analysis gave:

Calcium carbonate	70.53
Magnesium "	6.77
Ferrous "	3.02
Alumina	3.85
Silica	15.95
Carbonaceous matter	undt.
	100.12

4 The limestone used in the blast-furnace at Drummondville, P. Q., and probably from the Levis formation of that region. Analysis gave:

Calcium carbonate	52.12
Magnesium "	3.86
Ferrous "	4.82
Alumina	2.93
Insoluble matter	35.50
Copper	traces.
	99.23

CALCIFEROUS FORMATION.

5. From the township of Rigaud, near to the Rivière à la Graisse and also to the boundary line between Quebec and Ontario. A hard rusty-weathering dolomite supposed to be from the Calciferous formation. Its analysis gave:

Calcium carbonate	39.91
Magnesium "	32.85
Alumina and ferric oxide	3.56
Insoluble matter	23.54
	99.86

The insoluble portion contained,

Silica	76.34
Alumina and ferric oxide	14.74
Lime	1.02
Magnesia	7.99
	100.09

6. McNab, Ontario, Range III, lot II. A compact, dark brownish-grey limestone with conchoidal fracture. It was found to contain:

Calcium carbonate	81.78
Magnesium "	13.68

The stone is somewhat fossiliferous and probably less magnesian than the average material from the Calciferous. It has been used for building purposes at Arnprior.

7. McNab, Ontario, Range XIV, lot IX. From close to the shore of Lac des Chats on the Ottawa, and about two miles above the mouth of the Madawaska. A compact brownish-grey dolomite dotted with occasional crystals of white calcite. A partial analysis gave:

Calcium carbonate	53.00
Magnesium "	43.88

From the same set of beds as No. 6, but considerably lower in the formation.

CHAZY FORMATION.

8. Pembroke, Ontario, Range I, lot XII. Compact, light

brownish-grey limestone, with conchoidal fracture. Analysis gave:

Calcium carbonate	83.96
Magnesium "	9.29
Ferrous "	0.69
Insoluble matter	6.06
	100.00

The stone occurs in beds from six to eighteen inches thick and has been used for building purposes.

BLACK RIVER FORMATION.

9. From the "Rockland Quarry," on the bank of the Ottawa River, two miles south-east of Rockland Village, Clarence County, Ontario. A very compact grey limestone containing a little carbonaceous matter. A specimen with specific gravity 2.704 was found to contain:

Calcium carbonate	94.70
Magnesium "	2.37
Ferrous "	0.18
Insoluble (including carbonaceous matter)	2.75
	100.00

This is an excellent stone both for structural purposes and for making lime. It is classed here as from the Black River formation, but according to Dr. Ami the beds at the quarry belong in part to the Trenton, and a sharp line cannot be drawn between the two formations.

TRENTON FORMATION?

10. From Mount Royal Park, Montreal, a short distance north-east of the Park-keeper's house. A white to grey limestone whose crystalline texture has no doubt been induced by thermal action in connection with the eruptive mass of Mount Royal. A specimen of this limestone was found to have a specific gravity of 2.768 and gave on analysis:

Lime	42.07
Magnesia	1.85
Ferrous oxide	1.13
Alumina	2.96
Carbon dioxide	29.83
Silica	22.19
Moisture	0.06
	100.09

This analysis was made by Mr. Herbert Molson, student in Applied Science.

NIAGARA FORMATION.

11. Grimsby, Ontario. Brownish-grey dolomitic lime stone, holding a few fossils. Analysis gave:

Calcium carbonate	68.92
Magnesium "	29.48
Ferrous "	1.10
Insoluble matter	0.50
	100.00

12. Dundas, Ontario. Brownish-grey compact dolomite. A specimen was found to contain:

Calcium carbonate	51.85
Magnesium "	41.65
Ferrous "	0.62
Insoluble matter	5.88
	100.00

CARBONIFEROUS ?

13. From the Thompson River, British Columbia, 185 miles above Vancouver and about seven miles above Spence's Bridge. A thick bed of grey limestone, well suited for making lime, exposed in a cutting on the line of the Canada Pacific Railway. Analysis of a specimen collected by the writer gave:

Calcium carbonate	97.81
Magnesium "	1.08
Ferrous "	0.72
Alumina	0.14
Insoluble matter	0.90
	100.65

PERMO-CARBONIFEROUS.

14. From Miminigash on the west coast of Prince Edward Island. A reddish-grey limestone containing less insoluble matter than most of the limestones found on the Island. Analysis of a specimen gave:

Calcium car onate	78.07
Magnesium "	3.51
Alumina and ferric oxide	2.69
Insoluble matter	15.49
	99.76

15. From New London, Prince Edward Island. One of the reddish "conglomerate limestones," occurring in many localities on the Island. Composition:

Calcium carbonate	59.52
Magnesium "	1.04
Alumina and ferric oxide	2.47
Insoluble matter	35.52
	98.55

16. From Kildare, Prince Edward Island. A red conglomerate magnesian limestone, occurring in association with the red sandstones and shales of Kildare. Analysis gave:

Calcium carbonate	44.00
Magnesium "	22.93
Alumina and ferric oxide	3.73
Insoluble matter	26.59
	97.25

TRIASSIC.

17. Peace River, British Columbia. *Blackish-grey carbonaceous limestone, containing fragments of *Monotis subcircularis.* A specimen collected by Dr. Selwyn was found to have a specific gravity of 2.67, and gave on analysis:

Calcium carbonate	48.47
Magnesium "	5.85
Ferrous "	0.85
Insoluble matter	42.26
Carbonaceous matter, water and loss	2.57
	100.00

18. Peace River. Another specimen from the same region as the last was lighter in colour, being less carbonaceous, but also very impure. It was collected by Dr. Selwyn and its analysis gave:

Calcium carbonate	38.98
Magnesium "	7.59
Ferrous "	1.14
Insoluble matter	51.13
Carbonaceous matter, water and loss	1.16
	100.00

* See Rept. Geol. Survey of Canada 1875-76 p. 75, and 1876-77 p. 485.

NOTE.—In numbers 5, 14, 15, 16, the iron in the soluble portion of the rock may have been present partly or entirely as carbonate. The "insoluble matter" of the analysis is the portion that did not dissolve in boiling for about half an hour in hydrochloric acid.

ON THE FORMATION OF PEGMATITE VEINS.

By Prof. W. C. BRÖGGER, of Stockholm, Sweden.

(Translated from "Die Mineralien der Syenitpegmatitgänge der südnorwegischen Augit und Nephelinsyenite," by NEVIL NORTON EVANS, M. A. Sc.) [1]

As reviews of the older opinions with regard to the origin of pegmatite veins have already been presented by several authors,[2] it seems to me unnecessary to refer to these in detail, and I shall, therefore, leave unnoticed those which have no probability and which are held by no-one at the present time, [3] and consider only the principal and more rational views concerning them.

Many of the older authorities considered pegmatite veins to be simply eruptive injections; to them, acid granitic pegmatite veins were almost the only ones known, and therefore their statements refer almost entirely to such acid veins. Charpentier, in 1823, (in his "Essai sur la constit. géogn. d. Pyrénés") expressed the perfectly correct view, according to my opinion, that the granite pegmatites are fissure-veins "which were formed immediately or very soon after the solidification of the granite enclosing them" (quoted from Naumann, l. c., p. 232); they were, therefore, "injections of granitic material, which, originating in the still fluid granite deep down, were pressed into the cracks of the already solidified granite above—after-births, as it were, of the same granite formation in the district of which they occur." (Naumann, l. c.)

[1] One of the most important contributions which has been made in recent years to our knowledge of the igneous rocks, is the summary by Prof. Brögger, of the results of his admirable and long continued studies in the Christiania district, which appears in the first part of this book. As the question of the true origin of pegmatite veins is one of great importance to the right understanding of many facts in connection with our Archean geology, it has been thought well to present a translation of the chapter which deals with the general conclusions reached by Prof. Brögger concerning these veins, referring the reader to the monograph itself for a detailed statement of the evidence on which these views were based.

[2] e. g. C. F. Naumann, "Lehrbuch d. Geognosie," 1862, **2**, 231-233; F. Klockmann, "Beitrag z. Kenntn. d. granit. Gesteine d. Riesengebirges," Zeitschr. d. d. geol. Ges. 1882, **34**, 405-406, etc.

[3] With regard to the views of Alluaud, Ramond, Carne, etc., see Naumann, l. c., p. 232; with regard to Garrigous's views, see Bull. d. l. soc. géol. d. France, Ser. III. **8**, 11.

The essential features of pegmatite formation seem to me to be expressed in the above quotation with remarkable clearness and distinctness. With this view of Charpentier's most of the succeeding authorities seem to have come into accord (such as De la Beche, Angelot, Bronn, G. Rose,[1] C. F. Naumann, K.W. v. Gümbel, Th. Kjerulf, etc.); in France, this view appears still to be very generally accepted.[2]

In opposition to this conception are the views with regard to the genesis of pegmatite veins according to which they were deposited from aqueous solution; this theory propounded by Saussure has since been modified in many ways by different authorities.

The hypothesis which at present is perhaps most generally accepted in Germany, explains the formation of the pegmatite veins upon the so-called Lateral Secretion Theory; this view has also been very generally adopted as an explanation of the formation of veins of ore and of other similar mineral veins. This principle laid down by Forchhammer (hinted at also by older authorities), and advocated in recent times chiefly by F. Sandberger and his followers, is, however, even as regards the genesis of ore veins, by no means proven, but on the other hand is most uncertain and, according to my experience in the Norwegian ore deposits, is quite improbable; it has lately been strongly attacked by A. W. Stelzner and others, and, as it appears to me, with good reason.[3]

The very general adoption of this theory for the explanation of the genesis of pegmatite veins was brought about largely by Sterry Hunt's work on Canadian pegmatite veins,[4] and by a treatise, in many respects excellent, by H. Credner, "Die granitischen Gänge des sächsischen Granul-

[1] Pogg. Ann. 1842, 56.

[2] Cf. A. Lapparent's Geology; also A. Michel-Lévy, "Structure et classification des roches éruptives," Paris 1889, p. 15.

[3] "Die Lateralsecretions-Theorie," etc., Berg- u. Hüttenm. Jahrb. etc., 1889, 37.

[4] "Geology of Canada." 1863 (p. 476 and 644); "Notes on granitic rocks," "Amer. Journ. of Science," Ser. III, 1871 and 1872, "On Granites and Granitic Veinstones" in Chem. and Geol. Essays, 1875, p. 187.

itgebirges."[1] Credner here expresses very clearly and distinctly this view with regard to the Saxon occurrences studied by him:[2] "The mineral matter of our granitic veins is not derived from mineral springs, perhaps hot, rising from the depths, but from a partial decomposition and leaching-out of the neighboring rocks by water which, oozing through them, gradually becomes a mineral solution," etc. Credner's authority seems both in Germany and elsewhere to have exercised very great influence upon the theories with regard to the genesis of granitic veins; for example, we find this explanation adopted by F. Klockmann,[3] although not without careful reservations. In Sweden it was the view generally held until I opposed it in my lectures at the Hochschule, in Stockholm, in 1883.[4]

The incorrectness of this view is, however, very easily proved and with absolute certainty. It is not true, as Credner considered it to be of certain pegmatite veins of the Saxon granulite district, that a certain correspondence can in general be observed between the composition of the pegmatite vein itself and that of the wall-rock. On the contrary, this is found only exceptionally, whereas, according to a rule of general applicability, there is a more or less striking correspondence between the pegmatite veins and contiguous eruptive masses genetically related to them. When the pegmatite veins, as is very often the case, occur in those eruptive rocks with which they are genetically connected, there is a correspondence between the vein and the wall-rock; otherwise there is generally no such correspondence.

It is easy to enumerate a number of striking examples. I remember, first, the veins of Hitterö, in the south-west corner of Norway, so long celebrated for their richness in interesting accessory minerals (gadolinite, kainosite, orth-

[1] Zeitschr. d. d. geol. Ges. 1875, **27**; also **34**, 500.

[2] L. c. p. 218.

[3] "Beitrag z. Kenntn. d. granitischen Gesteine des Riesengebirges," Zeitschr. d. d. geol. Ges. 1882, **34**, 373–426.

[4] Compare Geol. Fören, Förhandl., **4**, 116. May, 1878. "Mr. Törnebohm remarked that in the last twenty years or so hardly a single Swedish geologist has advocated the eruptive origin of pegmatite." See also O. Torell, 12 Skand. Naturforskermödes Forhandl., p. 262.

ite, fergusonite, aeschynite, polykrase, xenotime, malakonite, etc.). These veins, which in all their characteristics correspond completely with the no less celebrated veins of granitic pegmatite of Arendal, which occur in gneiss and other crystalline schists, occur in a very basic rock, which in its composition is very unlike that of the vein; it is a labradorite rock (in part anorthite). To that excellent observer, Th. Scheerer, who, upon various grounds which at present must appear of no moment (occurrence of quartz in the veins, nature of the so-called pyrognomic minerals, etc.), declared against the eruptive origin of these veins, this circumstance appeared of so much weight that, unwilling as he then was to do so, he was obliged to assume that the material of the veins must in some way have been transported thither: "I believe that we are obliged to consider the granite as a mass in some way conveyed to the norite, when we consider how great the difference is which exists between the two rocks. We have seen that the constituents of the norite adjacent to the granite veins are labradorite, a peculiar soda feldspar, and, in part, hypersthene and titanic iron, while the mass of the granite consis s mostly of orthoclase, oligoclase and quartz," etc.[1]

The explanation of the exact correspondence of the numerous granitic pegmatite veins of Hitterö with those of the environs of Arendal is simply this, that in both localities they occur distributed along, although at a certain distance from, the boundary of a granite district with which they are genetically connected.

