THE CANADIAN

RECORD OF SCIENCE

INCLUDING THE PROCEEDINGS OF

THE NATURAL HISTORY SOCIETY OF MONTREAL,

AND REPLACING

THE CANADIAN NATURALIST.

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THE

CANADIAN RECORD

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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 abeut 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-

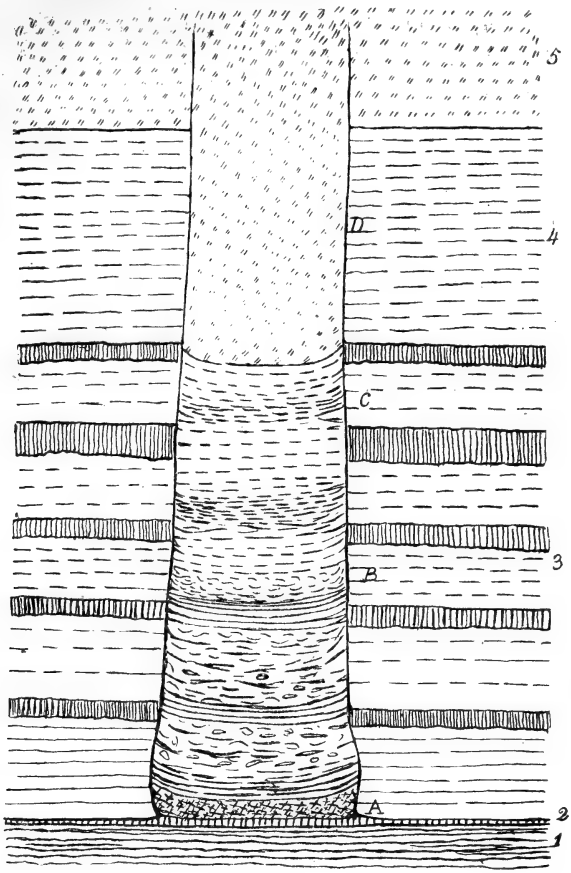


FIG. 1.—Section of tree No. 1, Division 4, Section XII., Coal-group 26, of South Joggins section; as observed *in situ* by Mr. P. W. McNaughton. (Scale 2 feet to an inch.)

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 lurnishes 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 special ist 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 (Schrib.), 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 *Lescuræa* 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 wâs 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 consists 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, 1880, 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 characterised 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 noted 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 was 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. AMI.

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.	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.
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	59.58	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	29.920	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 ....SUNDAY
30	30.17	43.7	28.0	15.7	30.3340	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	13.3	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 2840.

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 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	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	30.117	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.

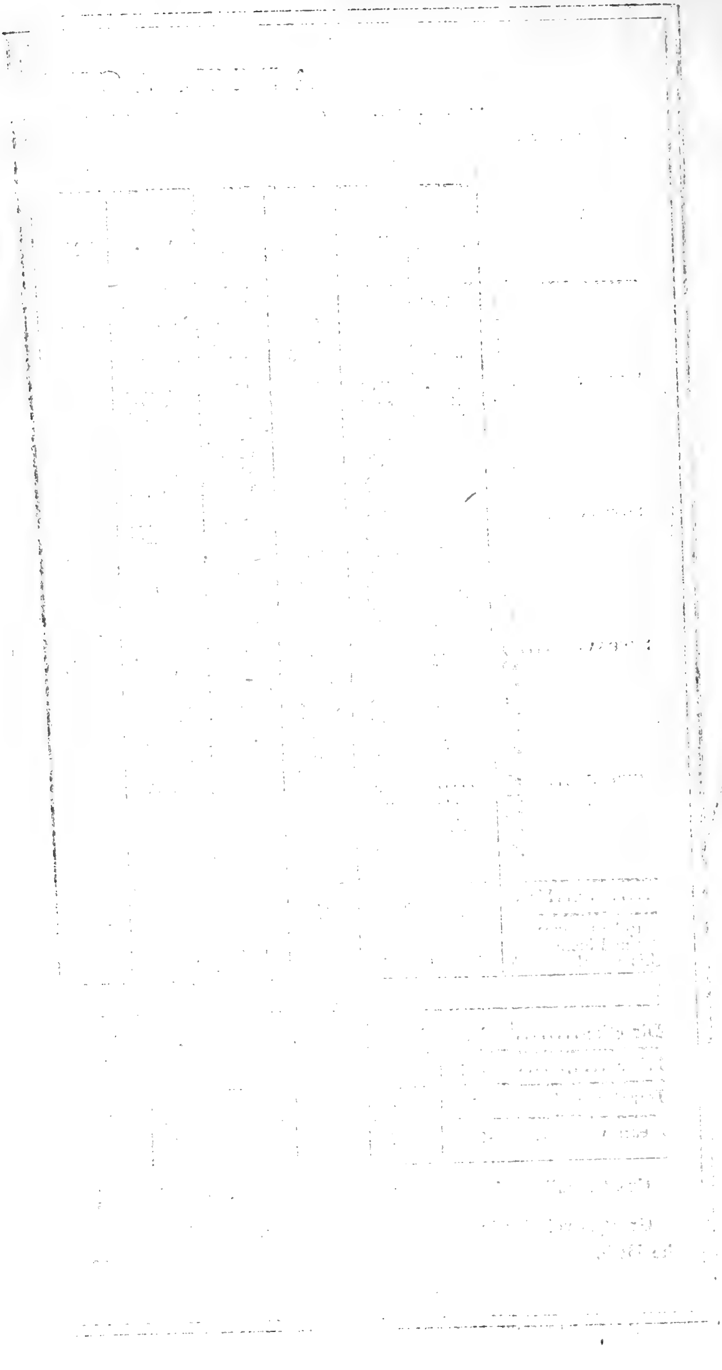
Auroras were observed on 3 nights.

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.				BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	Max.	Min.	Range.				General direction.	Mean velocity in miles perhour	Mean.	Max.	Min.					
1	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	86.5	— 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	29.6527	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	29.561	.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	16.7	......	......	......	....	.....	....	....	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	13.48	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	73.7	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	86.2	− 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	29.4152	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	29.660	.394	.0797	88.5	13.2	W.	26.2	1.7	10	0	88	....	....	....	31
.... Means	12.99	23.57	3.85	19.72	30.1271	....	.....	.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 53.9 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.				BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	R and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	Max.	Min.	Range.				General direction.	Mean velocity in miles perhour	Mean.	Max.	Min.					
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.	16.8	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 4,354.
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.	BARAROMETER. 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.	R in 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	29.9930	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	11.5	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 4h 54m 18s.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.	Per cent. possible bright sunshine	Inches of rain.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.	Month.
January	4.08	— 7.64	41.7	— 16.4	12.81	29.9449	30.637	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	29.9750	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	.223	.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 49.458. 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.

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AND REPLACING

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THE

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VOL. VI. APRIL, 1894. NO. 2.

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.).

(*Concluded.*)

This hypothesis is supported by a large number of facts; in what follows, will be given a *résumé* of the more important of these.

1. As far as the principal minerals are concerned, the composition of pegmatite veins corresponds, with great uniformity, and frequently over long distances, to that of the allied eruptive rock of the magma of which the veins are generally the final ejections. With certain special isolated exceptions, their composition is quite independent of the nature of their wall-rock.

As examples, we may again cite the norite pegmatites occurring in the norite and labradorite rocks of the large norite-labradorite district of the south-west part of Norway; the augite syenite pegmatites of the region round Fredriksvärn, corresponding to the augite syenites; the nepheline syenite pegmatites of the boundary zone along the Langesundfjord, corresponding to the nepheline syenite rocks of the neighborhood, and quite uninfluenced by the fact of whether they occur in rocks poor or rich in nepheline, *i. e.* whether they occur in laurvikite or in nepheline syenite; the akmite granite pegmatite of Rundemyr, Eker, in Silurian limestones and slates, corresponding to the adjacent äegerine granite of Kyrfjeld, etc.; the granite pegmatites of Hitterö in labradorite rock and norite, corresponding to the granitite of the neighboring main-land, etc. From the occurrence of certain mineral species, such as albite, some authorities have wished to deduce certain conclusions with regard to the origin of pegmatite veins in general.[1] Although at the present time it ought to be superfluous to reply to such propositions made many years ago, similar views are still put forward from time to time and render a reference to them necessary. Among the first to describe the microperthitic intergrowth of orthoclase and albite, or microcline and albite, from the above-mentioned locality, was Credner, and he quite correctly considered it to be a primary intergrowth; as far as this phenomenon is concerned, it also occurs very plentifully in the syenite and nepheline syenite veins which have been discussed in this treatise ("Die Mineralien der Syenitpegmatitgänge"); it occurs, however, developed in an exactly corresponding manner, very commonly, indeed predominatingly, in the normal-grained trachytoidal foyaïtes of Laugenthal which are true eruptive veins, and even in the same combination, microcline-albite, as in the pegmatite veins of the Langesundfjord, etc. Albite also occurs independently in the same rocks, though not widely distributed, in the form of individual crystals developed tabularly parallel to the brachypinacoid. In view of these facts, all

[1] See H. Credner, l. c. p. 179: "Albite forms for the association of minerals of which it is a member a 'guide' for aqueous formation. Now as albite is most intimately intergrown with the principal component of our pegmitite and granite veins, with orthoclase,—as the one, so the other of these two feldspars must have originated, and also the quartz which penetrates them both in the graphic granite structure;" see also F. Klockmann, l. c. p. 406.

theories which hold the presence ot albite as proof of aqueous origin must fall to the ground. [1]

It has been sufficiently dwelt upon above that all the minerals of the pegmatite veins (even all the albite) have not necessarily been formed by crystallization from a magma.

2. In their geological occurrence the pegmatite views are similar to other eruptive veins; they traverse all sorts of rocks, contain fragments of the same, etc. Examples of the first statement have already been cited, the presence of foreign fragments in pegmatite veins is so common that it is quite unnecessary to cite special cases. It can hardly be superfluous, however, to state explicitly that both in acid granite pegmatite veins (several of the veins in the neighborhood of Arendal) and in nepheline syenite pegmatite veins (southern point of Stokö) I have observed foreign fragments of the wall-rock exhibiting an arrangement relative to one another such as is possible only in the case of a rock formed from an eruptive magma.

The extremely intimate relations of pegmatite veins to veins formed in a different manner but of corresponding composition and of undoubted eruptive origin are also of weight in this connection; the gradual passage of the nepheline syenitic pegmatite veins of the boundary zone on the Langesundfjord into the normal-grained nepheline syenite veinstones of the same locality has been amply described above; in the case of ordinary acid granitic pegmatite veins this phenomenon is well known, and has been frequently and deservedly referred to by prominent petrographers. [2] The same thing is also true of granite types

[1] See further : Alfred Gerhard, "Beitrag zur Kenntniss d. sogen. Soda-granite," Neues Jahrb. f. Min. 1887, **2**, 267-275 ; he found as principal component of the vein-form granite of Ulfserud, Sweden, an almost pure albite, with microcline, quartz, biotite and muscovite, zircon, apatite. Significantly this granite rich in albite was a vein granite !

[2] Michel-Lévy (Struct. et class. d. roches érupt. p. 15) remarks, for instance, "notre structure pegmatoïde (pegmatite graphique à grands éléments) dont nous affirmons la liaison intime tant avec les granulites massives qu' avec les granu lites en filons (aplites)," &c. See also the excellent and instructive remarks of J. Lehmann, l. c. p. 26 : "It is not admissible to separate the half pegmatitic, half granular vein formations and the smaller veins of purely granular structure from

which differ from these in composition; in a special part of this Treatise, under akmite, the relationship between the fine-grained apophyses of the aegerine granite district and the akmite pegmatite vein of Rundemyr, is pointed out.

To every one who has occupied himself with a thorough study of the methods of formation of pegmatitic veins and has had opportunity of investigating in the case of hundreds and hundreds of veins of all varieties of occurrence, their close approximation to the normal eruptive vein type and their very various transitions to and connections with the same, these purely geognostic peculiarities of occurrence will perhaps be considered as the strongest proof of the undoubted eruptive origin of the veins.

3. The varieties of structure of pegmatite rocks are of kinds which in part at least are known only in eruptive rocks. In the case of acid granitic pegmatite veins there is very often a purely eugranitic granular structure with coarse grain (*e. g.* in the granitite of numberless pegmatite veins near Stockholm); in the nepheline syenite pegmatite veins, as has been mentioned above, a coarse-grained typical trachytoidal structure, corresponding to the foyaïtes of the Laugenthal (*e. g.* Laven), is frequently observed. The drusy structure of many pegmatite veins, particularly of granitic ones, is not (as considered *e. g.* by Klockmann l. c. p. 407) an argument against the eruptive nature of pegmatite, but is frequently very characteristically developed as large laccolites in the boundary zones of granitic rocks themselves (*e. g.* Hörtekollen, Solbergfjeld, near Drammen, Norway, Holmsboe and Rödtangen on the Drammenfjord, etc.). The peculiarity of structure most convincing in its nature, which must be considered virtually as proof of the eruptive formation and magmatic solidification of pegmatite veins in general, is the centric structure (spheroidal structure) first described by L. v Buch, afterwards by G. Rose, and re-

the more massive granites recognized as eruptive. An unprejudiced observer will not wish to make such a separation," &c. J. H. L. Vogt (Kristiania Vid. Selsk. Forhandl. 1881, No. 9. p. 28), describes, occurring at Skarningsfos, a granite pegmatite apophysis in gneiss, &c., passing directly into the main granitite.

cently by Klockmann, in the granitic pegmatite veins of Kynast, of Schwarzbach, etc., in Silesia (l. c. p. 399); Klockmann himself, although otherwise agreeing with Credner, has pointed out quite correctly that this structure can hardly be brought into accord with Credner's theory. In this connection it also deserves mention that Mr. H. Bäckström and I have found perfectly pegmatitic large-grained feldspar individuals forming the cores of spheres occurring in centrically-formed massive granitite at Vasastaden near Stockholm.[1]

A further argument in favor of the magmatic solidification of the pegmatite veins consists in the peculiarities of structure which point towards a simultaneous crystallization. First, the graphic structure which was more particularly referred to above, and which also occurs in a similar way in massive eruptive rocks, must be mentioned. Further also, must be considered the incomplete formation of the pegmatite vein minerals which is generally evident when these minerals have not crystallized out into drusy cavities originally open (sometimes still so); this fact also was more fully treated above. Such incomplete idiomorphically-bounded crystals exhibit through their whole nature unequivocally, that they have crystallized out from a surrounding magma.

As a peculiar detail of structure, which is also satisfactorily explained only upon the assumption of magmatic solidification, may be mentioned the very frequent occurrence of bent, broken, and in part re-cemented crystals; examples have been described above in many places.

As special structural forms, may be mentioned the sometimes exceptionally distinct fluid structures (Fluidalstructuren) of the nepheline syenite pegmatite veins on the Langesundfjord.

In assuming an eruptive origin for pegmatitic veins, some have found great difficulty in the fact of the occasional

[1] See W. C. Brögger and H. Bäckström: "Om förekomsten af 'klotgranit', i Vasastaden, Stockholm." Geol. Fören. Förhandl. 1887, **9**, 331 and 332, also Fig. 6, p. 325.

banded or zone-form arrangement of the vein material. This however is never laminated, as in the case of mineral veins deposited from genuine aqueous solution, [1] but only indistinctly zonal inasmuch as the outer zones pass continuously into the inner. [2] The zonal structure, when any such is present, which however is generally not the case, usually makes itself evident only in a finer-grained condition of the vein boundaries, and sometimes (especially in the case of granitic pegmatite veins) in a zone with graphic structure next the fine-grained eugranitic marginal zone, upon which there frequently follows (especially in acid granitic pegmatite veins) in the middle of the vein a tremendous size of grain, here often with special enrichment in rarer minerals and (also particularly in acid veins) not seldom with open or distinctly drusy cavities filled with peculiar mineral deposits.

Thus, this "zonal," band-form, etc., structure, as it occurs in genuine pegmatitic veins, may without any great difficulty be accounted for through magmatic crystallization. [3] Finer grained structure along the sides of the veins is in general characteristic of eruptive veins, the graphic structure is explainable only through magmatic crystallization, and the drusy structure of the middle of the vein, which however is frequently wanting, [4] may be explained as quite in accordance with the formation of miarolytic drusy cavities in normal grained eugranitic rocks. Moreover, it must again be remarked, that the minerals which have crystallized out in the drusy cavities have in part frequently had a different mode of formation to those of the

[1] Compare also G. Vom Rath, l. c. p. 649. "It reminds one of the almost symmetrical grouping of the minerals of certain ore veins. Nevertheless the two phenomena are quite distinct."

[2] I must distinctly remark, that I here leave out of the question a part of the "granitic" veins described by H. Credner in his treatise; in this treatise certain mineral deposits belonging to 'regional metamorphism' are evidently treated from the same point of view as true pegmatitic vein formations. To enter here more into detail would lead too far.

[3] Compare also J. Lehmann, Granulitgebirge, &c., p. 46. "A zonal structure of our granitic veins has in it nothing exceptional and speaks neither for nor against formation by injection."

[4] In the veins of the Anneröd Peninsula this is very rare.

main vein mass; and further, in the case of the formation of pegmatite veins, as compared with that of the corresponding normal-grained massive rocks, peculiar conditions of formation, the coöperation of particular "agents minéralisateurs," have in a high degree made themselves felt along with direct separation through simple cooling of the magmatic solution.

As far as the unusual coarse-grainedness which frequently occurs in pegmatitic veins of the most various compositions is concerned, this must in some may be connected with what was recognized some time ago, [1] *i.e.* that the pegmatitic veins generally (though not always) may be looked upon as end products of the series of eruptions with with which they are connected; both when they occur in the main mass of the allied eruptive rock, and when they occur in the neighborhood—and one of the two is always the case—we may assume that the rock surrounding the veinstone was first heated to a high temperature and that therefore the cooling must have taken place unusually slowly and uniformly; and upon this fact primarily the largeness of the grains may be explained. [2]

That this explanation of the coarse grain and of the imperfect zonal structure of many pegmatite veins is correct, is rendered probable in the highest degree by the frequent occurrence of pegmatitic structure in those portions of rock bordering on the open drusy cavities of many massive granites. I interpret these as analogous to the formation of the pegmatitic veins themselves, in the following way: First, on account of the contraction due to crystallization of the rock already for the most part solidified, there were formed crystal-free *lumina*; [3] the mixture of magma and

[1] See C. F. Naumann's Lehrb. d. Geogn. 2, 230.

[2] In the pegmatite veins at Kure, south of Moss, I have seen feldspar individuals measuring more than 10m. in length.

[3] That these ("miarolitische Drusenräume") are so plentiful in acidic rocks, while they are almost always wanting in basic rocks, may perhaps be connected, with the difference in specific gravity between the glass and the holocrystalline aggregates of the respective rocks. In the case of acidic rocks this difference is very great, in the case of basic rocks often very small; in the first case therefore the contraction during the cooling of the magma would be greater, and in the latter less.

crystals so formed, which must have constituted a somewhat solid rock, was however completely permeated by the magma (which on account of the crystallization already taken place would frequently have become somewhat more acidic), and with this these crystal-free spaces would naturally have been filled. By continued cooling this magma, beginning at the walls, also crystallized out slowly and uninterruptedly, often mixed with minerals which had been formed by special "agents minéralisateurs"; the conditions of such crystallization proceeding from the walls of the *lumina* inwards, must have been somewhat different from those of the former crystallization which took place within the mass of the whole solidifying rock-matter, where the separate individuals must have crowded upon one another, etc.; hence the ever increasing size of grain, the zonal structure (conditioned by the crystallization from the walls inward), etc. If the magmatic silicate solution were not concentrated to such an extent that the *lumina* were completely filled by its crystallization, first, open drusy cavities must have resulted, which finally through continued circulation might be filled in with minerals deposited from solutions at first still hot but later less and less hot (*c. f.* the description of the separate phases of vein formation of the veins of the boundary zone on the Langesundfjord, "Die Mineralien der Syenitpegmatitgänge.") The filling up of the drusy cavities corresponds according to this interpretation pretty exactly to the complete vein formation of the pegmatitic veins which occur outside the normal-grained rock mass; the explanation throws light in both cases upon the continuous transition from the rock formed purely by magmatic solidification to the final minerals of the druses deposited from solutions not exactly magmatic (less concentrated).[1]

This successive filling up of the drusy cavities under conditions of formation changing little by little, which in a

[1] The difference between the explanation given above and that of Rosenbusch and others is not so very great, and is, essentially, that I consider the principal filling of the drusy cavities as also the pegmatitic veins to be magmatic, which it will be difficult to deny in face of the totality of the observations given above.

corresponding way must also be assumed in the case of the formation of the minerals in the pegmatite veins themselves, is naturally also important for the correct understanding of many veins not truly pegmatitic, but clearly very closely connected with these. Between crack-fillings, principally magmatic, of a pegmatitic character, and those corresponding only to the later stages of mineral deposit in the pegmatitic druses and veins (e.g. in the class of acid granitic pegmatite veins, as final member, the quartz veins,) all possible gradations are known, as has been correctly emphasized by earlier authors (particularly by Lehmann); it must, however, always be borne in mind, that these crack-fillings, although genetically in part related, are however in no sense pegmatitic veins. Pegmatites form only one stage in the series of vein equivalents of a massive plutonic rock; granitite, granophyre, aplite, pegmatite, are different stages in the magmatic vein formations of the plutonic rocks, the pegmatites as a rule still in the main magmatically solidified veins, therefore formed under somewhat altered conditions, and even passing into the crack-fillings which succeed them in point of time and which are not in the main, or are not at all, deposited from true magmatic solutions.[1] Although in what has been said above, the coarse-grained structure, as usual, has been very strongly emphasized, it must be remembered that this alone does not condition the pegmatitic nature of the veins, nor is even necessarily present in order to justify the

[1] That many large-grained veins of a pegmatitic structure have been formed principally by pneumatolitic processes, and not mainly by magmatic solidification, has already been stated above many times; such are the apatite bearing basic veins, also many occurrences of cassiterite, of tourmaline and topas, &c. That also the muscovite granite pegmatite veins, containing especially beryl, topas, etc., and having as principal minerals microcline, oligoclase, albite, quartz, muscovite, are, in comparison with the ordinary granite pegmatite veins with which they frequently occur and which among fine-grained veins correspond to the genuine aplites rich in muscovite, perhaps of a somewhat later formation than these which are of a slightly different magma and to a larger extent of pneumatolitic formation, is for many reasons probable; this would also explain very well why they occur along the eruptive boundary of genuine granitite or within the granitite along with genuine granitite pegmatite veins, although massive rocks of corresponding composition are generally wanting in the neighbourhood. To enter into details would lead too far.

appellation "pegmatitic." In the boundary zone on the Langesundfjord are many veins, truly pegmatitic, which are less coarse-grained than the surrounding laurvikite, e. g. the hiortdahlite-bearing vein of Langodden, Ober-Arö. It is the habitus as a whole which determines this: the relatively irregular nature of mineral composition and structure in the different parts of the vein, the foreign appearance of the veinstone caused by the wealth in accessory pneumatolitic minerals, the intimate intergrowth with the wall rock, etc. The very indefiniteness of these limitations, which must always adhere to the definition of the pegmatite idea, is itself characteristic and gives a completely correct expression of the actual condition of things, that altogether between pegmatitic and not pegmatitic rock formation in nature often no sharp line can be drawn and indeed is not present.

Structure is, as Lossen [1] has so aptly said "of the first rank as an exponent of the geological relationships of rocks;" that the structural peculiarities of the pegmatite veins are in the main such as we otherwise find in the case of undoubtedly eruptive rocks only, is therefore one of the strongest evidences of their eruptive origin as veins formed principally through magmatic solidification.

4. In connection with the structural peculiarities, stand the age relations of the individual vein minerals, which may be comprehended under the common conception "order of crystallization" (Krystallisationsfolge).