In many other districts we notice that pegmatite veins occur in rocks which, in their composition, do not at all correspond to that of the veins. For instance, W. C. Kerr mentions[2] that the well-known pegmatite veins of North Carolina, so rich in minerals, occur in gneiss and mica schist. A. de Lapparent[3] describes granitic pegmatite

[1] Gaea Norvegica, 1884, 2, 339.

[2] "The Mica Veins of North Carolina," Transactions of the Am. Inst. of Mining Engineers. Feb., 1880. See Ref. in Neues. Jahrb., 1881, 2, 387.

[3] Note sur la pegmatite de Luchon," Bull. d. l. soc. géol. de France, 18%, Sér. III., 8.

veins at Luchon, which rise through mica schist and superimposed "schistes noirs carburés ou pyriteux," etc. An example, *instar omnium*, is the occurrence of akmite granite pegmatite at Rundemyr, on the Eker, already mentioned and described by me, in Silurian schists and limestones, about a kilometer from the boundary of the adjacent aegirine granite district of Kyrfjeld-Hamrefjeld, etc. This last example, so absolutely different to all the others, is of all the more interest, as it further invalidates the old erroneous idea that pegmatite veins never occur in the younger sedimentary rocks.[1] Further, the syenitic pegmatite veins occurring in augite porphyry to about one-half a kilometer away from the boundary of the augite syenite of Ramsas, west of Birkedalen, might also be introduced as an example of the fact that the composition of the pegmatite veins is independent of that of the wall-rock.

That these last-mentioned veins, as also those occurring in the Devonian sandstone of the boundary zone on the Langesundfjord, have, on account of resorption from the wall-rock, a composition somewhat different to that of the veins occurring in the augite syenite, does not alter the main result. Perhaps the connection between wall-rock and vein-material, which Credner records among his observations in the Saxony granulite district, may to some small extent be explained in a similar way; to a certain extent, veins formed in various ways seem to have been treated in Credner's description from a common point of view.

The above mentioned examples, particularly the ordinary acid granitic pegmatite veins in the basic labradorite and norite rock of Hitterö, and the ægirine granite pegmatite vein of Rudemyr in Silurian limestones and schists, demonstrate conclusively that Credner's opinion with regard to the formation of true pegmatite veins, by a leaching-out of the wall-rocks through the agency of percolating water at

[1] See e. g. A. v. Groddeck, "Ueber Tourmalin enthaltende Kupfererze," etc., Zeitschrift d. d. geol. Ges., 1887, **39**, 256: "First of all, granitic veins (pegmatite, graphic-granite) must be mentioned; these occur exclusively in eruptive (granite) and archaic rocks, and never break through younger sedimentary rocks."

ordinary temperatures, is absolutely untenable. On the contrary, by closer investigation, it will everywhere be found that each system of pegmatite veins of no matter what variety, may in general be referred to a mass of plutonic rock connected with it, and of closely related composition, and this quite independent of the nature of the wall-rock. The veins may occur in the corresponding plutonic mass itself, or within a certain distance outside it, but this will generally exert little influence on their composition. On the other hand the composition of the veins and that of the allied plutonic mass will, as far as the principal materials are concerned, be very nearly identical (the rarer pneumatolitic minerals which generally occur in small quantities and which are formed by special processes, by "agents minéralisateurs," are not considered here), and any local variation in the mineral associates of the pegmatite veins can, for the most part, be referred to peculiarities in the composition of the mass with which the veins are connected, and which they generally accompany as final and contact products.

If Credner's views upon the origin of pegmatite veins cannot be accepted as correct, it is still possible that these veins were deposited, as G. vom Rath concluded from his observations upon the celebrated Elba pegmatite veins, from solutions rising up from the depths.[1] The reason why vom Rath did not attempt to account for the Elba pegmatite veins according to the older Charpentier-Naumann theory, was this, "that tourmaline, beryl, lithia-mica, etc., are foreign to normal granite." In comparing the Elba veins with those of Brevig, "unequalled in their occurrences of minerals," and occurring in syenite, he further remarks: "These veins, on account of their wealth in rare and peculiar minerals, which for the most part are wanting in the wall-rocks, necessitate the assumption of a special

[1] G. vom Rath, "Die Insel Elba" (Geogn.-min. Fragmente aus Italien, VIII) in Zeitschr. d. d. geol. Ges. 1870, **22**, 649: "While proposing the hypothesis that the materials of the minerals in the veins of S. Piero have been brought up in solution from the depths of the earth and not from the wall-rocks, we must admit that many considerations are opposed to this view."

mode of formation quite different to that assumed for the wall-rock."

That these rare minerals, not generally found in the wall-rock, occur in the pegmatite veins, is no reason whatever for believing that the veinstone itself is to be considered as having been deposited from ascending aqueous solutions, even should such an explanation satisfactorily account for the rare minerals themselves which occur in small quantity, and of which by far the greater number have been formed by the agency of special "agents minéralisateurs."

Strictly speaking, as the more recent results of petrography have shown, it is true that aqueo-igneous (hydato-pyrogene) magmas such as those from which great masses of plutonic rocks as well as the pegmatite veins have been formed, are to be regarded as silicate solutions; thus, to a certain extent, vom Rath is correct in his opinion, though not in the sense in which at that time he must have meant it. From ordinary "hot springs" "rising from the depths of earth" the pegmatite veins, as far as their veinstone as a whole is concerned, have certainly not been formed; this is proved by many circumstances which for the most part have already been touched upon, and of which a *résumé* will be given below.

Formerly pegmatite veins were very often looked upon as "contemporary secretions" or "concretions of the surrounding eruptive rock."[1] Views of this kind have been especially insisted upon in connection with our syenite and nepheline syenite pegmatite veins by many authors. Thus, B. M. Keilhau says:[2] "They form an excellent example of veinlike segregations, which cannot be regarded as having been formed by the filling in of cracks, by any one who considers the intimate connection and, with the exception of the size of the grains, the complete agreement in character of the enclosing rock with the enclosed masses, and who also lays due weight upon the fact of their almost horizontal posi-

[1] Compare v. Groddeck l. c., p. 266.
[2] Gaea Norvegica, 1838, 1, 58.

tion." J. Fr. L. Hausmann[1] also remarks that they "are without doubt segregations, not filled cracks, and consequently of on origin contemporaneous with the formation of the whole syenite mass." Similar opinions were held with respect to the Arendal granite pegmatite veins by G. Kreischer,[2] and for those of Königshain in Oberlausitz, by G. Woitschach.[3] The latter remarks concerning the "segregations" of pegmatite granite: "Actual veins of this kind were never observed; the masses appear bounded on all sides by normal granite, and must be considered as local variations of the same whose origin was contemporaneous with that of the main mass," etc. He remarks further of the granite of Königshain, that it contains a number of cavities which, analogous to those occurring at Elba and Striegau, are lined with crystallized minerals, and adds: "An essential difference between pegmatite and these cavities does not exist; they are distinguished only by the accidental method of formation." E. Kalkowsky,[4] although he expresses himself rather indefinitely, also seems to regard the pegmatite veins in the Saxon granulite (which he connects with the Mittwida granite) as "segregation veins," (Ausscheidungstrümer).

H. Rosenbusch, in a very sagacious way, connects the formation of the pegmatite veins with the fine-drusy, miarolitic structure of the granite rock. After he has described[5] the fresh feldspar, quartz, etc., formed as "filling" of the miarolitic druses, and has delineated their graphic-granite structure, he proceeds: "If by the crystallization of the rock there had been formed, instead of innumerable small miarolitic cells, single larger druses and vein-like cavities, in the case of these a gradual secondary filling-up with feldspar and quartz, as well as with other minerals, could take place,

[1] Bemerk. üb. d. Zirkonsyenit, l. c., p. 8 (Sep.-Abdr.); see also Reise durch Scandinavien, **2**, 106.

[2] Neues. Jahrb. f. Min. 1869, p. 209.

[3] "Das Granitgebirge von Königshain," Abhandl. d. Naturf. Gesellsch. zu Görlitz, 1881, **17**, 10 (Sep.-Abdr.).

[4] "Ueber den Ursprung d. granitischen Gänge im Granulit in Sachsen," Zeitschr. d. d. geol. Ges. 1881, **33**, 653.

[5] Mikr. Phys. d. mass. Gest., 2 Ausg., **2**, 39.

and this would exhibit symmetrical arrangement. The filling-up is sometimes complete and sometimes only partial. The preponderating feldspar is here significantly microcline. Such a process might in many cases account for the formation of the graphic granite and pegmatitic masses, which form the mostly lenticular or vein-like accessory component masses of granite rock." Rosenbusch expresses himself very cautiously, so that it is rather difficult to understand whether he proposes to consider the "gradual secondary filling-up" as purely aqueous (hydatogenous), or not.

J. J. Harris Teall says of pegmatites: "They occur rather as segregations than as independent masses of eruptive origin." (British Petrography, p. 291.)

Citations such as the above will suffice to show how, on all sides, the difficulty of accounting for the pegmatitic druses in the granite and for the larger occurences of pegmatite in veins as formed by the same processes, has been felt. If so much stress has generally been laid on the fact of small pegmatitic druses and larger pegmatite vein-masses occurring together in granite, and from this there has been deduced a common interpretation of both as "simultaneous segregations" (gleichzeitige Ausscheidungen); "separated masses" (Aussonderungen); "segregation veins" (Ausscheidungstrümer), (cf. Primärtrümer, Lossen), or as similarly formed "secondary fillings," etc., then this may perhaps be essentially due to the fact that no correct conception has been had of the extraordinarily frequent occurrence of true pegmatite in the form of veins in rocks other than granite.

In my paper on the pegmatite veins at Moss I have mentioned how these veins, on the Anneröd peninsula for example, have a direction across that of the gneiss. Many of these veins were followed for a distance of 200 to 250 metres, and were often 5 metres thick. The veins here occur in gneiss, hornblende-schist and other crystalline schists. Also along the coast between Langesund and Christiansand, particularly between Tvedestrand and Arendal. the innumerable pegmatite veins occur as regular veins not only in the contiguous granite with which they are genetically connected, but also in various crystalline schists. The conditions at Hitterö have already been mentioned. I think I may assert that probably very few geologists have seen so many and such various occurrences of pegmatite as I have,[1] and, according to my experience, pegmatite veins occur at least as abundantly outside the boundaries of the corresponding eruptive rock as within it. Any theory with regard to the formation of pegmatite must therefore, in the first place, be able to account for the true vein occurrences which are completely independent of the wall rock, without at the same time losing sight of their close relationship with the scattered pegmatitic druses.

J. Lehmann,[2] in his large and excellent work upon "The Granulite District of Saxony," endeavours to account for the pegmatite veins of that district. He starts out with the "hydatopyrogene" formation of granite, and pronounces the veins in a sense to be injection veins; with complete correctness, he distinctly emphasizes the fact that their feldspar, etc., has not been deposited from ordinary percolating water. "The granitic veins of the granulite district have originated, no doubt, with the aid of more or less water, but this has not been atmospheric water which has percolated downwards through the cracks of the granite, but it is eruptive water, which was given up from the granite to the surrounding rocks, and which, under peculiar conditions obtaining at great depths, was supersaturated with mineral matter." Lehmann assumes for the granitic magma a gelatinous consistency, which was to be accounted for presumably by the presence of "viscous silicic acid." "These fluid secretions of granite may be compared to hot jelly." . . . "The capacity of silica to form jellies with much or with little water invites strongly to this hypothesis." . . . "Between such a gelatinous magma

[1] Th. Scheerer remarks (Pogg. Ann. 1842, 56, 493), that pegmatite veins "may be met with in Norway (and also in Sweden) in greater frequency than in other countries."

[2] Granulitgebirge, p. 52–58.

and a saturated aqueous solution a large number of consecutive intermediate stages can be imagined. In this way, it seems to me, the connection between the pegmatitic veins and the ordinary granites, the remarkable segregations in the shape of pegmatitic veins opening out into druses, and finally the connection of these with vein-fillings which consist only of quartz, tourmaline and potash mica, or of quartz alone, can be explained," etc., etc.