One of the principal results of the study of eruptive rocks in the light of the newer petrography is that, within certain limits, a regularity in the order of crystallization of the minerals of these rocks can be observed ; researches by Rosenbusch, Michel-Lévy, Iddings and numerous other investigators have determined pretty certainly the leading features of this regularity in the order of crystallization for a large number of rock-types. The sequence is dependent

[1] K. A. Lossen : "Uber die Anforderungen der Geologie an die petrographische Systematik," Jahrb. d. kgl. preuss. geol. Landesanstalt f. d. J. 1883, Berlin, 1884, p. 512.

upon the composition, temperature and pressure prevailing during the time of cooling of the magma, as well as upon the alterations in these conditions, and finally upon the action of special "agents minéralisateurs." As the crystallization intervals of the different minerals separating out from the magma frequently overlap for considerable distances, the order, as every mineralogist knows, is not an absolute one, but only determined within certain limits; it is only right to mention here also that the order of crystallization has been determined mainly with regard to the principal minerals and in a less degree for a number of accessory minerals produced by special processes, although for many of the latter the period of formation is pretty sharply defined.

For the nepheline syenite pegmatite veins of the boundary zone of the Langesundfjord it was evidenced above, that the order of crystallization over large areas is, within certain limits, a definite one, and the same as in the corresponding boundary rock of the Laugenthal which is undoubtedly eruptive. Similarly, for example, for the genuine granitite pegmatite veins (with black biotite) the crystallization order is in all probability a definite one and corresponds to that of the massive granitite.

This circumstance is also one of the strongest arguments for the eruptive genesis of the genuine pegmatitic veins; it can as little be accidental for the latter as for the rocks which have certainly crystallized out from a magma, and must in both cases be explained in similar ways.

Check-list of European and North American Mosses (Bryineæ).

By N. Conr. Kindberg, Ph. D.

(*Concluded.*)

Series I. **PLEUROCARPOUS.**

Tribe 2. DIPLOLEPIDEOUS.

Endostome with longitudinal line.

51. *Heterophyllum* (Schimp.), C. M.

nemorosum (Koch), Kindb.

52. *Calliergon* (Sull.), Kindb.

cordifolium (H.)
**Richardsoni* (Mitt.)
giganteum (Schimp.)
sarmentosum (Wahlenb.)
badium (C. J. Hartm.)
cuspidatum (L.)
scorpioides (L.)
trifarium (Web. et Mohr).
stramineum (Dicks.)
**nivale* (Lorentz).—Europe.
dilatatum (Wils.)
circulifolium, C. M. et Kindb.—America.
turgescens (Th. Jensen).
alpestre (Swartz).
arcticum (Sommerf.)
Goulardi (Schimp.)
torrentis, C. M. et Kindb.—America.
columbico-palustre, C. M. et Kindb.—America.

53. *Plagiothecium*, Schimp.

undulatum (L.), Br. eur.
neckeroideum, Schimp.—Europe.
denticulatum (L.), Br. eur.
**subfalcatum*, Aust.—America.
silvaticum (L.), Br. eur.
Boscii (Hampe), Schimp.
**aciculari-pungens*, C. M. et Kindb.—America.
latum (Berggr.), Schimp.
**attenuatirameum*, Kindb.—America.
brevipungens, Kindb.—America.
piliferum (Sw.), Br. eur.
latebricola (Wils.), Br. eur.
decursivifolium, Kindb.—America.

54. *Tsopterygium*, Mitt.

silesiacum (Schiz.), Kindb.
turfaceum, Lindb.
**pseudo-silesiacum* (Schimp.)—America.
elegans (Hook.), Lindb.
nitidulum (Wahlenb.), Lindb.
**Muelleri* (Schimp.)
pulchellum (H.), Kinbd.
Bottinii, Breidl.—Europe.
pseudo-latebricola, Kindb.—America.
subadnatum, C. M. et Kindb.—America.
passaicense (Austin.), Kindb.—America.
albulm C. M.), Kindb.—America.
geminum (Mitt.), Kindb.—America.
fulvum (Hook. et Wils.), Kindb.—America.

55. *Ptychodium*, Schimp.

plicatum (Schleich.), Schimp.—Europe.
hyperboreum, C. M.—Europe.

56. *Campylium* (Sull.), Mitten.

stellatum (Schreb.), Kindb.
protensum (Brid.), Kindb.
polygamum (Br. eur.), Kindb.
striatellum (Brid.), Kindb.
Fitzgeraldi (Renauld), Kindb.—America.
elodes (Spruce), Kindb.—Europe.
**densum* (Milde).—Europe.
subsecundum, Kindb.—America.
chrysophyllum (Brid.)—Kindb.
unicostatum, C. M. et Kindb.—America.
decursivulum, C. M. et Kindb.—America.

hygrophilum (Jar.), Kindb.—Europe.
bergenense (Aust.), Kindb.—America.
Duriæi (Mont.), Kindb. — Europe.

57. *Myurium*, Schimp.

Boscii (Schwagr.), Kindb.—America.
Hebridarum, Schimp.—Europe.

58. *Campothecium*, Schimp.

nitens (Schreb.), Schimp.
sericeum (L.), Kindb.
Geheebii (Schimp.), Kindb.—Europe.
sericeoides, C. M. et Kindb.—America.
Philippeanum (Spruce), Kindb.—Europe.
nevadense (Lesq.), Kindb.—Am-
Amesiæ, Ren. et Card.—America.
alsioides, Kindb.—America.
lutescens (Huds.), Schimp.
**æneum* (Mitt.)—America.
aureum (Lagasca), Br. eur.
pinnatifidum (Sull. et Lesq.)—Kindb.—America.
arenarium, Lesq.—America.
Nuttallii (Wils.), Schimp.—America.
hamatidens, Kindb.—America.
leucodontoides, Kindb.—America.
aureolum, Kindb.

59. *Brachythecium*, Schimp.

a. Eurhynchiopsis.

piliferum (Schreb.), Kindb.
Ryani, Kaur.—Europe.
Vaucheri (Schimp.), Kindb.
**fagineum* (H. Muell.)—Europe.
cirrhosum (Schw.), Schimp.
crassinervium (Tayl.), Kindb.—Europe.
colyrophyllum (Sull.), Kindb.—America.

b. Rutabularia.

rivulare, Bruch.
**flavescens* (Brid.), Kindb.—Europe.
**latifolium*, Lindb.
Rutabulum (L.), Br. eur.
rutabuliforme, Kindb.—America
spurio-rutabulum, C. M. et Kindb.—America,
**columbico-rutabulum*, Kindb.—America.
platycladum, C. M. et Kindb.—America.
cavernosum, Kindb.—America.
asperrimum, Mitt.—America.
vallium (Sull. et Lesq.), Kindb.—America.
lamprochryseum, C. M. et Kindb.—America.

c. Plumosaria.

plumosum (Sw.), Br. eur.
gemmascens, C. M. et Kindb.—America.
campestre, Bruch.
leucoglaucum, C. M. et Kindb.—America.
mirabundum, C. M. et Kindb.—Ameriea.

d. Salebrosaria.

Mildei (Schimp.), Kindb.
acuminatum (H.), Kindb.—America.
spurio-acuminatum, C. M. et Kindb.—America.
pseudo-albicans, Kindb.—America.
biventrosum, C. M.—America.
Fitzgeraldi, C. M.—America.
mammilligerum, Kindb.—America.
albicans (Neck.), Br. eur.
glareosum, Bruch.
turgidum, C. Harton.
digastrum, C. M. et Kindb.—America.
salebrosum (Hoffm.), Br. eur.
lætum (Brid.), Kindb.—America.
lævisetum, Kindb.—America.
luteolum, Kindb.—Europe.

e. Velutinaria.

velutinum (L.), Br. eur.
intricatum (H.), Kindb.
**salicinum*, Br. eur.—Europe.
subintricatum, Kindb.—America.
trachypodium (Brid.), Br. eur.
curvisetum (Brid.), Kindb.
Teesdalei (Sm.), Kindb.—Europe.
venustum, De Not.—Europe.
californicum (Lesq.), Kindb.—America.
tenellum (Dicks.), Kindb.—Europe.

Donnellii (Aust.) Kindb.—America.
Fendleri (Sull. et Lesq.), Kindb. —America.
Hillebrandi (Lesq.), Sull.—America.

f. Camptotheciopsis.

oxycladon (Brid.), Kindb.—America.

60. *Raphidostegium.*

Lorentzii (Mol.), Kindb. — Europe.
Roellii, Ren. et Card.—America.
recurvens (Mich.), Sauerb. et Jag.—America.
laxepatulum (Jarn.), Kindb.—America.
cylindricarpum, C. M.—America.
expallens, C. M. et Kindb.—America.
demissum (Wils.), De Not.
Kegelianum, C. M.
microcarpum (Brid.), Sb. et Jæg. —America.
**admixtum* (Sulliv.)—America.
subdemissum, Kindb.—America.
carolinianum, C. M.—America,
Welwitschii (Schimp.), Kindb.—Europe.
marylandicum, C. M.

61. *Limnobium*, Schimp.

ochraceum (Turn. et Wils.), Br. eur.
eugyrium, Schimp.
polare (Lindb.), Kindb.
palustre (L.), Schimp.
pseudo-arcticum, Kindb.—America.
viridulum (Harton), Kindb.
montanum, (Wils.), Kindb.
pseudo-montanum, Kindb.—America.
micans (Wils.), Kindb.
submolle, Kindb.—Europe.

62. *Hypnum* (Dillen.), L.

a. Alaria.

commutatum, Hedw.
**sulcatum*, Schimp.—Europe.
falcatum, Brid.
**irrigatum*, Zetteryt.—Europe.
decipiens (De Not.), Kindb.

b. Cratoneuron.

filicinum, L.
**curvicaule*, Jur.—Europe.
**Vallis Clausæ*, Brid.—Europe.
**fallax*, Brid.
fluviatile, Swartz.
**irriguum*, Hook. et Wilf.

c. Harpidium.

revolvens, Swartz.
**Cossoni*, Schimp.
**vernicosum*, Lindb.
**rigidum*, Kindb.—Europe.
Bambergeri, Schimp.
lycopodioides, Schwægr.
aduncum (L.), Hedw.—Europe.
Wilsoni, Schimp.
riparium, L.
**capillifolium*, Warnst.
**Kochii*, Br. eur.
vacillans (Sulliv.), Lesq. et Jam.
fluitans, L.
exannulatum, Br. eur.
**pseudo-stramineum*, C. M.
Kneiffi, Schimp.
**Sendtneri*, Schimp.
conflatum, C. M. et Kindb.—America.
hamifolium, Schimp.
uncinatum, Hedw.
**Moseri*, Kindb.

d. Rhytidium.

rugosum, Ehrh.

e. Drepanium.

curvifolium, Hedw.—America.
**Renauldi*, Kindb.
**Lindbergii*, Mitt.
**pseudo-drepanium*, C. M. et Kindb.—America.
arcuatiforme, Kindb.—America.

f. Ptilium.

crista-castrensis, L.
subimponens, Lesq.—America.

g. Hylocomium.

squarrosum, L.
loreum, L.
robustum, Hook.—America.

h. Cupressina.

Haldanianum, Grev.
flaccum, C. M. et Kindb.—America.

Jamesii (Sull.), Lesq. et J.—America.
pseudo-recurvans, Kindb.—America.
pseudo-complexum, Kindb.—America.
circinnale, Hook.
Sequoieti, C. M.—America.
callichroum, Brid.
Alaska, Kindb.—America.
Dieckii, Ren. et Card.—America.
fertile, Sendtner.
imponens, Hedwig.
canadense, Kindb.—America.
plicatile (Mitt.), Lesq. et Jam.
reptile, Michaux.
micro-reptile. Kindb.
pseudo-fastigiatum, C. M. et Kindb.
perichætiale, Br. eur.
reptiliforme, Kindb.—America.
molluscum, Hedw.
molluscoides, Kindb.—America.
procerrimum, Mol.—Enrope.
hamulosum, Br. eur.
fastigiatum, Brid.
**dolomiticum*, Milde.—Europe.
**Sauteri*, Br. eur.—Europe.
filiforme, Kindb.—America.
dovrense, Kindb.—Europe.
Halleri, L. fil.
cupressiforme, L.
**Waghornei*, Kindb.—America.
resupinatam, Wils.—Europe.
Vaucheri, Lesq.
complexum (Mitt.), Lesq. et J.—America.
subcomplexum, Kindb.—America.
depressulum, C. M.—America.
incurvatum, Schrad.

Fam. 11. FONTINALACEÆ.