On the whole I must agree with Lehmann, since he considers the pegmatite veins as true injection veins, eruptive veins, formed in essentially the same way as the granite itself; in his peculiar speculations upon the special conditions under which the plutonic rocks have been formed, I cannot agree with him in everything. He assumes for instance (l. c., p. 54) a relatively low temperature for the original granitic magma, (about 500° C.), because in the minerals of the granite no glass inclusions nor any attendant phenomena of corrosion have been recognised. This, however, is no evidence against a high temperature of the granitic magma, as the formation of glass is dependent naturally upon rapid cooling, which at the relatively great depths at which the magmas would solidify to granites, etc., is not possible. The strict connection of extruded eruptive masses with plutonic rocks[1] which is now known in many localities, would, according to Lehmann's hypothesis, lead to the remarkable result, that an eruptive magma, solidifying at a great depth, must have possessed a much lower temperature than the same magma solidifying at the surface; the extrusion of a magma must, therefore, have been accompanied on its upward way to the surface by an extraordinary increase of temperature! The depth, too, which Lehmann assumes as the horizon of granitic solidification is more or less conjectural. "It is not impossible that a line of fissure some 35 km. in length, such as that of the principal line of fracture in the Saxon granulite

[1] For granite rocks, for example, K. Dalmer's work "Die Quarztrachyte von Campiglia," etc., Neues. Jahrb. 1887, 2, 206-221, may be consulted. In the Christiania district I know excellent examples (for instance, the series of augite syenite to rhombic porphyry, with glassy enclosures in the apatite needles), etc.

district on which there is an almost continuous succession of granites from Penig to away beyond Böhringen, and which is as much as 1½ km. broad, should be as deep as it is long. Let us assume, however, only half this depth, 17½ km." etc., etc. That granite can be formed at such a depth is indeed possible; there are certainly, however, no grounds for such an assertion. On the other hand, it may be demonstrated from the Christiania district with the greatest certainty, that the granitites and other post-Silurian plutonic rocks occurring here, were formed at a much less depth below the then existing surface. The laccolitic mass of granite at Drammen, for instance, is covered by Silurian strata of Etage 8; it is here, therefore, absolutely certain that, at the time of its formation, it can have been covered at the very most by a superimposed mass[1] of about 2,000 ft., or about 600 m. At other places in the Christiania district, the depths at which the plutonic rocks (augite syenite at Kodal, in Ramnäs, etc.,) have solidified were only a few hundred feet; this is absolutely certain, as here they continue upwards into the porphyry covering. Also at Langesundfjord, where the augite syenites and nepheline syenites come into contact with the the augite porphyries and rhombic porphyries, the depth at which the solidification of the nepheline syenite occurred can have been only a few hundred feet. At Heivand, between Skien and Slemdal, the nordmarkite mass is similarly overspread with a cover of rhombic porphyry; hence the depth at which the nordmarkite mass solidified can have been at most only a few hundred feet. These observations are numerous and indisputable, and they demonstrate unequivocally that a depth of even a few hundred metres was sufficient to produce by solidification true eugranitic plutonic rocks from that part of the magma which did not reach the surface. Whether also at the depths postulated by Lehmann, 17,500 or 35,000 m., granitic magmas solidify to plutonic rocks or

[1] Namely, a few hundred feet of Etage 8, then Devonian sandstone 1,000 to 2,000 feet, then a few hundred feet of augite porphyry and rhombic porphyry. The only uncertainty is with regard to the thickness of the rhombic porphyry covering, but thousands of feet it certainly cannot have been.

not is a matter of superfluous speculation, as we know nothing about it.

The above mentioned observations in the Christiania district, which demonstrate definitely that here the granitic and syenitic, as well as other plutonic rocks, have been formed at relatively small depths below the surface, show[1] also that Lehmann's assumption that "it is sufficient to assume for the granite magma no higher temperature than that which prevails at the minimum depth which must be assumed for granite" (1. c., p. 55), must be incorrect, and further that the pressure under which the plutonic rocks solidified is not always so tremendously great as has often been assumed by Lehmann and other authorities. (He assumes, for instance, a pressure of 4,000 atmospheres.)

The principal requirement for the solidification of deep-seated magmas to holocrystalline plutonic rocks seems, therefore, to consist in a sufficiently slow cooling of the water-bearing magma, under a pressure of superimposed matter great enough to prevent the water separated out by crystallization from freely escaping to the surface, and compelling it by a pressure exerted from above to pass into the wall-rock (contact metamorphism.)[2] The temperature of the deep magma must, however, certainly have been considerable. The protecting covering of strata, which quickly became impregnated with and warmed by the escaping water-vapor, had, in the Christiania region, a thickness of but a few hundred metres, but was, nevertheless, sufficient to bring about this slow cooling. Of course the rate of cooling is further dependent upon the quantity of the magma solidifying at any one time.

The peculiar gelatinous consistency of the magma which Lehmann seems inclined to assume, the "viscous silica jelly," etc., of which he speaks, seems also hardly to be

[1] Similar conclusions may also be drawn from other eruptive districts which have recently been described.

[2] That contact metamorphosis is characterized by molecular re-arrangement, and only to a very small extent, and locally in direct contact with the eruptive rock itself, by any addition of material, shows that Lehmann's assumption, that the escaping water could not exist at the level of solidification of the granite in a liquid condition, is highly improbable.

borne out by the studies which have been made of the granitic and syenitic rocks of the Christiania district. The true granular, the aplitic, the granophyric, as well as the pegmatitic apophyses, those, for example, of the boundary of the granitite-laccolite in Hörtekollen, which run into the overlying Silurian limestones and schists from the underlying granitic rocks, indicate by their peculiarities a very fluid condition of the magma; even the narrowest veins and strings in the metamorphic schists are filled, even to their microscopically minute branches, with genuine granitic aplite or granophyre. Younger veins are represented by small quartz strings. That these last, the quartz veins, should be considered as "secretions," or, to use Reyer's expression, "exudations" of the solidifying granitic mass,[1] is most probable. The pegmatite veins themselves, however, according to my opinion, are in general not to be considered as secretion veins (Reyer, l. c., the same) etc., but as genuine magmatic eruptive veins formed under peculiar conditions.

(*To be continued.*)

THE CAMBRIAN TERRAIN AT TEJROVIC. BOHEMIA.

By G. F. MATTHEW, F.R.S.C.

The geological student will find matter of interest in the pamphlet published by Dr. J. J. Jahn of Vienna, on the Cambrian beds of the above locality.[2] In Bohemia the illustrious Barrande discovered what was once thought to be the oldest Palæozoic Fauna (which he named "Primordial") and hence the region must ever remain classic ground to the geologist.

The interest in Dr. Jahn's pamphlet centres in the fact that he has carefully gone over the Cambrian section at Tejrovic, fixed there the stratigraphical place of Barrande's Primordial Fauna, and shown the existence of the Primordial genera both above and below the typical horizon.

The foundation of the Cambrian terrain at Tejrovic is the

[1] See "Theoretische Geologie," Stuttgart, 1888, p. 101.
[2] Verh. der k. k. geologischen Reichsanstalt, Wien, 1893.

black slates of Barrande's Etage B., which are plainly laminated and are discordant in stratification to the Primordial Strata. These at the bottom consist of conglomerate and sandstone with some thin clay slates; and, beside *Orthis Remingeri*, Barr., contain trilobites of the genus *Solenopleura* and a genus allied to *Anomocare*. This member of the series is about 20 metres thick and is followed by a dark, crumbling conglomerate 2 to 4 metres thick.

Above this conglomerate is a sandstone bed of 10 metres with broken but unquestionable remains of trilobites, and then a zone of dark conglomerate of 4 to 6 metres. Upon these beds follow the great zone of Paradoxides slates, 100 metres thick, with numerous fossils of the well known Primordial Fauna.

Above this zone follows one about 30 metres thick, of a schistose porphyritic rock, corresponding in dip and strike to the slates, &c. To this succeeds a zone of slate with sandstone layers. This set of beds is 10 to 15 metres thick, and in it has been found a head of *Conocephalites striatus*, Emm. The upper bed has a very rich fauna, and is chiefly characterised by *Ellipsocephalus Germari*, Barr.; the next most frequent species are *Conocephalites striatus*, Emm., *Paradoxides spinosus*, Barr., and *Lichenoides priscus*, Barr.; besides these, but much less frequent, are *Conocephalites Sulzeri*, Schloth., *C. Coronatus*, Barr., and *Arionellus ceticephalus*, Barr. Much more frequent is a new species of Arionellus, *A. Spinosus*, very much like *Liostracus aculectus*. [*L. Onangondianus*, Htt., is the Canadian form, G. F. M.]; there also occurs here a species of the genus resembling *Anomocare*, cited above, and an *Agnostus*, as well as three species of cystideans, and two minute orthids, besides *O. Remingeri*.

Above these slates is a thick zone of conglomerate alternating with sandstone and Paradoxides slate. This highest conglomerate of the Cambrian is very similar to that near the bottom of the terrain, being dark, crumbling and very coarse grained. There are numerous remains of Paradoxides scattered through the whole mass, and *Sao hirsuta*, Barr., also occurs. This fact has not heretofore been recognized, and is significant as showing that no higher fauna is known in the Bohemian Cambrian Terrain. The next band of rock is a thick zone of aphanite.

According to Dr. Jahn the chief result of his studies on the Cambrian fauna of Tejrovic is to show that the Paradoxides stage alone is recognizable there; and that so far, neither the Olenellus, nor the Olenus stage can be distinguished.

The fauna of this station has heretofore on the authority of Kusta, been reckoned ante-primordial.

Proceedings of the Natural History Society.

Montreal, October 29th, 1893.

The first monthly meeting was held this evening.

Dr. Wesley Mills in the chair.

The minutes of the last monthly meeting were read and approved.

The minutes of Council meetings of May 29th, June 5th, September 21st, and October 23rd, were read.

Dr. Wesley Mills reported that the special committee appointed to enquire into the condition of the Society had met and reported progress.

The Librarian reported a large number of exchanges received.

The Curator reported the following additions to the Museum :—

Two lizards, a bat, and seaweed from Captain Clift.

A model of a sailing canoe or surf boat from Samoa from J. Murray Smith.

Fossils from Radnor Forges from J. Spurrier.

A specimen of bark of the giant trees of California and a stone axe from H. J. Tiffin.

A large exotic beetle from C. Ellacombe.

A beautiful exotic moth from Miss Aurbach, and iron sand of the Moisie from J. Miller.

The following were elected ordinary members :—

Charles Gurd, proposed by Geo. Sumner, seconded by J. Gardiner.

C. Gurd, Jr., associate member, proposed by Geo. Sumner, seconded by James Gardiner.

S. W. Ewing, proposed by J. S. Shearer, seconded by James Gardiner.

Dr. J. G. Adami, proposed by Dr. R. F. Ruttan, seconded by Dr. Wesley Mills.

F. W. Richards, proposed by E. D. Wintle, seconded by A. Ingles.

W. A. Carlyle, Ma. E., proposed by Dr. F. D. Adams, seconded by Dr. Wesley Mills.

Professor J. T. Nicolson, proposed by Dr. Wesley Mills, seconded by Dr. F. D. Adams.

J. A. Nicholson, M A., proposed by Dr. Wesley Mills, seconded by Dr. F. D. Adams.

Hon. John S. Hall, proposed by J. S. Shearer, seconded by Hon. Justice Wurtele.

R. L. Gault, proposed by J. S. Shearer, seconded by J. Gardiner.

Alfred Thibideau, proposed by John S. Shearer, seconded by Jos. Forbes.

Ald. W. Clendenning, proposed by J. S. Shearer, seconded by J. H. Joseph.

C. J. Coyle, proposed by J. S. Shearer, seconded by E. T. Chambers.

Owen McGarvey, proposed by Edward Murphy, seconded by J. S. Shearer.

Hon. L. O. Taillon, proposed by Hon. Justice Wurtele, seconded by J. S. Shearer.

Ald. J. H. Starnes, proposed by J. S. Shearer, seconded by James Gardiner.

J. D. Rolland, proposed by J. S. Shearer, seconded by G. Sumner. All as ordinary members.

Sir William Dawson, read a paper entitled " Some notes on the Guanches or Aborigines of the Canary Islands." The paper was highly interesting, and there were nearly 100 visitors present.

After a stimulating discussion a vote of thanks to Sir William was proposed by the Rev. Dr. Campbell, seconded by Walter Drake.

R. W. McLachlan,
Secretary.

Dr. Wesley Mills,
President.

Montreal, November 27th, 1893.

The second monthly meeting of the Society was held this evening, Dr. Wesley Mills, president, in the chair.

Minutes of last meeting were read and approved.

Minutes of Council meeting of November 20th were read.

The usual exchanges were reported by the Librarian.

The Curator reported two wasps' nests received from Mr. James Ferrier. On motion the thanks of the Society were tendered to Mr. Ferrier.

Mr. H. J. Tiffin was proposed as an ordinary member by R. W. McLachlan, seconded by J. S. Shearer; and A. E. Holden, proposed by Dr. Mills, seconded by A. Holden; and H. W. Shearer, proposed by Dr. Mills, seconded by Joseph Fortin, as associate members.

On motion of E. T. Chambers, seconded by J. H. Joseph the rules were suspended and these members elected by acclamation.

Dr. Wesley Mills then read his paper on "Hibernation and allied states in the lower animals and in man."

After some discussion Mr. Edgar Judge moved, seconded by Mr. E. T. Chambers, that the thanks of the Society be given to Dr. Mills for his interesting paper.

Sir William Dawson asked for information regarding the earthquake of the forenoon of this day.

R. W. McLachlan,
Secretary.

Dr. Wesley Mills,
President.

Montreal, January 29th, 1894.

The third monthly meeting of the Society was held this evening in the Chemistry Lecture-room of McGill College, Dr. Wesley Mills, president, in the chair.

The minutes of last meeting were read and approved.

The minutes of Council were left over until next meeting.

On motion of R. W. McLachlan, seconded by E. T. Chambers, the rules were suspended and the following were elected ordinary members by acclamation.

J. S. Buchan, proposed by Sir William Dawson, seconded by Dr. F. D. Adams; Nevil Norton Evans, proposed by Dr. Adams, seconded by A. F. Winn; De Lery Macdonald, proposed by J. S. Shearer, seconded by George Sumner.

Mr. Nevil Norton Evans then gave an interesting address, with experiments: entitled "How a chemical analysis is made."

On motion of Mr. Smaile, seconded by Professor Donald, the thanks of the Society were tendered to Mr. Evans.

Moved by George Sumner, seconded by Henry Lyman, that the thanks of the Society be tendered to the Corporation of McGill College for the use of their lecture hall and apparatus.

R. W. McLachlan,
Secretary

Dr. Wesley Mills,
President.

Montreal, February 26th, 1894.

The fourth monthly meeting of the Society was held this evening, Dr. Wesley Mills, president, in the chair.

The minutes of last meeting were read and approved.

The minutes of Council meetings of November 20th, December 18th, 1893, January 22nd and February 19th, 1894, were read.

Mr. Achille Fortier, proposed by Joseph Fortier, seconded by the Rev. Robert Campbell; Mr. C. T. Williams, proposed by R. W. McLachlan, seconded by Dr. Wesley Mills; and Mr. Pierre Bedard, proposed by Mr. J. A. U. Beaudry, seconded by M. de Beaujeu, were, on motion of George Sumner, seconded by J. S. Shearer, elected by acclamation.

Letters were read from the Hon. L. O. Taillon and J. T. Buchan asking to be excused for non-attendance.

Dr. F. D. Adams then read a paper on "Denudation or the Waste of Land," which was illustrated by a large number of excellent lantern slides.

On motion of Sir William Dawson, seconded by Mr. Geo. Sumner the thanks of the Society were given to the lecturer for his interesting paper.

MONTREAL, March 5th, 1894.

A special meeting of the Society was held this evening to receive report of the committee to enquire into the improvement of the Society and the committee on publication of the Record of Science.

Dr. Wesley Mills, president, in the chair.

The minutes of the special meeting of the Council were accepted as read.

Moved by Judge Wurtele seconded by Mr. Drake that the recommendations of the Council with regard to the publication of the Record be adopted. Carried.

Moved by Dr. Adams seconded by the Rev. Dr. Campbell that Mr. Nevil Norton Evans be added to the Editing Committee.

The report of the committee appointed to enquire into the condition of the Society was then taken up seriatum and adopted.

The committee beg to report that they have held a number of meetings and have carefully considered the whole subject submitted to them.

They desire to make the following recommendations:—

1. That the range of subjects presented to the Society at its monthly meetings be extended so as to include both the natural and the physical sciences.

2. That authors presenting papers to the Society be requested, in reading them, to make use of language as free from technicalities as possible, it being understood that those papers accepted by the Society for publication in the Record of Science may there appear in the technical language of the author.

It is thought that in this way a more popular character may be given to the meetings.

3. That strenuous efforts be made to secure the Government grant for the publication of the Record of Science from year to year.

4. That the Somerville bequest of $4,000.00 be freed as soon as possible.

5. That reports of the monthly meetings, with short summaries of the papers read, be regularly published in the daily papers.

6. That the Museum be opened free to the public, provided that the extra expense necessitated be secured by a special grant from the City Council or otherwise.

7. That the Microscopical Society, the Entomological Society and the Agassiz Association be affiliated with the Natural History Society on the terms set forth in the accompanying report of the sub-committee on affiliation.

8. That Associate members be admitted to the Society who shall pay subscriptions at the rate of $1.00 per annum. These members to have all the privileges of the Society except that of voting, holding office and receiving the Record of Science.

9. That the committee recognizing that the usefulness of the Society is largely dependent upon the Record of Science, recommend that every effort be made to continue its publication.

Report of the sub-committee appointed to enquire into the possibility of securing the affiliation of the various societies in Montreal, which are engaged in the study of Natural History, with the Montreal Natural History Society and for the purpose of ascertaining the terms on which such affiliation could be affected.

The sub-committee beg to report that they have held a number of meetings and have entered into negotiations with the following societies:—The Microscopical Society, The Entomological Society and the Agassiz Association.

All these societies have agreed to affiliate with the Natural History Society, but each desires at the same time to retain its name and thus preserve its identity.

The committee of the Microscopical Society have agreed to affiliate on the following terms:—

1st. The Microscopical Society shall hereafter be known as the Microscopical Society of Montreal, being the Microscopical section of the Natural History Society.

2nd. That those members of the Microscopical Society who are not already members of the Natural History Society be allowed the privileges of this latter Society, except those of voting or becoming officers, on payment of an annual fee of $2.00 which however would not include the Record of Science, it being optional with the members individually to join the Natural History Society under these conditions or not, as they may desire.

3rd. The Microscopical Society shall pay the Natural History Society $20.00 per annum for the use of its Library as a place of meeting and for the privileges stated above, and when the membership of the Microscopical Society warrants it an increased amount may be charged.

4th. A reciprocity of attendance at meetings is to be arranged for.

The Entomological Society is also willing to affiliate but desires to retain its name, being known in future as the Entomological Society of Montreal, being the Entomological section of the Natural History Society. The affiliation is to be arranged for on such reasonable terms as may be mutually agreed to.

It is suggested that the Natural History Society should offer this society the same terms as those arranged for in connection with the Microscopical Society, except that if the Entomological Society desire to use the Library as a place of meeting, two dollars a night is to be charged, which is practically the amount paid by the Microscopical Society.

The Agassiz Association also agrees to accept the proposal made by the Natural History Society for affiliation, upon the following terms:—

1st. That it be allowed to continue its name and identity observing its present constitution and by-laws as heretofore, and reserving, moreover, all rights and proprietorship in its museum, as well as powers as to the disposal of the same.

2nd. That all certified members of the Society in good standing may become Associate members of the Natural History Society with the usual privileges of access to their library, museum, etc., on payment by such members to that Society of fifty cents annually. This in addition to the regular fee of fifty cents payable to the Agassiz Society itself.

It was understood by this committee in carrying out its negotiations for these affiliations that the object aimed at was not in any way to improve the financial position of one society at the expense of another, but to bring the workers in the various branches of Natural History in Montreal into closer contact, thus strengthening all the societies and making their work more efficient.

It is hoped as a result of these affiliations, if they be carried out, that early next autumn a list, giving the dates of meeting of all the branches of the Natural History Society, for three or possibly six months in advance, may be issued, together with the titles of the papers to be read at the several meetings. Also that once or twice during the winter these branches may hold a meeting on a date appointed for one of the regular monthly meetings of the Natural History Society, such joint meetings being devoted to the consideration of such subjects as these several branches shall determine.

Notices of Books and Papers.

Lehrbuch der Petrographie von Dr. Ferdinand Zirkel —Zweite ganzlich neu verfasste Auflage—Erster Band—Wilhelm Engilman, Leipzig, 1893.

The appearance of the first volume of the new edition of Prof. Zirkel's Text-Book of Petrography will be most heartily welcomed by all students of this science. The first edition of the work appeared in 1866, Prof. Zirkel being one of the earliest workers in modern petrography, and since that time principally owing to the introduction of the microscope into petrographical work, the science has grown so enormously and its literature has become so extensive that from a single volume in the first edition the work has grown to three ponderous volumes of which the first, just published comprises no less than 845 pages. The work has been entirely rewritten, as it was found that owing to the great strides which have been made in petrographical science little or nothing in the original edition could now be reproduced.

The work has been eagerly expected for some years past but various causes have contributed to delay its appearance, among others the fact that the author's time has been largely devoted to editing successive editions of Nauman's Mineralogy, so extensively used as a text-book in Germany. The second and third volumes however are also finished and are promised within the present year, thus completing the work.

The work aims at being a complete compendium of the whole science of petrography, incorporating the results of all the literature of the science up to date, with a critical treatment of certain subjects. It is thus essentially one of those monumental summaries of a science, which are so useful to investigators and to advanced students, and which are given to the world principally by the German Universities.

The present volume deals first with general Petrography, under thirteen headings, as follows: General Characters of Rocks; Methods of Petrographical Investigation; Form and Structure of Rock Constituents; Mineralogical Composition of Rocks; Structure of Rocks; Secretions, Concretions, Inclusions, etc.; Joints, etc.; Mode of Occurrence of Rocks; Transitional Forms; Magnetic and Thermal Relations; Origin of Rocks; Alteration of Rocks; Classification of Rocks.

This is followed by a description of the general characters of the Massive Igneous rocks which closes the present volume.

It will thus be observed that the work is not confined to Petrography in the narrower sense in which the word is usually employed but treats in a general way of the arrangement of the various rocks in the architecture of the earth's crust, a department of science usually known as Structural Geology, as well. No cuts or illustrations are given, and although these are not especially required in the treatment of that portion of the subject dealt with in the first volume, it is feared that their absence in the subsequent portions of the work, dealing with microscopic petrography, will make itself felt. It is often a matter of regret to the reader that Prof. Zirkel, when presenting the results of the work of others and their opinions on debated points, has not more frequently given his own opinions, which in many of these cases at least would carry great weight, but in such an exhaustive treatise where so many points come up for discussion this perhaps would not always be possible.

It is beyond the scope of the present notice even to mention the many excellencies of the book. The present volume will be found especially useful as presenting a *resumé* of our present knowledge of various parts of the science in which rapid advances are now being made, as for instance the question of the chemical relations of the eruptive rocks, now so widely investigated and discussed—the artificial reproduction of rocks, etc. It may be notod however that even in the time which has elapsed since the writing of the earlier parts of this volume some of the incorporated material has already become somewhat antiquated.

It is a matter of much satisfaction and one which will afford much relief to geologists in general to find that in his classification of the eruptive rocks Prof. Zirkel agrees in the main with Prof. Rosenbusch, whose scheme is now in general use. It thus seems that at least in its principal features the petrographical classification has been generally agreed upon. Many modifications will undoubtedly be found to be necessary with the advance of the science, but we now have at least a good working classification.

Prof. Zirkel rejects Rosenbusch's division of Dyke Rocks, to which many objections have been raised by others as well, and although refusing to admit that the geological occurrence of an igneous rock is a proper basis for classification, he substitutes for this its structure, which in the great majority of cases depends on its geological occurrence, and this substitution does not therefore materially affect the form of the classification.

The separation of the "old" from the "new" volcanic rocks is still retained and justified on the ground that although their differences may be due merely to alteration, nevertheless since the distinction can be made in most cases the double nomenclature should be retained, it being quite as convenient to use the terms Rhyolite and Quartz-Porphyry as the terms Tertrary Rhyolite, Carboniferous Rhyolite, &c.

This argument has especial weight in the case of the German rocks, but since any classification universally adopted must be one which will be suitable and convenient for all countries, it remains to be seen whether this dual nomenclature for the eruptive rocks, so long opposed by English petrographers and fast losing its hold in all directions will not eventually be disgarded, being replaced perhaps by some simple method of distinction such as that recently proposed by Dr. Williams and Miss Bascomb, which consists in placing the prefix apo before the name of any rock which can be proved to have been derived from any of the ordinary types by a process of alteration. Thus there would be Rhyolites and Aporhyolites, Andesites and Apandesites, and so on.

Another point in the classification adopted by Prof. Zirkel is the retention of the old use of the terms Diabase and Gabbro, the former being a rock composed of plagioclase and augite and the latter one composed of plagioclase and diallage, the distinction between the two being thus made to depend on the presence or absence of a cleavage parallel to the orthopinacoid of the pyroxene. This cleavage, which is often nothing more than a parting, is now generally considered to be a most unsatisfactory basis of division, not nearly so good as that afforded by the ophitic (diabase) and granitoid structures displayed respectively by the two rocks—which structures although occasionally found in different portions of the same mass, certainly form a better and more distinct ground of classification than a more or less distinct or indistinct orthopinacoidal parting in a single constituent.

Prof. Zirkel's book is an excellent one and represents an enormous amount of careful work, and will take rank with the works of Prof. Rosenbusch as one which must find a place in the library of every petrographer. FRANK D. ADAMS.

NOTES ON THE GEOLOGY OF MIDDLETON ISLAND, ALASKA, BY GEORGE M. DAWSON, C.M.G., LL.D., F.R.S., F.G S., BULL. GEOL. SOC. AMERICA, vol. 4, pp. 427–431, 1892.

In this paper Dr. Geo. Dawson records the discovery made by Mr. J. M. Macoun, on June 15, 1892, of "boulder clay" or "true till" which on examination proved to be fossiliferous. Mr. Macoun furnishes an interesting sketch of the leading physical features of the island. The pebbles or rocks contained in the "till" are chiefly of Triassic age and form part of the "Vancouver Group." Numerous fragments of shells are found together with foraminifera.

Mr. Whiteaves has recognised the following foraminifera.

1. *Polystomella striatopunctata*, Frichtel & Moll.
2. *Pulvinulina Karsteni*, Reuss.
3. Probably *Nodosaria* (*Glandulina*) *laevigata*, D'Orb.

Dr. Dall's observations on Middleton Island had led him to suppose the "clay-stone" to be Post-Pliocene and possibly Pliocene.