63. *Fontinalis*, L.

disticha, Hook. et Wils.—America.
filiformis, Sull. et Lesq.—America.
Sullivantii, Lindb.—America.
Lescurii, Sull.—America.
squamosa, L.—Europe.
dalecarlica, Bruch et Sch.
dichelymoides, Lindb.
seriata, Lindb.—Europe.
maritima, C. M.—America.
Novæ-Angliæ, Sull.—America.
hypnoides, C. J. Harton.
antipyretica, L.
**gracilis*, Lindb.—Europe.
**californica*, Sull.—America.
**Duriæi*, Schimp.
**Kindbergii*, Ren. et Card.
**gigantea*, Sull.—America.
Heldreichii, C. M.—Europe.
gothica, Card. et Arnell.—Europe.
mollis, C. M.—Ameriea.
biformis, Sull.—America.
neomexicana, Sull. et Lesq.—America.

64. *Dichelyma*, Myrin.

falcatum (H.), Myr.
pallescens, Br. eur.—America.
uncinatum, Mitt.—America.
cylindricarpum, Aust.—America.
capillaceum (Dicks.), Br. et Sch.

65. *Brachelyma*, Schimp.

subulatum (P. B.), Schimp.—America.

INDEX OF THE GENERA.

CONTRIBUTIONS TO CANADIAN BOTANY.

By JAS. M. MACOUN.

II.

THALICTRUM FENDLERI, Engelm.

Kicking Horse Lake, Rocky Mts. 1890. (*Jas. M. Macoun.*) Only Canadian station.

THALICTRUM OCCIDENTALE, Gray.

The western limit of this species is placed by Prof. Macoun (Cat. Can. Plants, p. 479) in the Selkirk Mts., B.C. Recent collections and a re-examination of our specimens have greatly extended its range.[1] Mountains near Kootanie Lake, B.C.; Sproat, B.C.; Mountains near Griffin Lake, B.C.; Nanaimo, Vancouver Island. (*John Macoun.*) Mountains near Spence's Bridge, B.C. (*Jas. M. Macoun.*) Dean or Salmon River, B.C. (*Dr. G. M. Dawson.*)

THALICTRUM POLYGAMUM, Muhl.

T. Cornuti, Linn.

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

This species is confined to Eastern Canada and does not extend across the continent as stated in Macoun's Cat. Can. Plants, p. 15. Our most western specimens are from Flat Rock Portage, Lake Nipigon, Ont.

THALICTRUM PURPURASCENS, Linn.

Long Lake, Assiniboia; Warm Springs, Kootanie Lake, B.C. (*John Macoun.*) Not before recorded west of Ontario. References under var. *ceriferum,* Macoun's Cat. Can. Plants, p. 479 go here.

THALICTRUM VENULOSUM, Trelease.

Additional stations for this rare species are Manitoba House, Lake Manitoba; Kicking Horse Lake, Rocky Mts. (*John Macoun*).

THALICTRUM DIOICUM × PURPURASCENS.

Specimens from Eel River, Restigouche, N.B., (*R. Chalmers.*) with leaves glandular and fruit intermediate have been referred here by Dr. Trelease.

Note—All the specimens of *Thalictrum* referred to above have been examined by Dr. Wm. Trelease and our determinations confirmed or corrected by him.

ANEMONE DELTOIDEA, Dougl.

Specimens collected in the Coast Range by Dr. G. M. Dawson, were referred here by Prof. Macoun, (Cat. Can. Plants p. 13.) A recent examination of these specimens shews them to be *A. Richardsoni.* *A. deltoidea* has not been found in Canada.

ANEMONE HEPATICA, L.

A few leaves collected by Dr. Robt. Bell on the Upper Savage Islands, Hudson Straits, (Macoun, Cat. Can. Plants, p. 478), prove to be the root-leaves of *Saxifraga cernua* and not *A. Hepatica.*

ANEMONE LYALLII, Britton, Annals of N. Y. Academy of Sciences, Vol. VI. p. 227.

A. nemorosa, Linn., var. (?), Macoun, Cat. Can, Plants, Vol. I, p. 478.

A. Oregana, Macoun, Cat. Can. Plants, Vol. II, p. 295.

Slender, erect, nearly glabrous throughout, 10-40 cm. high, from a short horizontal root-stock. Radical leaves not seen: leaves of the involucre on very slender petioles 1.5-3 cm. long., 3-divided, the divisions sessile, ovate, or the terminal ones sometimes nearly orbicular, dentate-crenate, or sometimes incised, acute, or obtuse, very thin, more or less ciliate along the margins; flowers solitary white, about 1 cm. broad, its peduncle slightly exceeding the petiols of the involucral leaves, sepals about 5, oval-oblong, obtuse; young achenia quite densely strigose-pubescent.

Dean or Salmon River, B.C., (*Dawson*). Near Victoria, V.I., (*Fletcher*), Goldstream, V.I., and Burnside Road near Victoria. V.I., (*Macoun.* Herb. Nos. 912, 913).[1]

ANEMONE QUINQUEFOLIA, L.

A. nemorosa, Amer. Authors.

" Readily distinguishable from the European *A. nemorosa* by its slender habit, slender petioles, less lobed divisions of the involucral leaves, paler green of the foliage and smaller flowers." (Dr. N. L. Britton.)

The western limit of this species as shown by our herbarium specimens is Wingham, Ont.

Note. See Revision of the genus *Anemone* by Dr. N. L. Britton in Annals of the New York Academy of Sciences, Vol. VI. pp. 215-238.

AQUILEGIA CHRYSANTHA, Gray.

On the portage between Hope and the head of the Similkemeen River, B.C., (*A. J. Hill.*), New to Canada.

ARABIS MACOUNII, Watson, Proc. Am. Acad. of Arts and Sciences, p. 124.

Biennial, branched from the base, slender, pubescent

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

below with mostly stellate spreading hairs, glabrous above or but sparingly puberulent, a foot high; leaves small and narrow, ½ inch long or less, the lower very rarely few-toothed, the cauline sagittate at base; flowers very small, pale rose-colour, 2 lines long; pods very narrow, 1 to 1½ inches long and about ½ line broad, glabrous, slightly curved, mostly divaricate on very slender pedicels 2 to 4 lines long, acute, the stigma nearly sessile; seeds (immature) approximately 1 rowed, apparently wingless; near *A. hirsuta.*

Gravelly banks, Revelstoke, B.C., May 13th, 1890. (*John Macoun.*)

TRIFOLIUM PROCUMBENS, Linn.

An erect form of this plant was found by Prof. Macoun in 1893, growing in fields at Comox, Vancouver Island. Not recorded before from western Canada, though the var. *minus* is common on Vancouver Island.

TRIFOLIUM INVOLUCRATUM, Willd.

Collected at Revelstoke, B.C. in 1890 by Prof. Macoun. Abundant on Vancouver Island, but not before collected in the interior of British Columbia.

TRIFOLIUM MICROCEPHALUM, Pursh.

Collected at Revelstoke and Sproat on the Columbia River, B.C. in 1890 by Prof. Macoun. Common on Vancouver Island, but not before recorded from interior of British Columbia.

LOTUS CORNICULATUS, Linn.

Recorded from New Brunswick. Collected in 1890 at Victoria, Vancouver Island, by Rev. Edw. L. Greene.

ASTRALAGUS ROBBINSII, Gr. var. OCCIDENTALIS, Wat.

Not before separated in Canada from *A. alpinus*, the western form of which it somewhat resembles. Bow River at Morley, Alberta; near the Glacier at Lake Louise, Rocky Mts.; Deer Park, Columbia River, B.C. (*John Macoun.*) Guichon Creek, B.C. (*Dr. G. M. Dawson.*) All the above specimens were found growing on gravelly shores or banks.

FRAGARIA CANADENSIS, Michx.

This plant has been separated from *F. Virginiana* by Dr. N. L. Britton. (Bull. Torr. Bot. Club, Vol. XIX., p. 222.) At the time Dr. Britton's note was written our herbarium contained no specimens of this species. In 1892, however, it was collected by Miss E. Taylor at Fort Smith, on the Great Slave River, and in 1893 by Mr. Jas. W. Tyrrell on the banks of the Black River, east of Lake Athabasca. "The leaflets are much narrower, oblong or the middle one obovate and cuneate at the base, all obtuse rather sparingly and not deeply toothed." In Miss Taylor's specimens the largest leaflet is 20 lines long and but 7 lines broad at its widest part. The plants here referred to are very much slenderer than any of our specimens of *F. Virginiana*. The stations given for this species by Dr. Britton are Lake Mistassini, (*Michaux.*) Arctic America. (*Dr. Richardson.*) Elk River [Athabasca River] (*Kennicott.*)

EPILOBIUM, Linn.

In the last addendum to his catalogue of Canadian Plants (Vol. II., p. 323), Prof. Macoun wrote: "Many additional species and varieties of *Epilobium* have been added to our flora since the publication of Part III, but our whole series of this genus is now being examined by Prof. Trelease who is unable to report upon them in time to include them in this part." Since the above was written botanical explorations in the Rocky Mountains, British Columbia, and elsewhere have added greatly to our knowledge of this genus, and the revision here given covers all the specimens in our herbarium and gives the distribution of each species as we now understand it. All our specimens have been examined by Dr. Wm. Trelease, and references to many of them have been included in his revision of this genus. (See Second Annual Report, Missouri Botanic Gardens, pp. 69-116.)

(1.) E. SPICATUM, Lam.

Common from the Atlantic to the Pacific and north to the Arctic Circle. The most northern specimens in our herbarium are from the mouth of the Mackenzie River (*Miss E. Taylor.*) and from Lat. 60° 20, Long. 104° 30. (*Jas. W. Tyrrell.*)

Var. CANESCENS, Wood.

"An albino variety with more than usually canescent pods." Marmora Village, Hastings Co. and Owen Sound, Ont. (*John Macoun.*) Lake of the Woods, Ont. (*Burgess; Dawson.*) Norway House, Lake Winnipeg. (*Otto Klotz.*)

(2.) E. LATIFOLIUM, L.

Newfoundland, Labrador and the Gaspé Peninsula; Bow River, Rocky Mts., to the Pacific Coast and throughout Canada north of Lat. 53°. Most of the northern specimens in our herbarium are the broad-petaled variety *grandiflorum*, Britton. Specimens collected by Mr. Jas. W. Tyrrell in Lat. 64° Long. 101° were just coming into flower Aug. 25th, 1893. Albinos with very large cream-coloured flowers have been collected on both sides of Hudson Bay by Mr. Jas. M. Macoun.

(3.) E. HIRSUTUM, L.

Naturalized at Niagara Falls, Ont. (*R. Cameron.*) Introduced in garden seed.

(4.) E. LUTEUM, Pursh.

Abundant by rivulets and on damp grassy slopes in the Selkirk Mts., B.C., between Beaver Creek and the Glacier House, but not known to occur elsewhere in Canada. The petals are bright yellow a little lighter than those of *Œnothera biennis*.

(5.) E. PANICULATUM, Nutt.

Abundant at Colpoy's Bay, Georgian Bay, Lake Huron. (*John Macoun.*), but not found in any other part of Eastern Canada. Rare in the prairie region, but common in British Columbia and on Vancouver Island.

(6.) E. MINUTUM, Lindl.

From several localities in British Columbia and common on Vancouver Island. The form named *adscendens* by Suksdorf, was collected on Mt. Benson, Van. Island, by Prof. Macoun in 1893.

Var. FOLIOSUM, Torr. & Gray.

Sproat, Columbia River, B.C., (*John Macoun*) and Yale Mt., B.C., (*Fletcher.*) Common on Vancouver Island.

(7.) E. STRICTUM, Muhl.

E. molle, Torr. of Macoun Cat. of Canadian Plants, p. 171 in part and p. 530.

Specimens in our herbarium are from East Pt., P.E.I., and Belleville, Ont. (*John Macoun*); Cartwright, Ont. (*W. Scott.*)

(8.) E. LINEARE, Muhl.

Common from Prince Edward Island west to Beaver Creek, Selkirk Mts., B.C.

(9.) E. PALUSTRE, L.

Common from the Atlantic to the Rocky Mts. No specimens in our herbarium from British Columbia, but found north of that province by Dr. G. M. Dawson on the Lewis River in Lat. 62°.