Dr. Dawson also found shells of *Cardium blandum* in the till of Middleton Island and the samples of sand collected by Mr. Macoun were submitted by Dr. Dawson to Mr. Ferrier and the results incorporated in the paper.

H. M. AMI.

"NOTES ON THE OCCURRENCE OF MAMMOTH REMAINS IN THE YUKON DISTRICT OF CANADA AND IN ALASKA." BY GEORGE M. DAWSON, C.M.G., LL.D., F.R.S., F.G.S.

The following "Notice of Memoirs read before the Geological Society of London, England," occurs in the December number of the Geological Magazine, for 1893, pp. 574–575.

In this paper various recorded occurrences of Mammoth remains are noted and discussed. The remains are abundant in, if not strictly confined to, the limit of a great unglaciated area in the north-western part of the North American Continent; whilst within the area which wac covered by the great ice mass which the author has described as the Cordilleran glacier, remains of the Mammoth are either entirely wanting or are very scarce. As the time of the existence of the Mammoth the North American and Asiatic land was continuous, for an elevation of the land sufficient to enable the Mammoth to reach those islands of the Behring Sea where these bones have been found would result in the obliteration of Behring Straits.

The bones occur along the northern coast of Alaska, in a layer of clay resting on the somewhat impure "ground-ice formation" which gives indications of stratification; and above the clay is a peaty layer. The author considers this "ground-ice" was formed as a deposit when more continental conditions prevailed, by snow-fall on a region without the slopes necessary to produce moving glaciers. The Mammoth may be supposed to have passed between Asia and America at this time. At a later date, when Behring Straits were opened and the perennial accumulation of snow ceased on the lowlands, the clay was probably carried down from the highlands and deposited during the overflow of rivers. Over this land the Mammoth roamed, and wherever local areas of decay of ice arose, bogs would be produced which served as veritable sink-traps. The author considers it probable that the accumulation of "ground-ice" was coincident with the second (and latest) epoch of maximum glaciation, which was followed by an important subsidence in British Columbia."

NOTE ON THE RECENT DISCOVERY OF LARGE UNIO-LIKE SHELLS IN THE COAL MEASURES AT THE SOUTH JOGGINS, N. S. BY J. F. WHITEAVES. TRANS. ROYAL SOCIETY OF CANADA. SEPARATE COPIES.

Pl. I., Figs. 1, 2, pp. 21–24, ISSUED DECEMBER, 1893.

Beside the Presidential Address for the year, Mr. Whiteaves contributed a second paper to Section *Four* of the Royal Society and in it describes under the name of *Asthenodonta Westoni*, a large species of Carboniferous mollusc whose affinities and structure show a strong resemblance to the genera Anthracosia, Plagiodon and Unio.

Mr. Whiteaves briefly and succiently reviews the literature of shells whose affinities and habitat have caused them to be referred to the Unionidae and allied forms in Palaeozoic and later times.

Choffat, Douvillé, D'Orbigny, S. P. Woodward, Forbes, Sowerby, Phillips, Hibbert and Brown, in Europe have written on this subject, while Meek, Vanuxem, Hall, Sir Wm. Dawson and others in America have written on the same subject.

This species was discovered by Mr. Weston during the summer season of 1893, and named in his honour by Mr. Whiteaves. It may be stated here that from the same horizon at the same locality Sir William Dawson has obtained a large number of trunks of trees containing remains of microsauria, molluscs and insects.

H. M. Ámi.

ABSTRACT FOR THE MONTH OF OCTOBER, 1893.

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

DAY.	THERMOMETER. Mean.	THERMOMETER. Max.	THERMOMETER. Min.	THERMOMETER. Range.	* BAROMETER. Mean.	* BAROMETER. § Max.	* BAROMETER. § Min.	* BAROMETER. Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	WIND. Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	SKY CLOUDED IN TENTHS. Max.	SKY CLOUDED IN TENTHS. Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	.....	64.0	41.0	23.0	....	......	......	....	.....	....	....	N.	15.4	....	....	..	88	....	....	....	1 .. ..SUNDAY
2	54.67	64.0	46.0	18.0	29.9537	30.020	29.906	.114	.2800	66.8	43.0	N.	5 6	1 2	7	0	85	....	....	....	2
3	52.37	60.5	44.0	16.5	30.0288	30.095	29.964	.131	.3142	80.0	46.2	N.	11.6	2.0	6	0	80	....	....	....	3
4	57.05	64 0	47.5	16.5	29.9120	29.970	29.845	.125	.3863	83.8	51.7	S.E.	12.1	8.3	10	0	00	0.04	....	0.04	4
5	58.43	62.0	55 0	7.0	30.0185	30.077	29.964	.113	.4125	84.5	53 7	S.W.	13.2	1.8	8	0	59	0.05	....	0.05	5
6	58.63	72.0	47.8	24.2	29.9810	30.103	29.837	.266	.3795	78.3	51.3	S.E.	9 6	4.7	9	0	49	....	....	....	6
7	58.25	65.5	55.0	10.5	29.8560	29.917	29.770	.147	.3937	81.2	52.2	S.W.	19.4	9.0	10	3	23	0.22	....	0.22	7
SUNDAY 8	.....	62.5	47.0	15.5	....	......	......	. ..	.....	....	....	S,W.	13.3	....	....	..	66	Inap	....	Inap	8 ....SUNDAY
9	53.50	65.6	46.5	19.1	29.6973	29.980	29.466	.514	.3155	74.7	45.2	S.W.	24.7	5.8	10	0	31	0.29	....	0.29	9
10	47.28	55.0	39.0	16.0	30.1533	30.231	30.028	.203	.2213	67.5	36.8	W.	15.8	0.5	2	0	75	....	....	....	10
11	50.33	58.0	43.0	15 0	30.2323	30.297	30.184	.113	.2742	75.8	42.7	E.	6.2	1.5	9	0	67	....	....	....	11
12	55.55	68.3	43.0	25.3	30.0770	30.166	30.003	.163	.3330	76.5	47.7	E.	6.7	1.8	8	0	66	....	....	....	12
13	62.13	71.6	52.6	19.0	29.9077	30.043	29.700	.343	.3562	64.7	49.7	S.E.	12.0	7.7	10	0	62	....	....	....	13
14	61.42	70.5	54.0	16.5	29.1735	29.446	29.016	.430	.4052	71.8	52.2	S.E.	24.5	7.7	10	0	10	0.46	....	0.46	14
SUNDAY 15	.....	56.2	40.0	16.2	....	......	......	....	.....	....	....	W.	32.3	....	...	..	00	0.06	....	0.06	15 ....SUNDAY
16	40.33	45.4	35.5	9.9	30.2520	30.347	30 063	.284	.1855	74.2	32.3	W.	18.2	2.2	9	0	51	....	....	....	16
17	47.42	55.5	37.0	18.5	30.3382	30.366	30.263	.103	.2615	80.2	41.2	W.	14.2	5 0	10	0	53	....	....	....	17
18	40.25	53.2	36.0	17.2	30.5497	30.602	30.474	.128	.1662	66 5	29.7	N.	17.5	1.2	4	0	78	....	....	....	18
19	43.08	54.0	32.0	22.0	30.4522	30.558	30.363	.195	.2157	75.0	35 5	S.E.	12.3	5.0	9	0	58	....	....	....	19
20	48.92	58.0	41.5	16 5	30.2197	30.374	30.091	.283	.2792	81.0	43.2	S.	16.3	6.5	10	0	66	....	....	....	20
21	52.17	60.0	45.0	15.0	30.1322	30.259	30.056	.203	.3143	80.8	46.2	S.W.	15.2	6.0	10	0	48	....	....	....	21
SUNDAY 22	.....	59.3	40.0	19.3	....	......	......	....	.....	....	....	N.E.	9.2	....	....	..	58	....	....	....	24..........SUNDAY
23	55 58	67.8	48.0	19.8	30.1998	30.313	30.029	.284	.4092	81.0	53.3	S.E.	15.6	7.0	10	0	51	....	....	....	22
24	60.13	65.5	57.5	8.0	29.7338	29.926	29.639	.287	.4675	89.8	57.0	S.E.	13.9	9.3	10	3	00	0.16	....	0.16	23
25	46.08	60.4	38.0	22.4	30.0303	30.221	29.780	.441	.2243	70.2	36.7	W.	19.4	5.2	9	0	20	0.01	....	0.01	25
26	40.28	50.0	32.0	18.0	30.1870	30 307	29.999	.308	.1792	71.2	31.5	N.	16.7	6.3	10	0	50	0.01	....	0.01	26
27	50.83	54.5	42.5	12.0	29 8847	29 967	29.844	.123	.3413	91 7	48.3	S.E.	15.9	10.0	10	10	00	0.48	....	0.48	27
28	46.25	52.5	42.0	10.5	29.7527	29.817	29.700	.117	.2457	78.3	39.7	W.	15.7	8.0	10	1	65	0.40	....	0.40	28
SUNDAY........29	.....	49.5	31.5	18.0	....	......	......	....	.....	....	....	S.W.	24.3	....	....	..	18	Inap	Inap	Inap	29 ....SUNNAY
30	30.17	43 7	28.0	15.7	30.3940	30.453	30.283	.170	.1270	75.7	23.5	W.	9.2	5.0	10	0	43	....	....	....	30
31	32.42	38.3	25.0	13.2	30.3808	30.467	30.265	.202	.1382	75.7	25.7	S.	7.6	2.0	4	0	67	....	....	....	31
....Means	50.29	58.94	42.35	16.59	30.0576	.....	......	.223	.2933	76 80	42.55	S. 43° W.	14.95	5.03	..	..	48 9	2.18	0.00	2.18	Sums ....
19 Years means for and including this month	45.40	52.43	38.69	13.75	30.0011	.....	......	.209	.2437	76.39	...	......	....	6.42	..	..	¶41.79	3.17	1.41	3.31	19 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..........	1606	368	388	2735	772	2182	2659	416	
Duration in hrs..	126	33	50	177	54	128	145	28	3
Mean velocity...	12.7	11.2	7.8	23.4	14.3	17.0	18.3	14.9	

Greatest mileage in one hour was 43 on the 15th.

Greatest velocity in gusts 60 miles per hour, on the 15th.

Resultant mileage 2340.

Resultant direction, S. 43° W.

Total mileage, 11126.

Average mileage per hour 14.95.

Thunder was heard on two days without lightning.

Lightning was seen on one day without thunder.

Solar halo on four days.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 12 years only.

The greatest heat was 72.0 on the 6th; and the greatest cold was 25.0 on the 31st, giving a range of temperature of 47.0 degrees. Warmest day was the 13th. Coldest day was the 31st. Highest barometer reading was 30.602 on the 18th; lowest barometer was 29.016 on the 14th, giving a range of 1.586 inches. Maximum relative humidity was 100 on the 4th. Minimum relative humidity was 48 on the 13th.

Rain fell on 13 days.

Snow fell on 1 day.

Rain or snow fell on 13 days.

Auroras were observed on 1 night.