(10.) E. PALUSTRE × LINEARE. (*E. pseudolineare*, Hausskn.)

Specimens collected by Prof. Macoun at Ellis Bay, Anticosti, have been referred here by Dr. Trelease.

(11.) E. DAVURICUM, Fisch.

" Habit of *E. palustre;* stems terete or with occasional low decurrent lines; seeds fusiform, prominently beaked."

A span or two high mostly simple, the very slender stem sparingly incurved-pubescent, otherwise glabrous; roots densely fascicled; leaves less than 15 mm. long, somewhat crowded at base, alternate and remote above, linear or oblong, obtuse, remotely denticulate, sessile 1-nerved; flowers pale not very numerous, nodding; capsules erect

40 mm., or long slender peduncles; seeds, ·4 × 1·5 mm.; coma white.

In bogs, Beaver Creek, Selkirk Mts., B.C., Aug. 14th, 1885. (*John Macoun.*) In one of these specimens "the beak of the seed is very narrow and 3 mm. long."

(12.) E. FRANCISCANUM, Barbey.

Of many of our specimens examined by Dr. Trelease, but one collected at Qualicum, Vancouver Island, has been definitely referred to this species. Of other specimens examined by him he says: "Specimens collected on Vancouver Island and in British Columbia are doubtfully referred here, though they may belong to *adenocaulon.* The smaller, more closely crisp-hairy form approaches the next species. [*E. Watsoni.*] A curious simple plant with large glossy thin leaves, scarcely to be referred elsewhere occurs from Queen Charlotte Islands, B.C. (*Dawson*, July 10th, 1878.)"

Specimens collected by Prof. Macoun on Vancouver Island in 1893 are placed here, though "too near *E. adenocaulon var. occidentale.*" The specimens now referred to this species were formerly included under *E. coloratum.*

(13.) E. COLORATUM, Muhl.

Represented in our herbarium by but one specimen from Casselman, Ont. All the eastern specimens placed under *E. coloratum*, and most of the western placed under *E. coloratum* and *E. tetragonum* in Prof. Macoun's Catalogue of Canadian Plants, (pp. 169-170) have been referred to *E. adenocaulon* by Dr. Trelease.

Specimens from Salt Lake, Anticosti; Little Flat, Rock Portage, Nipigon River, Ont., and Little Slave Lake, N.W.T., are probably *coloratum* × *adenocaulon.*

(14.) E. ADENOCAULON, Hausskn.

Common from the Atlantic to British Columbia. Dr. Trelease considers that a very small crisp-pubescent form (1½ to 3 inches in height), collected by Prof. Macoun at Brackley Pt., P.E.I., may be *E. ciliatum*, Raf.

Var. OCCIDENTALE, Trelease.

Lake Okanagan and Burrard Inlet, B.C., and common on Vancouver Island. "Sometimes comes too near *E. Franciscanum*, but differs in its usually smaller flowers less corymbosely clustered and more acute at base, and in its shorter glandular pubescence."

(15.) E. GLANDULOSUM, Lehm.

In damp places at an altitude of 5,000 feet at Warm Springs, Kootanie Lake, B.C. (*John Macoun.*)

(16.) E. BREVISTYLUM, Barbey.

Specimens from mountains south of Tulameen River B.C. (*Dawson*), have been doubtfully referred here by Dr. Trelease.

(17.) E. HALLEANUM, Hausskn.

Collected by Prof. Macoun in 1887 on Cedar Hill, Vancouver Island, and in 1893 at Esquimault, V. I.

(18.) E. DRUMMONDII, Hausskn.

Young specimens from Stewart's Lake, B. C., (*Macoun*) with leaves in whorls of 3, have been doubtfully referred here by Dr. Trelease.

(19.) E. LEPTOCARPUM, Hausskn.

A span or less high, glabrous except for some incurved pubescence on the stem; leaves less than 20 mm. long, broadly lanceolate, sparingly low-toothed, tapering from near the middle to the obtuse or subacute apex and winged petiole; flowers abundant for the size of the plant; calyx-tube narrow; petals about 3 mm. long, rosy; capsules 20 mm., on very slender peduncles of nearly equal length; seeds nearly ellipsoidal, shortly hyaline beaked, $\cdot 25 \times \cdot 75$ mm.; coma at length cinnamon-colored.

Var. MACOUNII, Trelease.

Less branched, crisp-pubescent in lines, the same pubescence more or less abundant also on the flowers and capsules; leaves more ovate; seeds 1 mm. long; coma paler.

New variety first collected in 1878 near Lake Athabasca by Prof. Macoun, for whom it is named, and again by him at the head of Lake Louise, Rocky Mts., in 1891.

(20.) E. Hornemanni, Reichenb.

Nearly all the references under *E. origanifolium*, Lam., Macoun's Catalogue of Canadian Plants, p. 169, belong here.

In one or other of its forms from Labrador to Vancouver Island.

(21.) E. alpinum, L.

From Kicking Horse Lake to Vancouver Island. Generally found with the preceding species which it greatly resembles. *E. Hornemanni* is "somewhat crisp-hairy in the inflorescence and along the decurrent lines or slightly glandular at top, otherwise glabrate"; in *E. alpinum* the inflorescence and decurrent lines are more nearly glabrous. In the former species the seeds are "rather abruptly short-appendaged, from nearly smooth to very rough;" in the latter they are "smooth gradually alternated at apex with very evident beak."

(22.) E. Oregonense, Hausskn.

Borders of rivulets, Swamp River, B.C. (*Macoun.*) Only Canadian station.

(23.) E. anagallidifolium, Lam.

Specimens in our herbarium are from Cape Chudleigh, Hudson Strait. (*Dr. Bell.*) Rocky Mts. (*Drummond.*) Kicking Horse Lake, Rocky Mts., and Mt. Benson, Vancouver Island. (*Macoun.*)

(24.) E. clavatum, Trelease.

A span high, mostly densely cæspitose, the slender stems ascending, glabrate to sparingly glandular throughout; leaves 15 to 20 mm. long, divergent, broadly ovate, very obtuse, subentire to remotely serrulate, mostly rounded to evident petioles, firm, drying brownish; flowers rather few, suberect, petals rose-colored, about 5 mm. long; capsules 25 mm., subclavate arcuately divergent, the lowest often not reaching the apex of the stem, their slender peduncles equalling the subtending leaves; seeds fusiform, tapering into a pale beak, nearly smooth to coarsely papillate, ·4 to ·6 × 1·5 to 2 mm.; coma barely dingy.

First collected in Canada by Jas. M. Macoun in 1890, at an altitude of 7,500 feet on mountains near Kicking Horse Lake, Rocky Mts. In 1891 by Prof. Macoun on several mountains near Banff and Lake Louise, Rocky Mts.

ANGELICA LYALLII, Wat.

Specimens collected by Dr. Geo. M. Dawson on the summit of the South Kootanie Pass in 1891, were doubtfully referred here by Prof. Macoun (Cat. Can. Plants, Vol. I., p. 535.) These specimens have since been examined by Coulter and Rose, who confirm his determination. This species has since been found at Sproat, Columbia River, B.C., 1890, (*John Macoun*) and at Chaperon Lake, B.C., (*Jas. McEvoy.*)

ECHIUM VULGARE, Linn.

Though well naturalized and spreading in Canada, east of the great Lakes, of very local occurrence in the west. Our western specimens are from Wabigon Tank, on the C. P. Railway, east of Lake of the Woods, (*Wm. McInnes*) and Cariboo, B.C. (*John Macoun.*)

MENTHA CANADENSIS, L.

Colquitz River, near Victoria, V. I., and Sooke, V. I., 1893. (*John Macoun*, Herb. Nos. 1054, 1055.) Not before recorded from Vancouver Island.

MENTHA CANADENSIS, L. var. GLABRATA, Benth.

Fort Simpson, Mackenzie River. (*Miss E. Taylor.*) Sproat, B.C.; Kamloops, B.C.; Sproat Lake, Vancouver Island. (*John Macoun.*) Not before recorded west of Rocky Mountains.

NEPETA CATARIA, L.

Beacon Hill, near Victoria, Vancouver Island, 1893. (*John Macoun*, Herb. No. 977.) Not before recorded west of Ontario.

STACHYS CILIATA, Dougl. var. PUBENS, Gray.

New Westminster, B.C., 1892. (*Law.*) Fishery Bay, Nasse River, B.C. (*Jas. McEvoy*, Herb. No. 1096.) Our only other specimen is from Queen Charlotte Islands.

MENTHA VIRIDIS, L.

Growing in the streets of Victoria, Vancouver Island, 1893. Naturalized. (*John Macoun*, Herb. No. 1052.)

ASARUM CAUDATUM, Lindl.

Common at Revelstoke, B.C. (*John Macoun.*) Eastern limit in Canada.

EPIPACTIS HELLEBORINE, Crantz.

First found in Canada in 1890 at Lambton Mills, Humber River, Ont., by W. & O. White, and more recently (1892) on Mount Royal, Montreal, Que., by N. D. Keith.

The only stations given for this species in the last edition of Gray's Manual are Syracuse and Buffalo, N.Y.

EPIPACTIS GIGANTEA, Dougl.

Collected by Dr. G. M. Dawson in 1877 at Osoyoos Lake, B.C., but not again until 1890, when it was found by Prof. Macoun at Lower Arrow Lake, Columbia River, and Hot Springs, Kootanie Lake, B.C.

ALLIUM NEVII, Watson.

Found growing on gravelly banks at Botanie near Spence's Bridge, B.C., by Jas. McEvoy. Found on Vancouver Island, but not before on the mainland.

JUNCUS GERARDI, Lois.

This rush, though common on the Atlantic Coast, had not been found on the Pacific Coast until it was discovered in 1887 by Prof Macoun near Victoria, Vancouver Island. It was again collected by him at Nanaimo, V. I. in 1893. As in the east it was found growing in salt marshes and is without doubt indigenous.

POTAMOGETON NATANS, Linn.

Enderby, B.C., and Shuswap Lake, B.C. (*Jas. M. Macoun.*) Griffin Lake, B.C., and Revelstoke, B.C. (*John Macoun.*) Not before recorded from British Columbia.

POTAMOGETON PAUCIFLORUS, Pursh.

Revelstoke, B.C., 1890. (*John Macoun.*) Not before recorded from British Columbia.

BOTRYCHIUM LANCEOLATUM, Angst.

Near Niagara Falls, Ont. (*R. Cameron.*) Not before found in Ontario.

PRELIMINARY NOTE ON THE LIMESTONES OF THE LAURENTIAN SYSTEM.

By ELFRIC DREW INGALL.

GEOLOGICAL SURVEY, OTTAWA.

In view of the attention which is now being directed to the above mentioned subject, in connection with the work of the Geological Survey of Canada in the Laurentian area lying north of Ottawa, it is deemed a fitting time to record the observations and conclusions of the writer on the question above denoted.

These observations were made whilst studying the mode of occurrence of the phosphate deposits of the county of Ottawa, Province of Quebec in the years 1888, 1889 and 1890, and have not before been presented to the public owing to the pressure of other duties in connection with the supervision of the division of Mineral Statistics and Mines of the Geological Survey. A fuller and more complete statement of results must even yet await the evidence to be adduced from a microscopical study of the very complete series of rock specimens collected.

At the commencement of the investigation with a view to prevent any prejudice in observation special care was taken to avoid any preconceived theoretical bias and the views arrived at are simply the result of an extended and detailed study of the phenomena observable in the field.

Apart from the chief object of the investigation—i.e. the mode of the occurrence of the phsophate deposits—it was intended to show the distribution of the rocks over a typical area which should include the chief mines of the district, and in this way it became necessary to attempt a delimitation of certain limestone areas, in doing which the following features were brought forcibly to light.

Their mode of occurrence was extremely indefinite and irregular. Although great pains were taken it was found impossible in most places to draw any very sharp line between the limestones and the surrounding rocks.

They contained inclusions of gneissic and other associated rocks in the form of bands, nodules, etc.

The proportion of this included rock in relation to the limestone proper was extremely variable so that whilst at some places limestone with inclusions might be a fitting designation, at others one would rather describe as gneiss with intercalated ribbons or bands of calcite. Thus, in passing from a limestone area on to another rock, it became a question of percentage as to where one would draw a line between the two and in the area of gneiss, etc., proper, one would often find little scattering patches of limestone.

These limestone areas show a very constant and more or less definite striping or parallel structure which always maintained a marked parallelism with that of the surrounding gneiss in all its variations of direction.

On close observation, the inclusions in these limestone areas, show some very interesting features. In shape they are varied. One exposure might show a number of contorted bands of gneissic material running parallel to each other, separated by limestone, and much thickened at the sharp bends by doubling. At other places these inclusions form a comparatively small proportion of the rock mass showing as detached nodules, of irregular shape. These nodules are very commonly roughly lenticular, showing a tendency to taper off at either end along the striping of the enclosing limestone; at places this tapering off is seen, on closer inspection, to be due to strings of particles of felspathic and similar material arranged in line.

All these inclusions of whatever shape seem to have one feature in common. Their exterior surface it hackly, pitted and with a generally corroded appearance.

The general striping of the limestones would seem, on careful study, to be due, either to little irregular chains of such particles or to a different colouring of the replacing calcite crystals, probably marking the places where such particles have been.

The detailed explanation offered by the writer seems to him to satisfactorily and thoroughly explain these and other features of the limestones of the Laurentian. He is led to the conclusion that they simply represent areas of gneissic and similar rocks altered in place into limestones. Furthermore, that the extent and location of these areas have been largely determined by the presence of the abrupt bends and other contortions of these rocks, whose foliæ would thus be separated and opened up to the complete action of the subterranean waters. Where such contortions and crumpling of the rocks had extended over a considerable area, the alteration would have gone further and have produced the solid limestone masses so frequently found. In these the inclusions would naturally be scarcer and represent the more solid portions of the ribs of the gneiss which for this reason or owing to their mineral composition were less amenable to change than the rest of the area. These would naturally show the corroded surface already alluded to, and the tapering off along the striping of the rock. The lesser and scattering occurrences of limestone throughout the district, which are a very confusing feature on any other supposition, would thus be satisfactorily accounted for as well as the extreme irregularity of the boundaries of these limestone areas and other phenomena of their occurrence.

Doubtless also the mineral constitution of the original rocks must have been an important factor in the determination of the position, etc., of these alteration areas.

The occurrence of these limestones at the anticlinal folds of the formation has been noticed in a general way by Dr. Ells, of the Geological Survey staff, who is now engaged in mapping the general geology of a very large district north of the Ottawa River, extending from Ottawa city eastward, nearly to Montreal. The writer, however, believes that this is the first attempt to explain *in detail* the reason of this association on the basis of subsequent alteration in place, and to put forward a theory which should harmonize all the features observable both in the larger and more definite areas and in the smaller and scattering patches found throughout the district.

Since writing the above I understand from Dr. Selwyn, the Director of the Geological Survey, that in some correspondence he had with Messrs. Rowney and King in regard to their book on Rock Metamorphism, issued in connection with the Eozoon controversy in 1881, he wrote as follows: "I am led to believe that the two kinds of limestone or dolomite have had a distinct origin and that the non-fossiliferous and generally crystalline set are newer than the strata with which they are associated. Nearly if not quite all our Laurentian and Huronian limestones seem to me to have this non-contemporaneous character notwithstanding that they conform more or less perfectly with the lamination and with the larger flexures of the associated gneiss."

Teratological Notes.

By D. P. Penhallow, McGill University.

Marked departures from the ordinary course of development in plants are interesting, and often instructive, as throwing additional light upon the morphological character of organs, the original features of which have become lost in the course of development and adaptation to special functions. This is particularly true where these changes are of the nature of reversions to the primitive type of structure. The present notes are designed to draw attention to a few instances of such reversions which have lately come under notice, and which have already served an important purpose in the instruction of students. During the past winter, Mr. N. N. Evans brought to my notice a common cultivated tulip which displayed an alteration in some respects most unusual. The flower was perfectly normal as to form and size, and exhibited three normal carpels in the pistil. There were, however, seven stamens instead of six, and seven divisions of the perianth instead of six. The addition of an extra number to each of these whorls of organs was found, upon examination, to be a result of chorisis or deduplication, an alteration which is by no means rare, but which leads to the breaking up of a normally single organ into two or more organs of the same kind. The most marked change, and one which is comparatively rare, was to be found in the presence of a bract below the flower. This organ was found to arise from the scape at a distance of about one and one-half inches below the flower. It was two and one half inches long and one-half inch wide. One margin, for a width of about one-eighth of an inch, was distinctly petaloid, showing the tendency for this organ to become a true spathe. This case has more recently been paralleled by the occurrence of a double calla lily, in which a second spathe of full size and form was developed below the normal spathe at a distance of about one inch.

In a flower of the common fuchsia all parts were normal with the exception of one calyx lobe, which had developed into a perfectly normal leaf except along one margin, where it remained attached to the adjoining sepal.

In the common pelargonium one flower was completely replaced by a branch bearing well-developed and normal leaves.

Roses under cultivation often exhibit interesting conditions of reversion in the flower, less frequently do they show them in the leaves. Two specimens in our collection give a clear indication of the reversion of a compound leaf to the simple form of that organ. The specimens are of the common wild rose (*Rosa carolina*). In one case the flower is normal, and only one leaf shows reversion. Here the five normal leaflets are replaced by two leaflets. The basal one of these shows from its position that its opposite was arrested in development. The terminal leaflet shows three strong lobes, with a prominent vein running into each, so that if we consider these three lobes as three leaflets which have become united, we then have a complete correspondence with the number of parts in a normal leaf. In the second case the flower was proliferous and greatly reduced in size, while five leaves exhibited various stages of reversion. In all five leaves the three terminal leaflets had become joined so as to form a more or less strongly three-lobed leaflet. Counting these lobes as the representatives of leaflets, it was then found that there was an exact numerical correspondence with the parts, 5–7, of a normal leaf.

Ancient Myriapods.

G. F. Matthew, F. R. S. C.

The Common Earwig is the best known example of a class of articulate animals, not very familiar to us because of their comparative scarcity and secretive habits. In these respects they are the opposite of some species of the immensely more numerous, and obtrusively familiar Hexapods or True Insects. Myriapods differ strikingly from the latter in their long worm-like bodies composed of numerous segments, and having equally numerous or more numerous feet.

So distinct are the Myriapods in these and other respects from the true insects, that many writers recognize them as a separate class, of equal rank with the Crustaceans, Hexapods and Arachnids (spiders and scorpions).

Though now comparatively rare, in past ages the Myriapods played an important part in peopling the land areas of the globe, and possessed great diversity of structure. Only a few species from the Palæozoic rocks have been known until of late years, but gradually the number has been increased, and as their diversity of form has been recognized, the importance of their bearing upon the classification of insects has become more manifest.

A sketch of the discoveries of fossil Myriapods which have been made from time to time, may serve to show how rare an event is the discovery of the remains of one of these little animals.

In 1854 C. L. Koch and J. C. Berendt described the Crustaceans, Myriapods and Spiders of the Amber of Vorwelt, North Germany. These amber fragments contain a rich insect fauna, admirably preserved, have yielded 35 species of Myriapods (15 Chilopods and 20 Diplopods) and are of late Tertiary age.

In 1859 Sir J. W. Dawson found and described[1] remains of a species of Millipede (*Xylobius Sigillariæ*) in erect stumps of trees in the Coal Measures at the Joggins in Nova Scotia. At a later period (1873) Dr. S. H. Scudder, of Cambridge, Mass., reviewed the Millipede remains from these stumps and found three species of the genus established by Sir Wm. Dawson and established the new genus, *Archiulus*.

In 1863 J. W. Salter described two fossils from the English Coal Measures under the genus *Eurypterus*. These specimens were re-examined by Mr. Henry Woodward and found to be of other genera. One *E. armatus* he suggested was a gigantic Arachnid, and the other *E. ferox* was plainly a species of Meek and Worthen's new genus *Euphoberia* and therefore a Myriapod.

Salter in that year also described a Eurypterus from the Plant Beds at St. John, N.B. Later discoveries lead the author to think that this species, *E. pulicaris*, should also be referred to the Myriapods, or to the Insects.

In 1868, A. Dohrn described a Millipede from the coal beds of Saarbruck, in Germany. These beds are of Permian Age.

In 1868, Meek and Worthen began to make known those remarkable Myriapods from the Lower Coal Measures of Mazon Creek, Ill., which, together with the plants found there, have made that locality famous. These remains were more fully described by Dr. Scudder at a later date with more ample material at his command, and such was

[1] Journal Geol. Society of London, Vol. XVI. p. 268, 1859.

the extraordinary nature of these remains that their study quite revolutionized the classification of the Myriapods.

In 1871, H. Woodward discovered a Myriapod (Euphoberia) in the English Coal Measures, and a few years later (1878) P. L. Bertkau one in the Brown Coal of Rott, near Bonn, Miocene in age.

In 1882, B. N. Peach carried back a knowledge of these creatures to the Devonian, describing two forms from the old red Sandstone of Forfarshire, in Scotland.

In 1886, Dr. Scudder issued a systematic review of the Insects, Myriapods and Arachnids which remains to-day the most systematic and philosophical grouping of the Insectea. He has since made some important changes however, as for instance in recognizing Chilopods among the Carboniferous Myriapods.

The insect faunas of the Tertiary deposits are notably poor in remains of Myriapods. Prof. Oswald Heer, in 1862, described the Insect Fauna of Œningen, in Bavaria, finding no less than 844 species of insects chiefly beetles, and almost all of living families. But, as quoted by Lyell, he does not mention the occurrence of a single Myriapod. Rev. P. B. Brodie described no less than 24 families of insects from the Lower Lias, Great Britain, but Myriapods are equally wanting there.

For ten years (1881-1890), Dr. Scudder was at work on the Insect Fauna of the Tertiary lake basin of Florissant and other localities of Western North America. His results were published by the U. S. Geological Survey and fill a large quarto volume with 28 plates, representing this extensive series of fossils.

The remarkable richness of the Florissant fauna may be inferred from Dr. Scudder's statement that in one summer about 10,000 specimens were collected from these beds; whereas it had taken Heer thirty years to gather the 5,000 specimens from Œningen, on which he founded his descriptions. Yet from all the material gathered at Lake Florissant, Dr. Scudder has figured only one broken example of a Myriapod.

Modern Myriapods are divided into three orders, Chilopods, Decapods and Pauropods; the third of which, only known as Recent, is insignificant both in numbers and size. Dr. Scudder was once disposed to claim that these orders like those of the True Insects had originated in the Secondary Rocks (Mesozoic), and that all the Palæozoic Myriapods were included in his new orders, Palæosygnatha and Archipolypoda; but he has since discovered examples of the Chilopod forms in the Carboniferous beds. It follows that three if not four of the orders of the Myriapods existed in the Palæozoic rocks.

The Chilopods are distinguished from the Diplopods by the possession of only one pair of feet to each joint of the body, whereas the Diplopods have the ventral plate of each joint in two pieces and carry two pairs of legs to each joint except a few anterior joints which have only one pair; their feet therefore are twice as numerous as those of the Chilopods (except on the anterior joints). The Chilopods differ also in having the body flattened. Some small species of this order has been found in the plant beds at St. John.

Dr. Scudder has made a separate order, Protosygnatha, of that singular larva-like form described by Meek and Worthen under the name Palæocampus. It has only a few joints (12) and is covered with tufted bristles. A Myriapod with the bristles more uniformly diffused and having more numerous joints occurs at St. John.

Omitting Protosygnatha and the few Chilopods from view, the bulk of the Palæozoic Myriapods are included in the extensive order Archipolypoda, characterized by a rounded body of many joints, and having the ventral plate of each somite as in Diplopoda divided into two pieces, with a pair of legs attached to each piece. The anterior half of each dorsal plate is elevated, ridged transversely to the body and frequently bears spines or tubercles; while the posterior portion is flatter and lower. The body in the Myriapods of this order is elongated, fusiform, largest in the middle or towards the anterior end, and is composed of many segments.

A peculiar family, *Archidesmidæ*, referred by Scudder to this order has been found in the Devonian rocks of Scotland; in this family the halves of the dorsal plate of the several joints are scarcely consolidated; but the anterior half is more important, both by its size and by the expanded lateral lamellæ that ornament it. These curious Myriapods are found in the old red sandstone of Forfarshire.