Lunar halo on one night.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1893.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	* BAROMETER. Mean.	§ Max.	§ Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	43.17	51.0	32.0	19.0	30.1272	30.259	30.048	.211	.1885	66.8	32.8	S.	17.9	7.0	10	0	66	....	....	....	1
2	47.92	53.5	44.0	9.5	29.9787	30.217	29.827	.290	.2578	77.2	41.2	S.	19.0	4.7	10	0	21	0.05	....	0.05	2
3	44.83	50 0	38.0	12.0	29.9107	30.080	29.776	.304	.2388	79.2	38.7	S.W	20.2	6.7	10	0	42	0.33	....	0.33	3
4	36.25	42.5	32.5	10.0	30.1288	30.158	30.109	.049	.1443	67.5	26.7	W.	7.7	4.7	10	0	08	....	....	....	4
SUNDAY....... 5	.....	47.3	30.0	17.3	....	......	......	....	.....	....	....	S.W.	10.2	....	....	..	89	....	....	....	5 ....SUNDAY
6	41.10	46.7	36.3	10.4	30.2423	30.437	30 076	.361	.1583	61.5	28.3	S.W.	21.3	2.3	10	0	96	....	....	....	6
7	35.25	44.0	29.0	15.0	30.4368	30.527	30.328	.199	.1333	65.7	24.5	E.	10.5	0.8	3	0	93	....	....	....	7
8	41.67	48.5	30.0	18.5	30.1903	30.348	30.060	.288	.1647	63.2	29.7	S.	16.2	5.7	10	0	36	....	....	....	8
9	36.58	48.5	28.5	20.0	30.2150	30.318	30.106	.212	.1563	70.8	28.0	N.E.	25.1	2.2	10	0	69	....	....	....	9
10	29.25	35.0	23.1	11.9	30.3250	30.378	30.286	.092	.1308	80.5	24 3	N.E.	11.0	0.5	3	0	96	....	....	....	10
11	34.42	39.5	26.8	12.7	30.3947	30.406	30.358	.048	.1500	75.5	27 5	S.W.	7.9	8.3	10	0	00	....	....	....	11
SUNDAY........12	.....	46.0	29.2	16.8	....	......	......	....	.....	....	....	S.E.	11.9	....	....	..	00	....	....	....	12 ....SUNDAY
13	43.25	49.3	36.8	12.5	29.9225	30.098	29.824	.274	.2272	81.0	37.7	S.	19.0	5.8	10	0	00	0.04	....	0.04	13
14	40.17	47.8	35.3	12.5	29.8323	29.942	29.732	.210	.1927	77.3	33.5	S.W.	16.9	7.8	10	0	28	Inap	....	Inap	14
15	33.58	43.2	29.0	14.2	29.5352	29.737	29.407	.330	.1468	76.5	27.0	S.W.	15.3	5 7	10	1	35	Inap	Inap	Inap	15
16	27.38	32.0	23.3	8.7	29.7187	29.992	29.450	.542	.1188	80.5	21.8	S.W.	25.6	5.2	10	0	15	....	Inap	Inap	16
17	38.05	49.7	21.2	28.5	29.7525	30.025	29.604	.421	.1978	71.2	29.0	S.	20.2	6.8	10	0	65	....	Inap	Inap	17
18	35.67	49.5	26.5	23.0	29.7973	30.020	29.607	.413	.1388	62.3	24.0	S.W.	27.7	4.8	10	0	85	0.09	....	0 09	18
SUNDAY........19	.....	35.0	24.8	10.2	....	......	......	....	.....	....	....	S.W.	12.5	....	10	0	10	....	Inap	Inap	19 ....SUNDAY
20	28.67	32.2	26.3	5.9	30.0037	30.077	29.908	.169	.1308	82.8	24.2	S.W.	7.4	8.5	10	1	00	....	0.9	0.09	20
21	31.75	37.0	23.8	13.2	29.9427	30.079	29.826	.253	.1470	81.2	26.8	S.E.	15.3	9.7	10	8	15	....	Inap	Inap	21
22	34.47	36.8	32.0	4.8	29.6018	29.775	29.510	.265	.1857	93.2	32.7	S.E.	14.9	10.0	10	10	00	0.23	1.1	0.42	24
23	35 92	39.0	33.2	5.8	29.5928	29.635	29.539	.096	.1667	79.0	30.0	S.W.	24.2	9.8	10	9	00	0.06	....	0 06	22
24	26.40	39.0	15.8	23.2	29.7272	29.922	29.638	.284	.1150	78.7	21.0	W.	22.0	10.0	10	10	00	....	0.3	0.03	23
25	18.12	24.0	14.0	10.0	30 2170	30 381	30.066	.315	.0795	80 0	13.2	W.	22.4	7.0	10	0	46	....	0.0	0.00	25
SUNDAY........26	.....	18.5	8.8	9.7	....	......	......	....	.....	....	....	W.	14.2	....	....	..	96	....	....	....	26 ....SUNDAY
27	24.42	30.8	15.5	15.3	30.3472	30.615	30.066	.549	.1093	81.5	19.7	N.E.	10.3	8.3	10	0	00	....	....	....	27
28	38.33	46.3	25.5	20.8	29.6123	29 918	29.486	.432	.2025	87.0	34 8	S.W.	20.7	10.0	10	10	00	0.32	2.4	0.56	28
29	35.75	39.8	33.0	6.8	29.7385	29.835	29.567	.268	.1708	81.3	30.5	S.W.	19.0	9 2	10	5	03	0.09	0.9	0.18	29
30	33.30	36.0	29.8	6.2	29.7365	29.793	29.629	.164	.1570	82.8	28.7	S.W.	20 9	8.3	10	3	21	0.10	0.2	0.12	30
............Means	35.21	41.28	27.80	13.48	29.9626	....	......	.2707	.1619	76.3	28.3	S. 36°¼ W.	16.91	6.5	..	..	.345	1.31	5.8	1.97	Sums ....
19 Years means for and including this month......	32.43	38.90	26.53	12.39	30.0078	.....	......	.2623	.1558	79.35	...	......	....	7.37	..	..	¶.295	2.32	12.88	3.62	19 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..........	295	815	573	985	2361	4585	2454	110	
Duration in hrs..	17	52	57	81	138	241	128	6	
Mean velocity...	17.4	15.7	10.1	12.2	17.1	19.0	19 2	18.3	

Greatest mileage in one hour was 39 on the 29th.

Greatest velocity in gusts 48 miles per hour, on he 18t h.

Resultant mileage 6635.

Resultant direction, S. 36¼° W.

Total mileage, 12178.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 12 years only.

The greatest heat was 53.5 on the 2nd; and the greatest cold was 8.8 on the 26th, giving a range of temperature of 44.7 degrees. Warmest day was the 2nd. Coldest day was the 26th. Highest barometer reading was 30.615 on the 27th; lowest barometer was 29.407 on the 15th, giving a range of 1.208 inches. Maximum relative humidity was 95 on the 22nd, 28th 29th and 30th. Minimum relative humidity was 44 on the 7th.

Rain fell on 11 days.

Snow fell on 12 days.

Rain or snow fell on 18 days.

Snow and rain fell on 5 days.

Auroras were observed on 3 nights.

Luna halos on 19th and 26th.

Solar halos on 4th, 8th, 12th and 21st.

Rainbow 2nd.

Sharp earthquake shock at 11h. 47m. on the 27th, apparent direction N.E. to S.W.

ABSTRACT FOR THE MONTH OF DECEMBER, 1893.

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	22.67	35.2	18.0	17.2	29.8938	29.969	29.805	.164	.0935	75.8	16.3	W.	9.1	8.2	10	2	58	....	1.5	0.15	1
2	8.10	20.5	4.5	16.0	30.2697	30.396	30.062	.334	.0473	75.8	1.7	W.	12.5	2 0	10	0	94	....	....	....	2
SUNDAY....... 3	.....	14.3	6.5	7.8	....	......	......	....	.....	....	....	N.E.	19 5	....	....	..	00	....	9.5	0.95	3 ....SUNDAY
4	5.17	13.5	1.8	11.7	30.2343	30.478	29.954	.524	.0415	75.5	-0.8	W.	9.5	1 7	10	0	99	....	....	....	4
5	1.57	8.5	-6.2	14.7	30.3628	30.546	30.154	.392	.0398	86.0	-2.0	N.	10.0	10 0	10	10	00	....	....	....	5
6	17.67	27.4	6.5	20.9	30.1258	30.244	30.022	.222	.0852	85 2	13.8	S.W.	14 5	7.0	10	0	20	....	Inap	Inap	6
7	23.78	29.5	19.8	9.7	30.2298	30.315	30.148	.167	.1135	88.7	21.0	S.W.	14.4	3.8	10	0	17	....	0.4	0.04	7
8	17.72	22.2	12.8	9.4	30.3215	30.421	30.194	.227	.0868	89.2	15 2	S.W.	9 5	6.5	10	0	00	....	Inap	Inap	8
9	30.25	34.3	14.8	19.5	29.9968	30.280	29.702	.478	.1432	84.7	26 3	S.	15.5	9.5	10	7	00	....	Inap	Inap	9
SUNDAY........10	.....	38.5	21.2	17.3	....	......	......	....	.....	....	....	S.W.	26.8	....	....	..	08	0.18	1.0	0.26	10 ....SUNDAY
11	-0.68	27 5	-4.2	31.7	30.2027	30.334	29 923	.411	.0337	79.7	-5 8	W.	25.7	0 8	3	0	96	....	....	....	11
12	-2.25	1.8	-5.8	7.6	30.1695	30.385	29.979	.406	.0337	87.2	-5 5	N.E.	19.5	7.7	10	0	00	....	4.4	0.38	12
13	-9.33	-0.5	-13.2	12.7	30.6640	30.813	30.515	.298	.0238	86.0	-12.3	W.	17.0	2.2	8	0	52	....	....	....	13
14	-5.20	0.0	-13.8	13.8	30 7130	30.882	30.448	.434	.0298	87.8	-8.3	W.	10.3	6.3	10	0	32	....	....	....	14
15	5.42	13 0	-4.3	17.3	30.1830	30.317	29.995	.322	.0512	88.7	2.7	N.E.	15.5	10.0	10	10	00	....	3.7	0.37	15
16	15.58	24.5	11.0	13.5	29.4998	29.867	29.345	.522	.0808	90.2	13.2	N.	22.9	10.0	10	10	00	....	4.6	0.46	16
SUNDAY........17	.....	25.8	3.4	22.4	....	......	......	....	....	....	....	S.W.	20.6	....	....	..	24	....	0.8	0.08	17 ....SUNDAY
18	3 20	7.5	-3.2	10.7	29.8998	29.971	29.801	.170	.0440	86.3	0 5	S.W.	10.5	5.5	10	0	87	...	0.9	0.08	18
19	14.35	19.5	3.5	16.0	29.6568	29.774	29.550	.224	.0760	90.3	12 6	N.	11.5	10.0	10	10	00	....	4.1	0.34	19
20	1.27	19.0	-5.2	24.2	30.2370	30.357	30.009	.348	.0382	79.7	-3.8	W.	28.7	5.0	10	0	96	....	Inap	Inap	20
21	27.58	33.0	-0.2	33.2	29.9913	30 150	29.903	.247	.1275	83.7	23.3	S.W.	28.5	10 0	10	10	00	Inap	0.3	0.03	21
22	2.27	32.5	-2.7	35.2	30.4162	30.532	30.239	.293	.0418	80.5	-1.3	N.	18.2	5.2	10	0	95	....	0.1	0.01	22
23	23 78	36.9	1.3	35.6	29.9998	30.156	29.856	.300	.1302	92.7	22.0	S.W.	14.5	10.0	10	10	00	Inap	2.1	0.21	23
SUNDAY........24	.....	41.0	34.0	7.0	....	......	......	. ..	.....	....	....	S.W.	18.9	....	...	..	00	0.15	....	0.15	24 ....SUNDAY
25	25 75	37.8	18 8	19 0	29.8517	30.003	29.717	.286	.1367	94.5	24.3	N.	12.0	10.0	10	10	00	0.43	2.0	0.63	25
26	7.00	19.5	3.0	16.5	30.3315	30.432	30.109	.323	.0490	82.0	2.5	N.	14.7	0.0	0	0	97	....	....	....	26
27	18.45	30.2	4.6	25.6	29.9680	30.289	29.721	.568	.0953	90.2	16.3	W.	10.0	9.2	10	6	00	....	1.0	0.10	27
28	30 65	33.8	26.9	6.9	29.4863	29.688	29.357	.331	.1588	92 7	28.8	S.W	19.1	10.0	10	10	31	....	2.6	0.26	28
29	27.17	35.0	9.5	25.5	29.6302	30 049	29.474	.675	.1450	90 8	24.8	W.	14 8	8.8	10	4	17	....	0.2	0.01	29
30	-4.97	18.0	-9.8	27.8	30.2887	30.361	30.213	.148	.0312	90.7	-7.0	W.	18.6	1.8	10	0	95	....	Inap	Inap	30
SUNDAY........31	....	5.8	-4.7	10.5	....	......	......	....	...	....		W.	12.7	....	..	..	40	....	1.2	0.09	31 ....SUNDAY
....Means	11.81	22.76	4.79	17.97	30.1009	......	......	.339	.0761	86.2	8 4	S. 80° W.	16.3	6.6	..	..	.34	0.76	40.4	4.60	Sums ....
19 Years means for and including this month ...	18.57	25.75	11.34	14.41	30.0241	.....	......	.289	.0374	82.3	....	......	....	7.0	..	..	¶28.9	1.33	24.0	3.68	19 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............	1946	1313	173	127	945	4291	2907	433	
Duration in hrs..	136	69	23	12	58	209	193	38	6
Mean velocity...	14.3	19.0	7.5	10.6	16.3	20.5	14.1	11.4	

Greatest mileage in one hour was 45 on the 10th and 21st.

Greatest velocity in gusts 60 miles per hour, on the 10th.

Resultant mileage 5,131.
Resultant direction, S. 80° W.
Total mileage, 12,135.
Average velocity, 16.3 m. per hour.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 12 years only.

The greatest heat was 41.0 on the 24th; and the greatest cold was −13.8 on the 14th, giving a range of temperature of 54.8 degrees. Warmest day was the 28th. Coldest day was the 13th. Highest barometer reading was 30.882 on the 14th; lowest barometer was 29.345 on the 16th, giving a range of 1.537 inches. Maximum relative humidity was 100 on the 12th. Minimum relative humidity was 59 on the 1st.

Rain fell on 5 days.

Snow fell on 23 days.

Rain or snow fell on 24 days.

Lunar halos on one night.

Solar halos on two days.