The most important family of the Palæozoic Myriapods is the *Euphoberidæ*, distinguished from the last by the more or less complete soldering of the two portions of the dorsal plate; in this the elevated anterior portion is ornamented with large, often forked spines, or with tubercles. The Euphoberidæ are the typical forms of the order Archipolypoda, and some are of great size. According to Dr. Scudder some species were amphibious, being provided with organs, apparently of the nature of gills, beside the ordinary spiracles, and with lamellate legs. They appear to have been far more abundant in the new world than in the old, and in the latter are scarcely known outside of Great Britain.

The ironstone nodules of the shales on Mazon Creek, Ill., have produced the greatest number and the most remarkable forms of these archaic Myriapods, though some have been found in the British carboniferous deposits. Those found at Coldbrook Dale were at first taken to be the caterpillers of certain butterflies, and afterwards as belonging to the Merostomata. Myriapods of this family have lately been found at St. John, N.B.

A third family of ancient Myriapods is that designated as Archiulidæ by Dr. Scudder. In this group a near approach to Diplopoda of modern Myriapods is seen. The two pieces of the dorsal plate are closely consolidated, but still are distinctly visible, though the anterior is rarely elevated much above the posterior, the body is almost smooth or covered more or less abundantly with serially disposed papillæ, from which in some cases hairs or small spines arise. The members of this family resemble modern

Diplopoda in their general appearance much more closely than either of the preceding families. Sir Wm. Dawson, who first discovered their forms in the Palæozoic rocks, classed them with the Diplopoda, and spoke of them as the oldest "gally worms" known. Sir William's figures would indicate that the back (not the front part as Scudder says) was the more elevated. While first found in the erect stumps of Sigillarian trees at the Joggins, they have since been detected in the Coal Measures of Great Britain and on the continent of Europe. Possibly also some species found in the Dyas of Bohemia may belong to this family. Two species have been found at Mazon Creek.

As regards the development of the Myriapods, Dr. Scudder says that in the early life of Pauropus and the Diplopoda we have what may be fairly considered a true larval form, in which for a brief period after leaving the egg the body, much shorter than in after life, is provided with three pairs of legs, borne on the anterior segments of the body. These segments are never fully provided with legs, though most of the segments posterior to them, both those which exist during the larval state and those which originate subsequently, bear each two pairs. In the Chilopoda on the other hand, although the appendages of the anterior segment develop earlier than those behind them there is no true larval condition, or perhaps one may say a larval condition is permanent, in that the same anterior legs become early and permanently developed, as organs subsidiary to manducation, while each segment of the hinder part of the body develops only a single pair of legs.

To close these remarks it may be said that nine genera of Palæozoic Myriapods have been recognized in the Coal Measures, and two in the Devonian rocks of Scotland. While of those found at St. John and which are supposed to be older, the genera are the same as those of the Coal Measures or are nearly related to them.

The air-breathing articulates of the Plant bed of St. John so far recognized, consist of:—

Insects, nine species of eight genera........................... 9

Myriapods, six species of several genera	6
Arachnid, similar to Anthracomartus	1
Probable Pedipalp (Eurypterella)	1
Probable Arachnid or Isopod (Amphipeltis)	1
Scorpion (Palæophonus arctus)	1

Two species of land snails also have been found, raising the number to twenty or twenty-one kinds of air-breathing animals found in the Plant Beds at St. Johns.

Annual Presidential Address.

NATURAL HISTORY SOCIETY, MONTREAL.

By Prof. Wesley Mills, M.A., M.D., etc.

In accordance with the custom of my predecessors, I present a brief retrospect of the year that has just closed, and offer a few suggestions for your consideration.

The Executive began its work with the duty before it of carrying into effect a motion passed at the last annual meeting which directed that we should ascertain the exact standing and condition of our Society, and if possible devise means for its improvement. To my own mind this was a good indication—a sign of life and a progressive spirit—for the society, like the individual, that is perfectly satisfied with present attainments is apt to be in a stage of incipient decline, if it has not already reached a condition of advanced atrophy.

The Special Committee appointed to investigate the subject, held many meetings, and with the assistance of subcommittees finally devised a scheme which was presented to a special meeting of the society, and unanimously adopted.

The principal features of this plan of improvement were: Affiliation with other local societies having kindred aims; broadening the range of subjects to be brought under discussion; making the themes presented somewhat more popular in form; and finally reporting them regularly and adequately for the public press of the city. The first part of the scheme has yet to be tried, but if the right spirit prevails we have no doubt our society will find, as all other organizations have done, that union is strength. Several of the other parts of the plan have been fairly tested this year, and I am sure you will agree with me, most successfully.

The attendance of members has not been smaller, while that of the general public has been considerable, so that perhaps never before were the regular meetings as well attended; while the notices in the press prior to the meeting and the reports afterwards, both of which emanated from the Society, were a great improvement on the scanty references of the past.

The abstracts of the Somerville lectures supplied by the lecturers, and kindly published by some of the newspapers in full, were all that could be desired.

This has entailed considerable labour, but it seems to me that it is worth while, for in a community like ours we must sow the seed of science beside all waters if we would see even a little fruit. Those of scientific tastes have no more excuse for exclusiveness or selfishness—of which there is still surely more than enough in the world—than other people.

Thanks largely to the forethought and generosity of one man, the Rev. Dr. Somerville, this society for about sixty years has been in a position to invite those who would to come to its annual feasts of popularized science.

That the courses of lectures have been the means of doing great good there can be no doubt. It may be said that without reference to age, sex, social position or any other distinction thousands have been interested listeners during the last half century to those unfoldings of nature's ways, which have been attempted in this historic lecture course.

May the Society never underestimate their importance, and never cease to welcome the poor man and the poor child, as well as the rich, who may wish to put themselves under the ennobling influence of a loving contact with nature and so attain to true science—real knowledge.

For some years the Society has attempted to have the lectures of the Somerville course not only consecutive but on subjects connected by natural affinities. Many people attend the whole course when thus arranged and receive an amount of educational benefit not possible, when the lectures, however good in themselves, are not closely related. It should be the object of every teacher—no matter what his exact position, to beget a desire on the part of his hearers to know more and to attempt to investigate in some humble way for themselves—for after all, we know just so much as we really make a part of our individual nature by personal observation or experience.

This year the Society appropriated such a sum as it could afford for illustrating the Somerville course, in carrying out which we were efficiently assisted by Mr. Williams So great is the tendency to use illustrations these days that it is scarcely possible to be up to the times without them. On the other hand we witness almost daily evidence of their abuse, and I should be sorry ever to see Mr. Somerville's noble purpose degraded into the giving of a mere show or exhibition for amusement. I cannot believe it is ever the purpose of science as science to amuse.

People who regard our domestic animals merely as objects of amusement, a sort of animated toys, never rise to proper conceptions of these creatures. On the contrary, from the student's point of view, all creatures are alike worthy of the most earnest, perhaps I may say reverent study, as illustrating great laws which apply throughout the universe.

I therefore think that the Somerville course of lectures of last winter on our domestic animals, given by persons who were thoroughly competent to treat of them, should have done much to lead to a better study of those creatures that have been most truthfully termed "our dumb friends."

It is scarcely possible to observe wild animals so closely and to study their relations to their surroundings so successfully as in the case of domestic animals. That part of natural history which we can best understand is what pertains to the working of the animal body, because we can supplement study of wild and domestic forms of life by observation on ourselves.

By a study of ourselves and those animals that live under conditions most akin to our own we are, in my opinion, best prepared for a really profitable study of wild forms. To go no further than the mere external forms of things is not to really understand nature. It was said of old, and is repeated to-day, that the proper study of mankind is man. The naturalist may grant this because it is only through our own experiences that we can understand other creatures. Man can understand animals because he is himself an animal —and but for a similarity of nature this would be impossible. I have often thought of late that our domestic animals receive far too little attention at the hands of naturalists—amateur and professional.

There seems to have been but one opinion in regard to the Somerville course of this year—that it was an unqualified success. The lantern and other illustrations were of great service, yet never abused; the serious aims of science were never subordinated to mere amusement.

We must remember, too, that the better living creatures are understood, the happier the lot of our domestic animals, if not all animals, will become. Knowledge in this case is sure to beget kindliness--true sympathy, and I know of no other way by which it is possible. I therefore think the moral effect of the course of last winter will be especially good.

We have to congratulate ourselves on the widening of our sphere of study to include physical science; and those who heard Professsor Nicolson's lecture on "The Mechanics of Haulage," as applicable to the drawing of loads by horses—coming as it did just after the close of the Somerville course, will agree that the change has been a wise one. The Society had already tried the happy experiment of a course of popular lectures a year ago on physical science kindly given by the professors of the Faculty of Applied Science in McGill University, and constituting the Somerville course of last year.

Noticing the extent to which our museum is used on the evenings of the Somerville lectures one cannot but feel that it would be well if it could be open to the public daily free of charge. It seems a pity that such a valuable collection of nature's treasures should not be more used. The museum is admirably located, and I hope that some means may be devised by which it may become a school in which nature's lessons may be effectively if silently taught.

As you all know, for two years the existence of THE RECORD OF SCIENCE, the Society's publication, with so long and worthy a history as the chief medium for the publication of general natural science in the Dominion, has been imperilled by the withdrawal of the Provincial Government grant. We are not without hope that this well deserved grant may be restored. But the Society, with an independence and a fortitude which will command admiration and respect, has resolved that this evidence of its life and progress shall not cease to exist—grant or no grant.

We have many subjects of congratulation. One of our most frequent contributors to THE RECORD OF SCIENCE—a man who has done so much to make Canada known by his long continued and valuable scientific researches, Mr. G. F. Matthew, of St. John, N.B., has added to the success of our monthly meetings by sending us a paper on a subject and in a form suitable for one of our regular monthly meetings. This action on his part has been greatly appreciated on all hands and will, I trust, be imitated by others.

It is a source of satisfaction to find that all or nearly all the veteran members still retain their connection with the Society and encourage younger men by their presence and faithful attention to the duties assigned to them.

Sir Wm. Dawson, for so many years the President of the Society, and one of its warmest friends and supporters, though incapacitated by feeble health from taking part in those many duties and enterprises which have made him so well-known and respected in this city and throughout America, has still given the Society a goodly share of the energy he has had at command. There are few things that have more impressed me in connection with Sir William Dawson than his close attendance at the meetings of this

Society for so many years, when he was occupied with matters of great importance, and often when the meetings were very poorly attended. It is to be hoped that this example will not be lost on us. In a society like ours the duty of mutual encouragement is clear.

Dr. Harrington, one of the good friends of this Society, who did so much for it in the past, when resigning his position as president, urged that the Society should consider the advisability of attempting to bring to this city some of the eminent scientific workers or teachers from the United States and offer to the public a lecture or two from them during the winter in some large hall. Considering how little is done in Montreal in the way of providing lectures for its citizens by distinguished men, this proposition of Dr. Harrington's should not, I feel, be allowed to pass into oblivion. I have myself for many years felt the great need of such lectures in this city, though it must be confessed the financial risk is considerable in attempting to carry such a scheme into effect.

In a society like ours we must never forget that it exists to increase the knowledge of science and to spread that knowledge. This implies the need above every thing else of a body of enthusiastic workers, and no material acquisition can ever compensate for the lack of such people. Without these a natural history society is poor, poor indeed.

I am, therefore, deeply concerned as to how we shall discover and enlist the co-operation of men, especially young men, who will infuse into us some of that enthusiasm which nearly always means success in achievement and give us a promise of a fullness of the life-tide of science which will widen and deepen the channels which the same enthusiasm and the work it begets, have worn in the past.

Our superintendent, Mr. Griffin, has continued to discharge his duties with intelligence, energy, courtesy and success generally, and I have always found him ready to assist in any matter which has been brought to his notice.

From the reports of the various officers and committees read this evening you will be able to judge somewhat as to the faithfulness and efficiency of those to whom the Society has entrusted its management.

Before resigning my office, I wish to thank the officers of the Society and all with whom I have come in contact in the discharge of my duties, for their uniform courtesy and kindness, which have greatly lightened the labours and added to the pleasures associated with my office.

Proceedings of the Natural History Society.

Montreal, 26th March, 1894.

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

The minutes of the regular meeting of February 26th, and of the special meeting of March 5th, were read and approved.