ABSTRACT FOR THE MONTH OF JANUARY, 1894.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	7.80	10.8	1.8	9.0	30.3042	30.360	30.184	.176	.0543	87.7	4.8	W	19.5	2.7	10	0	95	....	0.2	0.02	1
2	13.40	17.0	5.6	11.4	30.0187	30.238	29.937	.301	.0720	89.3	11.0	W.	9.0	8.3	10	0	00	....	0.1	0.01	2
3	15.75	20.0	12.5	7.5	29.7918	29.951	29.685	.266	.0825	93.0	13.8	E.	8.6	5.0	10	0	27	....	Inap	Inap	3
4	31.02	41 2	12 0	29.2	29.6622	29.845	29.497	.348	.1645	91.5	28.7	S.W.	27 0	9.2	10	5	00	0.21	....	0.21	4
5	15.30	37.0	8.6	28.4	29.9827	30 070	29.913	.157	.0758	82.3	11.0	N.	25.2	10.0	10	10	00	....	1.8	0.18	5
6	9.90	14 3	6.2	8.1	30.1202	30.187	29.992	.195	.0603	89.2	7.3	N.	6.4	9.8	10	9	13	....	1.5	0.14	6
SUNDAY. 7	...	22.3	6.8	15.5	....	.....	......	....	.....	....	....	S.W.	17.3	....	....	.	45	....	1.2	0.12	7 ....SUNDAY
8	10.22	19.8	4.2	15.6	30.2088	30.354	29.943	.411	.0540	77.8	4.8	W.	19 9	3.7	10	0	60	....	Inap	Inap	8
9	4.57	12.7	− 6.1	18.8	30.3870	30.430	30.339	.091	.0453	84.0	0.8	W.	14.2	1.2	5	0	89	....	....	....	9
10	− 8.12	− 0.5	−12.7	12.2	30.2210	30.344	30.092	.252	.0268	91.0	−10.2	N.E.	13.1	4.3	10	0	32	....	....	....	10
11	16.05	31.2	− 5.9	37.1	20.6527	30.035	29 358	.677	.0902	84.7	12.3	S.E.	16.5	9.0	10	4	00	....	1.8	0.18	11
12	1.27	26 0	− 6.9	32.9	29.8512	30.095	29 56[illegible]	.534	.0385	78.8	− 3.8	W.	32.0	1.0	4	0	95	....	....	....	12
13	− 0.88	4 5	− 7 5	12.0	30.0992	30.184	29.947	.237	.0320	77.5	− 6.7	W.	16 7	1.8	10	0	100	....	....	....	13
SUNDAY 14	.....	12.7	− 4 0	16.9	....	......	......	....	.....	....	....	E.	8.3	....	....	..	99	....	....	....	14 ....SUNDAY
15	23.50	31.2	10 2	21.0	29 9827	30.087	29.916	.171	.1175	87.7	20.7	S.	9 5	10.0	10	10	00	0.20	....	0.20	15
16	21.97	30.2	9.0	21.2	30.2055	30.521	29.971	.550	.1083	88 2	19 2	N.	18.6	6 7	10	0	00	Inap	2.1	0 21	16
17	5.52	15.3	0 8	14.5	30.6518	30.710	30 551	.159	.0480	84.7	2.0	N.E.	17 7	0.7	2	0	95	...	....	....	17
18	25.25	35 7	2 0	33 7	30.2128	30.493	30.010	.483	.1330	89.8	22.7	S.	21.7	7.3	10	0	23	0.12	...	0.12	18
19	20.05	36 7	10.0	26.7	30.5860	30.762	30.272	.490	.0987	83 2	15 8	N.W.	13 3	0.3	2	0	97	Inap	....	Inap	19
20	13 43	34 0	0.3	33.7	30.5422	30.776	30.282	.494	.0748	84.5	9.8	E.	14 3	4.0	10	0	50	0.05	....	0.05	20
SUNDAY.......21	.....	37.5	21 3	16.2	....	.....	......	....	.....	..	....	S.E.	23 0	....	....	..	00	....	....	....	21 ....SUNDAY
22	25.85	37.3	6.5	30.8	30.0615	30.317	29.906	.411	.1227	81.5	21.0	S.W.	22 1	5.5	10	0	63	....	...	....	22
23	7.37	15.2	− 0.5	15.7	30.4457	30.508	30.391	.117	.0515	83 7	3.2	N.E	7.4	3.7	8	0	71	....	..	....	23
24	24.25	40.2	5.5	34.7	29.9037	30.384	29.542	.842	.1235	87.8	20.7	S.E.	23.2	9.8	10	9	00	0.32	0.1	0.33	24
25	4.68	39.8	0 3	39.5	30.4080	30.634	30.088	.546	.0403	7[illegible].7	1.7	S.W.	25.3	0.2	1	0	96	....	....		25
26	1 07	5 5	− 6.2	11.7	30.5650	30.705	30.382	323	.0393	[illegible].2	− 2 0	N.E.	10.1	8 5	10	3	16	....	0.1	0.01	26
27	10 23	15.2	3.0	12.2	30.1682	30.337	30.084	.253	.0620	88 8	7.5	N.	9 0	6.3	10	0	73	....	0.9	0.09	27
SUNDAY 28	....	20.2	10.4	9 8	....	......	......	....	.....	....	....	S.W.	11.8	....	...	..	79	....	0.1	0.01	28 ....SUNDAY
29	14 72	21.2	5.8	15.4	30.1190	30.349	29.730	.619	.0802	92.0	13.0	N.	12.2	8.3	10	0	00	....	0.8	0.08	29
30	20.90	25.2	18.0	7.2	29.415[illegible]	29 563	29.273	.290	.0930	84.2	16.8	N.E.	39.5	8.3	10	0	00	....	8.5	0.85	30
31	15.78	21.2	8 3	12.9	29.8640	30.054	29.66[illegible]	.394	.0797	88.5	13.2	W.	26.2	1.7	10	0	88	....	....	....	31
....Means	12.99	23.57	3.85	19.72	30.12[illegible]	....	.....	.362	.0766	85.6	9 60	S. 78¼° W.	17.2	5.45	..	..	45	0.90	19.2	2.81	Sums ....
20 Years means for and including this month ...	11.78	20.33	3.80	16.52	30.0569	.....	.....	.333	.0722	81.1	....	.....	....	6.4	..	..	¶33.0	0.83	28.4	3.61	20 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	1563	2128	505	1111	1481	2092	3540	413	
Duration in hrs .	97	118	63	64	103	98	166	28	7
Mean velocity...	16.1	18.0	8.0	17.4	14.4	21.3	21 3	14.7	

Greatest mileage in one hour was 69 on the 30th.
Greatest velocity in gusts 84 miles per hour, on the 30th.
Resultant mileage 2,592.

Resultant direction, S. 78¼° W.
Total mileage, 12,833.
Thunder storm on 4th.
Lightning on 24th.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only

The greatest heat was 41.2 on the 4th; and the greatest cold was − 12.7 on the 10th, giving a range of temperature of [illegible] degrees. Warmest day was the 4th. Coldest day was the 10th. Highest barometer reading was 30.776 on the 20th; lowest barometer was 29.273 on the 30th, giving a range of 1.503 inches. Maximum relative humidity was 100 on the 15th, 18th and 24th. Minimum relative humidity was 49 on the 1st.

Rain fell on 7 days.

Snow fell on 15 days.

Rain or snow fell on 20 days.

Auroras were observed on 3 nights.

Hoar frost on 1 day.

Solar halos on 10th, 20th, 24th, 26th and 27th.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1894.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	R and snow melted.	DAY.
1	9.42	12.8	5.5	7.3	30.0028	30.102	29.933	.169	.0557	83.8	5.3	S.W.	12.0	2.8	10	0	24	....	..	....	1
2	10.13	17.7	2.7	15.0	30.0598	30.202	29.864	.338	.0602	85 3	6.7	S.	18.2	6.3	10	0	45	. ..	Inap	Inap	2
3	25.12	30.5	16.0	14.5	29.6858	29.770	29.644	.126	.1152	83.8	21.3	S.	17.9	7.7	10	0	00	....	0.1	0.01	3
SUNDAY 4	.....	27.5	− 0.7	28.2	......	......	......	....	.....	....	....	N.	17.7	....	....	..	45	....	....	....	4 .. ..SUNDAY
5	− 0.83	3.8	− 8.5	12.3	30.3557	30.371	30.314	.057	.0353	84 3	− 4.8	N.	12.8	2.0	10	0	94	....	....	....	5
6	12.85	19 5	0.3	19.2	30.1720	30 333	39.017	.316	.0628	77.2	7.2	S.	17.6	3.2	10	0	88	....	....	....	6
7	26.37	32.3	18.0	14.3	29.8748	30.007	29.804	.203	.1187	82.0	21.7	S.E.	19.2	6.2	10	0	18	....	....	....	7
8	33.75	38.3	28.0	10.3	29.8832	30.107	29.719	.388	.1655	85.2	29.7	W.	14.9	5.5	10	0	51	....	2.2	0.22	8
9	21.60	29.1	14.3	14.8	30.0432	30.187	29.884	.303	.1015	90.0	19.2	N.	19.0	10.0	10	10	01	....	0.3	0.03	9
10	33.57	38.0	26.3	11.7	29.6710	29.806	29.603	.203	.1692	88.5	30.3	S.	22.3	9.8	10	9	00	....	2.3	0.23	10
SUNDAY........11	.....	24.5	9.0	15.5	....	......	......	....	....	....	....	S.W.	27.2	....	....	..	08	....	1.0	0.10	11 ....SUNDAY
12	2.60	8.4	− 3.2	11.6	30.3543	30.500	30.144	.356	.0385	78.0	− 2.3	N.	19 3	5.0	10	0	60	....	....	....	12
13	0.03	5 8	− 5.6	11.4	30.2802	30.393	30 130	.263	.0373	86 5	− 3 3	N.E.	27.6	3.8	10	0	76	....	....	.	13
14	− 1.18	6.0	− 9 7	15.7	30.3110	30.464	30.120	.344	.0373	93.2	− 3.7	N.E.	4.8	5.7	10	0	04	...	0.2	0.02	14
15	9.87	18.3	2.1	16.2	29 6707	30.004	29.462	.542	.0620	89.3	7.5	N.W.	15 8	9.8	10	9	00	....	2.7	0.27	15
16	− 0.82	13.1	− 8.2	21.3	30.0835	30.436	29.678	.758	.0348	81 5	− 5 5	W.	28.3	1.8	10	0	94	....	....	....	16
17	4.47	25.0	− 9.5	34.5	30.2053	30.491	29 889	.602	.0515	87.3	1.7	S.E.	14 8	6.7	10	0	30	....	....	....	17
SUNDAY........18	.....	38 7	25 2	13 5	....	......	......	....	.....	..	....	S.W.	29 4	....	....	..	03	0.12	0.1	0.13	18 ....SUNDAY
19	30.42	38.0	21.0	17.0	29.9252	30.103	29.809	.294	.1283	74.7	23.3	S.W.	13.2	6.5	10	0	64	....	....	....	19
20	15.55	31 0	10.0	21.0	30.0598	30.128	29.920	.208	.0612	68.2	7.0	S.W.	20.5	4.7	10	0	83	....	....	....	20
21	12.15	17.6	8 0	9.6	30.1023	30.150	30.063	.087	.0610	80.2	7.5	S.W.	15.6	4.8	10	0	51	....	0.2	0.02	21
22	15.85	23.8	6.2	17.6	30.0118	30.184	29.825	.359	.0690	76.7	9.8	S.W.	10.8	8.7	10	6	39	....	....		22
23	0.17	21.8	−14.1	35.9	30.2045	30.539	29 883	.654	.0395	79.3	− 5 0	S.W.	28.3	3 0	10	0	93	....	....	....	23
24	−12.58	− 8.0	−19.5	11.5	30.7555	30.833	30.631	.202	.0197	83.5	−16.3	S.W.	21.9	0.0	0	0	94	....	....	....	24
SUNDAY 25	....	8.5	−13 1	21.6	....	......	......	....	.....	....	....	S.	12.1	....	...	..	66	....	....	....	25 ....SUNDAY
26	8.25	17 8	− 2.5	20.3	30.2867	30.359	30.222	.137	.0505	76.8	3.0	N.	8.0	2.5	8	0	94	....	....	...	26
27	16.47	24.2	8.0	16.2	30.3265	30.393	30.242	.151	.0697	74.8	9.7	S.	10.2	5.0	10	0	89	....	. ..	....	27
28	30.62	34.5	20.0	14.5	30.1545	30.234	30.111	.123	.1325	77.2	24.3	S.	16.5	10 0	10	10	00	....	Inap	Inap	28
..	....	....	....	....	....	......	......	....	.....	....	....	......	...	...	...	..	..	....	....	....	..
..	.....	....	....	....	....	......	......	....	.....	....	....	......	....	.	...	..	..	....	....	....	..
..	.....	....	....	....	....	......	......	....	.....	....	....	......	....	..	....	..	..	....	....	....	..
....Means	12.65	21.38	4.50	16.88	30.1033	.....	......	.299	0740	81.8	8.1	S. 49¾° W.	17.8	5.5	..	..	47	0.12	9.1	1.03	Sums ....
20 Years means for and including this month ...	15 43	23.81	6.78	17.03	30.0483	.....	......	.321	.0818	78.9	....	......	....	6.0	..	..	¶41.3	0.82	22.4	2.97	20 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles............	1407	1070	172	980	2080	3927	1594	719	
Duration in hrs .	99	59	14	58	130	178	87	39	8
Mean velocity...	14.2	18.1	12 3	16.9	16.0	22.1	18.3	18.4	

Greatest mileage in one hour was 44 on the 13th. Greatest velocity in gusts 54 miles per hour, on the 13th.

Resultant mileage 4,374. Resultant direction, S. 49¾° W. Total mileage, 11,949.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only.

The greatest heat was 38.7 on the 18th; and the greatest cold was − 19.5 on the 24th, giving a range of temperature of 58.2 degrees. Warmest day was the 8th. Coldest day was the 24th. Highest barometer reading was 30.833 on the 24th; lowest barometer was 29.462 on the 15th, giving a range of 1.371 inches. Maximum relative humidity was 99 on the 10th. Minimum relative humidity was 42 on the 2nd.

Rain fell on 1 day.

Snow fell on 11 days

Rain or snow fell on 11 days.

Auroras were observed on 2 nights.

Hoar frost on 6 days.

Lunar halos on 13th, 15th, 18th and 19th.

Solar halos on 4th, 7th, 12th, 13th, 17th and 21st.

Lightning on 7th.

ABSTRACT FOR THE MONTH OF MARCH, 1894.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	35.03	40.2	27.0	13.2	30.0417	30.147	29.925	.222	.1465	71.7	26.8	S.	12.3	3.5	10	0	90	....	....	....	1
2	37.20	40.8	35.0	5.8	29.9053	30.016	29 843	.173	.1933	87 0	33.7	S.W.	21.1	10.0	10	10	00	0.04	...	0.04	2
3	32.37	38.5	29.0	9.5	30.2850	30.356	30.161	.195	.1392	76.0	25.5	S.W.	19.6	1.8	10	0	79	....	....	....	3
SUNDAY 4	.....	41.4	28.7	12.7	......	......	......	....	.....	....	....	S.	19.1	....	....	..	60	....	....	....	4 .. ..SUNDAY
5	42.20	47.2	36.6	10.6	.30.1540	30.218	30.096	.122	.1713	63 3	30.7	S.	19.5	5.5	10	0	93	Inap	....	Inap	5
6	46.07	52 3	40.1	12.2	29.9537	30.098	29.819	.279	.2082	66.5	35.3	S.	18.1	6.7	10	0	61	....	....	....	6
7	36.63	47.7	29.3	18.4	29.9453	30.094	29.742	.352	.1845	82.0	31.8	W.	21.9	4.7	10	0	54	0.32	....	0.32	7
8	28.43	31.8	25.7	6.1	30.1200	30.187	30.075	.112	.1235	78.8	22.8	N.	5.9	6 0	10	0	26	....	....	....	8
9	28.72	33.8	21.4	12.4	30.1408	30.230	30.063	.167	.1315	82.8	24.2	N.E.	7.6	5.0	10	0	44	....	....	....	9
10	36.68	43.0	28.2	14.8	30.1293	30.199	30.010	.189	.1735	79.2	30.8	S.	11.4	2.8	10	0	95	....	....		10
SUNDAY 11	.....	48.3	36.0	12.3	....	......	......	....	.....	....	....	S.W.	28.8	....	....	..	36	0.05	....	0.05	11 ....SUNDAY
12	34.95	39.0	32.3	6.7	29.9355	29.971	29 837	.084	.1265	62.7	23.5	S.W.	17.8	5.5	10	0	47	....	....	....	12
13	34.47	41.5	26.2	15.3	29.6840	29.935	29.403	.532	.1482	73 7	26.8	S.E.	14.4	9.0	10	5	14	0.24	....	0.24	13
14	30.85	39.5	24 5	15.0	29.6692	30.058	29.396	.662	.1493	83.3	26.5	W.	21.0	8.3	10	1	00	0 02	2.5	0.27	14
15	24.37	29.0	16.5	12.5	30.0168	30.181	29.719	.462	.0937	71.0	16.7	W.	10.1	5.7	10	0	29	...	Inap	Inap	15
16	33.73	38.2	26.4	12.0	29.7053	29.917	29.594	.323	.1538	79.3	28.0	S.	18 5	9.7	10	9	00	0 05	0.3	0.08	16
17	33.30	36.8	28.0	8.8	30.1870	30.220	30 111	.109	.1225	64.5	22.7	N.W.	11 8	4 0	10	0	94	....	....	....	17
SUNDAY........18	.....	38 3	31 5	6.8	....	......	......	....	.....		....	S.E.	13.1	....	....	..	00	0.26	....	0.26	18 ....SUNDAY
19	42.18	57.0	32.6	24.4	29.7480	30.154	29.402	.752	.2182	77.2	35.5	S.	27 6	5.8	10	0	27	0.12	....	0.12	19
20	31.95	37.8	26.8	11.0	30.3553	30.419	30.287	.132	.1093	60 8	20.3	N.	12.4	4.2	9	0	95	....	....	....	20
21	33.22	38.5	29.0	9.5	29.9710	30.292	29.733	.559	.1662	86.3	29.7	N.	11.2	10.0	10	10	00	0.28	....	0.28	21
22	31.82	34.7	29.5	5.2	30 0858	30.153	30.001	.152	.1275	70.3	23.3	N.	17.5	8 2	10	1	00	....	Inap	Inap	22
23	31.77	37.4	26.5	10.9	29.6553	29.939	29.465	.474	.1588	88.2	28.5	W.	22.5	8 5	10	1	00	....	4.3	0.43	23
24	28.58	37.5	19.7	17.8	29.9910	30.138	29.734	.404	.1163	71.8	20.7	W.	13.5	4.7	10	0	71	....	....	....	24
SUNDAY 25	....	37.5	23 9	13.6	....	......	......	....	.....	....	....	S.W.	17.5	....	...	..	35	....	Inap	Inap	25 ....SUNDAY
26	16.85	24 6	1..5	13.1	29.9478	30.062	20.905	.157	.0658	69.5	9.0	W.	21.4	4.5	10	0	93	....	....	...	26
27	12.43	18.0	5.0	13.0	30.2112	30.290	30.166	.124	.0492	64.2	2.8	W.	20.7	1.7	8	0	95	....	....	....	27
28	22.22	29.8	12.0	17.8	30.3242	30.388	30.253	.135	.0937	76.2	16.2	S.W.	16.3	4 3	9	0	78	....	Inap	Inap	28
..	29.47	34.5	23.3	11.2	29.9642	30 210	29 821	.389	.1330	80.8	24.3	W.	11.7	5.0	10	0	29	....	0.2	0.02	..
..	30 47	35.8	25 8	10 0	29.9265	30.025	29.871	.154	.1107	64.8	20.5	W.	15 4	5.3	9	0	72	....	....	...	..
..	27.00	39.0	19.2	19.8	29.7745	30 016	29.506	.510	.1260	80.8	22.0	N.E.	13.0	10.0	10	10	09	0.07	0.1	0.08	..
....Means	31.59	38.37	26.03	12.34	29.9939	....	......	.293	1385	74.5	24.4	S. 49½° W.	16.5	5.9	..	..	45.8	1.45	7.4	2.19	Sums ....
20 Years means for and including this month......	24 39	31.71	16.99	14.72	29.9706	.....	......	.262	.1087	75 5	....	......	....	6 0	..	..	¶46.3	0.96	23.7	3.32	20 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles............	821	490	479	886	2815	2834	3108	878	
Duration in hrs..	72	39	41	65	165	143	165	48	6
Mean velocity...	11.4	12 6	11.7	13.6	17.1	19.8	18.8	18.3	

Greatest mileage in one hour was 47 on the 19th.
Greatest velocity in gusts 60 miles per hour, on the 19th.

Resultant mileage 5,630.
Resultant direction, S. 49½° W.
Total mileage, 12,311.

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

The greatest heat was 57.0 on the 19th; the greatest cold was 5.0 on the 27th, giving a range of temperature of 52.0 degrees. Warmest day was the 6th. Coldest day was the 27th. Highest barometer reading was 30.419 on the 20th; lowest barometer was 29.396 on the 15th, giving a range of 1.023 inches. Maximum relative humidity was 98 on the 21st and 23rd. Minimum relative humidity was 46 on the 20th.

Rain fell on 11 days.
Snow fell on 9 days.
Rain or snow fell on 17 days.
Auroras were observed on 2 nights.
Hoar frost on 5 days.
Lunar halos on 1 night.
Solar halos on 5 days.
Thunder without Lightning on 7th.

Meteorological Abstract for the Year 1893.

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

C. H. McLEOD, *Superintendent.*

Month.	Thermometer. Mean.	¶ Deviation from 19 years means.	Max.	Min.	Mean daily range.	* Barometer. Mean.	Max.	Min.	Mean daily range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Mean dew point.	Wind. Resultant direction.	Mean velocity in miles per hour	Sky clouded per cent.	Percent. 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	4.08	− 7.64	41.7	− 16.4	12.81	29.9449	30.627	28.943	.220	.0475	81.3	0.1	S. 77° W.	14.8	57.	34.0	0.10	1	22.4	16	2.49	1	16	January
February	12.99	− 2.58	40.8	− 12.7	15.50	30.0611	30.866	29.296	365	.0690	80.8	0.9	S 71° W.	18 9	61.	40.0	0.42	4	21.1	12	2.81	2	14	February
March	25.25	+ 1 22	42 9	− 0.3	14 52	30 0136	30 633	29.441	.263	.1150	77.5	19.4	S. 46° W.	19.6	54.	41.0	1.28	5	6.1	9	1.97	0	14	March
April	36.80	− 2.88	60.8	11.9	15.96	30.0005	30.580	29 204	.274	.1494	67.8	26.5	S. 43° W.	18.1	62.	42.2	1.32	12	8.4	4	2.18	2	14	April
May	53.87	− 0.47	84.8	34.9	17.43	29.8364	30.261	29.245	.212	.2856	69.7	43.0	S. 65° W.	16.6	68.	41.6	3.36	19	....	..	3.36	..	19	May
June	68.01	+ 3.26	86 5	53.2	17.90	29.9597	30.187	29.612	.131	.5109	74.5	59.2	S. 40° W.	11.2	59.	50.0	4.99	14	...	..	4.99	..	14	June
July	67.69	− 1.14	87.1	52.0	17.66	29.8624	30.136	29.530	.154	.4884	72.6	57.9	S. 70° W.	12 7	61.	58.0	4.59	16	....	..	4.59	..	16	July
August	67.85	+ 0.89	90.0	48.0	16.38	29.9175	30.169	29.124	.166	.5113	75.5	59.1	S. 89½° W.	11.4	52.	55.9	7.37	15	...	..	7.37	..	15	August
September	54 83	− 3.63	76.5	38.5	15.74	29.9730	30.334	29.415	.189	.3345	77.4	47.5	S. 60½° W.	12.3	54.	49.0	2.40	12	....	..	2.40	.	12	September
October	50.29	+ 4.89	72.0	25.0	16.59	30.0576	30 602	29.016	.228	.2933	76.8	42 5	S. 43° W.	14.9	50.	48.9	2.18	13	0.0	1	2.18	1	13	October
November	35.21	+ 2.78	53.5	8.8	13.48	29 9626	30.615	29.407	.271	.1619	76.3	28.3	S. 36½° W.	16.9	65.	34.5	1.31	11	5.8	12	1.97	5	18	November
December	11.81	− 6.76	41.0	− 13.8	17.97	30.1009	30.882	29.345	.339	.0761	86.2	8.4	S. 80° W.	16.3	66.	34.0	0.76	5	40.4	23	4.60	4	24	December
Sums for 1893	...	...	....	....	....	...	....	....	....	....	.	....	S. 60¾° W.	....	....	....	30.14	127.	104 2	77	40.91	15	189	Sums for 1893
Means for 1893	40.72	− 1.01	....	....	15.99	29.9744	....	....	.234	.2536	76.4	33.3	...	15 31	59.1	44.1	....	....	....	....	3.41	..	16	Means for 1893
Means for 19 years ending Dec. 31, 1893.	41.73	....	....	....	...	29.9871	....	....	....	.2500	74.4	....	....	* 15.21	61 3	§ 45.7	28.18	133	122.6	82	40.14	16	200	Means for 19 years ending Dec. 31, 1893.

* Barometer readings reduced to 32° Fah. and to sea level. † Inches of mercury. ‡ Saturation 100. § For twelve years only. * For seven years only. ¶ "+" indicates that the temperature has been *higher*: "—" that it has been *lower* than the average for 19 years inclusive of 1893. The monthly means are derived from readings taken every 4th hour, beginning with 3 h. 0 m. Eastern Standard time. The anemometer and wind vane are on the summit of Mount Royal 57 feet above the ground and 810 feet above the sea level.

The greatest heat was 90.0 on August 11: the greatest cold was 16.4 below zero on January 11, and 16.3 below zero on January 12. The extreme range of temperature was therefore 106.4. Greatest range of the thermometer in one day was 40.3 on February 6; least range was 4 1 on April 15. The warmest day was August 11, when the mean temperature was 78.57. The coldest day was January 11, when the mean temperature was 12.63 below zero. The highest barometer reading was 30.882 on December 14. Lowest barometer reading was 28.943 on January 2, giving a range of 1.939 for the year. The lowest relative humidity was 23 on May 12. The greatest mileage of wind recorded in one hour was 62 on January 29, and the greatest velocity in gusts was at the rate of 72 m. p. h. on January 29. The total mileage of wind was 134,972. The resultant direction of the wind for the year was S. 60¾° W., and the resultant mileage was 49,438. Auroras were observed on 28 nights. Fogs on 5 days, Thunder storms on 23 days. Lightning without thunder, on 5 days. Lunar halos on 16 nights. Lunar coronas on 5 nights. Solar Halos on 10 days The first snowfall of the autumn was on October 29. The first sleighing of the winter was on December 3. On November 27, at 11 h. 47 m., there was a very sharp earthquake shock, its apparent direction was N. E. to S. W.

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