The minutes of Council meetings of March 5th and 19th were read.

The Librarian reported that "Bechstein's Natural History of Cage Birds," and "Minot's Land and Game Birds of New England," were donated to the Society by Mr. E. D. Wintle.

On motion by Mr. E. T. Chambers, seconded by Mr. James Gardner, the thanks of the Society were given to Mr. Wintle for this valuable donation.

Mr. J. W. Marling, proposed by Edgar Judge, seconded by J. S. Shearer, and J. Bickertoun Williams, proposed by Dr. Wesley Mills, seconded by George Sumner, were, on motion of J. A. U. Beaudry, seconded by J. H. Joseph, elected as ordinary members by acclamation.

A letter was read from J. Thorburn, of the Geological Survey, asking regarding certain volumes sent to the Survey from Italy, and also inquiring about the affiliation of the various societies in Montreal. Referred to the Librarian and Secretary to answer.

Prof. J. T. Nicolson then read his paper on the "Mechanics of Haulage."

On motion of R. W. McLachlan, seconded by Joseph Fortier, the thanks of the Society were tendered to Prof. Nicolson for his interesting paper.

MONTREAL, April 30th, 1894.

The sixth monthly meeting of the Society was held this evening, J. H. Joseph, Vice-President, in the chair.

The minutes of last meeting were read and approved.

The minutes of Council of April 23rd were read.

It was moved by the Rev. Dr. Campbell, seconded by J. A. U. Beaudry, that the Society begs to offer its congratulations to Dr. Wesley Mills upon the success of the Somerville course, arranged by him, for the present season, and records its appreciation of the exceedingly instructive and valuable lectures delivered by him and the other professors of the Faculty of Comparative Medicine in McGill University, Dr. D. McEachran, Dr. Baker and Dr. Adami, who aided him in favoring the public with this course, under the auspices of this society.

A letter was read from Dr. F. D. Adams, enclosing one from Mr. Lamb, of the Geological Survey, Ottawa, offering to give the Society a valuable exchange for four sponges which he had borrowed from the Society's collection, some time ago, on order of Sir William Dawson. On motion, the letter was referred to Messrs. Winn and Chambers.

Mr. J. M. M. Duff, proposed by J. A. U. Beaudry, seconded by George Sumner, was, on motion that the rules be suspended, elected an ordinary member by acclamation.

Mr. J. S. Shearer reported, on behalf of the Field Day Committee, that the committee had arranged for the field day to be held on the 2nd of June; the train to start from Windsor Station at 8 a.m. for Labelle, about forty miles beyond St. Agathe, the place selected for last year's field day.

On motion by R. W. McLachlan, seconded by Joseph Fortier, the report was adopted; the price of tickets to be $1.50 for adults and 75 cents for children.

As Mr. Joseph had to leave, Mr. Shearer was called to the chair.

A paper by Mr. G. F. Matthew on "Ancient Myriapods" was read by the Rev. Dr. Campbell.

It was moved by Dr. Campbell, seconded by George Sumner, that the thanks of the Society be given to Mr. Matthew for his valuable paper, and that he be requested to furnish specimens of some of these Myriapods for the Society's museum.

MONTREAL, 28th May, 1894.

The annual meeting of the Society was held on Monday, the 28th of May, Dr. Wesley Mills in the chair.

The following reports were read and adopted :—

REPORT OF THE COUNCIL.

GENTLEMEN,—The Chairman of Council begs to report that for the session 1893-94 eleven meetings of Council were held, all of which were well attended.

The Society held six ordinary meetings and one special meeting. At the six regular meetings, interesting papers were contributed by Sir Wm. Dawson, Dr. Wesley Mills, Nevil Norton Evans, Dr. Frank D. Adams, Prof. J. T. Nicolson, and F. B. Matthew.

The Somerville Course of Lectures for the past season proved of unusual interest, and the Society is indebted to the lecture committee for arranging the course and particularly to our President, Dr. Wesley Mills, for his untiring efforts in watching over the course so faithfully and giving so much of his valuable time to make the course such a complete success. A well deserved vote of thanks was tendered by the Society to the several gentlemen who delivered the lectures. Those attending were so deeply impressed with the importance of some of the subjects brought before them, that at two of the meetings committees were named to wait upon the Health Committee of this city and urge that a proper inspection should be made of all dairies supplying milk to the city as also of all animals sold for food, with a view of stamping out the disease tuberculosis ; joint committees of the Natural History Society and Board of Trade accordingly waited upon the Health Committee of this city and urged very strongly the importance of having duly qualified inspectors appointed. The health committee received the deputation very kindly and after the subject had been well discussed, requested

Prof. Duncan McEachran and Dr. Wesley Mills to formulate a plan covering the object desired, which was done by these gentlemen, when the health committee at once adopted the proposition and asked the Council for funds to carry out this important recommendation. It is most desirable that the matter should be pressed to a conclusion.

On the arrival of the Earl of Aberdeen in Canada, he was asked to accept the position of Patron of the Society, to which he graciously consented.

In June of last year a committee was appointed to see in what manner the usefulness of the Society could be increased, which resulted in the affiliation of the Microscopical Society, the Entomological Society, and the Aggassiz Association with this Society ; and we trust that this may prove to the mutual advantage of all concerned. A full report of the committee was presented to the Society on the 25th of March last ; it has been suggested that it would be very desirable to celebrate the affiliation in an especial manner next autumn.

We were informed by the Hon. J. S. Hall, Treasurer of the Province, on the 19th of February last, that he regretted that the usual Government grant made to the Society for the publication of the Record of Science, could not be given this year.

The Annual Field Day of the Society was held at Ste Agathe last year, on the 3rd of June, and proved to be one of the most successful and enjoyable ever held by the Society.

During the year the membership has been increased by the addition of three associate and twenty-seven ordinary members, being an increase of thirty for the year.

We mourn the loss of Messrs. W. F. Kay, G. Knowlton and Hollis Shorey, who died during the past year.

The whole respectfully submitted,

Geo. Sumner,
Chairman of Council.

Report of Hon. Curator.

Gentlemen :—During the past season the following donations have been received and put in their places in the museum :—

Fossils from Radnor forges.

Model surf boat from Samoa.

Indian war canoe.

Bark from California giant trees.

Stone axe.

Two lizards.

One bat.

Specimens of seaweed.

Bone of Mastodon and other geological specimens from R. Felch, Esq.

Magnetic iron sand.

Two wasps' nests.

Brazilian beetles.

Exotic butterfly—*Morpho*—sp.

Also the following specimens from Bermuda presented by J. S. Buchan :—

Specimen of coral rock from Bermuda, the ordinary building material of the country.

The same hardened into limestone.

Stalagmite from the surface of the rock at Ireland Island, near the dockyard, Bermuda, taken from a surface about 30 feet above sea level, possibly the site of an ancient cave.

Specimens of Bermuda juniper.

Compared with the last few years but little work has been done at the museum. The case of mammals, which was being destroyed by moths has been thoroughly overhauled and all traces of the invaders exterminated, and when our birds have all received a similar "going-over" the museum will present a much better appearance. But this work is almost endless and it is to be hoped that the incoming Hon. Curator will be able to organize a strong museum committee and give the whole collection a general and much needed revision.

The number of visitors to the museum shows a slight falling off from last year, which is accounted for, probably, by the decrease of American travel last summer.

Respectfully submitted,

ALBERT F. WINN,
Hon. Curator.

REPORT OF THE LIBRARIAN.

GENTLEMEN :—On behalf of the library committee I am glad to report that the books of your library have been more used by members than they have for some years past. Not only have many books been taken out, but the library itself has been more used for purposes of reference than in former years.

No meetings of the committee have been called, as the work of arranging and cataloguing cannot be proceeded with on account of the large number of volumes waiting for the binder. The number requiring binding now exceeds 200.

I have to acknowledge the great assistance received from Mr. Griffin, the superintendent, who is always ready and willing to help the committee—especially in caring for and acknowledging the large and increasing number of exchanges received by the library.

The following donations have been received :—

From E. D. Wintle, Esq., "The Land and Game Birds of New England," "The Natural History of Cage Birds."

From Dr. G. M. Dawson, "Geological Notes on the Coasts and Islands of Behring Sea and its Vicinity." "On the Occurrence of Mammoth Remains in the Yukon District."

E. T. CHAMBERS,
Hon. Librarian.

REPORT OF THE EDITING AND EXCHANGE COMMITTEE.

GENTLEMEN :—During the past year the publication of the CANADIAN RECORD OF SCIENCE has continued as usual. Three numbers have already issued, while the fourth is now in press. The withdrawal of the Government grant to the Society during the past two years has made it doubtful whether the publication of the RECORD OF SCIENCE can be continued, and although the Council of the Society have decided to carry it on for the coming year the financial difficulties have rendered it impossible during the past year to issue the several numbers at the dates on which they should have appeared.

The rule of accepting only papers of merit and as far as possible original papers, for publication, has been adhered to and a high standard has thus been maintained. One or two papers which appeared in German periodicals, and which were of especial importance to scientific workers in Canada, have also been translated and published in the RECORD.

As in past years a large number of valuable exchanges have been received for the RECORD and placed in the library.

Respectfully submitted,

FRANK D. ADAMS,
Chairman.

The rules having been suspended, Mr. F. Notman was elected an ordinary member of the Society by acclamation.

Mr. Justice Wurtele, who had been appointed as the Society's delegate to the meeting of the Royal Society at Ottawa, reported that he had attended the said meeting and presented a report of the work done by the Natural History Society. This report was then handed to the secretary.

The following officers were then elected for the ensuing year :

Honorary President—Sir. J. Wm. Dawson.

President—Dr. Wesley Mills.

Vice-Presidents—Jno. S. Shearer, Sir Donald Smith, Hon. Edward Murphy, Hon. Justice Wurtele, Rev. Dr. Campbell, Dr. B. J. Harrington, George Sumner, J. H. R. Molson, Edgar Judge and J. H. Joseph.

Recording-Secretary—R. W. McLachlan.

Corresponding Secretary—Dr. J. W. Stirling.

Treasurer—F. W. Richards.

Curator—E. D. Wintle.

Librarian—E. T. Chambers.

Members of Council—Dr. Frank D. Adams, N. N. Evans, Joseph Fortier, J. S. Brown, James Gardner, Hon. J. K. Ward, Major L. A. H. Latour, A. Holden and F. Winn.

Editing and Exchange Committee—Dr. Frank D. Adams, N. N. Evans, J. F. Whiteaves, G. F. Matthews, Dr. Wesley Mills, Dr. B. J. Harrington.

It was moved by Hon. Justice Wurtele, seconded by George Sumner, that the sincere thanks of the Society be tendered to Mr. James Gardner for his services as treasurer during the past five years.—Carried.

A similar vote of thanks was tendered to Dr. Adams for his services in connection with the RECORD OF SCIENCE.

A motion was passed requesting the Council to appoint a committee to assist the Curator in rearranging the museum.

NATURAL HISTORY SOCIETY OF MONTREAL IN ACCOUNT WITH JAS. GARDNER, HON.-TREASURER.

Receipts.

To Balance from last year	$ 57.47
" Rents	873.25
" Members' Annual Subscriptions	667.00
" Field-day Surplus	30.96
" Entrance Fees Museum	17.00
" Interest	9.43
" Life Membership Endowment Fund *re-transferred*	250.00
	$1,905.11

Disbursements.

By Superintendent's Salary and Commissions	$508.00
" Sundry Expenses	234.76
" Light	180.42
" Fuel	150.98
" Taxes	45.36
" Lectures	76.09
" Insurance	52.37
" Museum	44.70
" Library	5.56
" Record of Science	606.87
	$1,905.11

Memo.

Accounts Due to the Society:

Numismatist and Antiquarian Society, balance of Rent to 1 May, 1894	$50.00
Camera Club, rent	4.00
Prof. Labonde, rent	2.00
Unpaid Subscriptions considered collectable	34.00
	$ 90.00

Examined and found correct

J. W. STIRLING.

Montreal, 28 May, 1894.

Book Notices.

The Canadian Ice-Age. By Sir J. William Dawson, C.M.G., F.R.S. (Montreal: Wm. V. Dawson. New York and London: The Scientific Publishing Company, 1893.)

It is continually brought to the notice of geologists that the most recent period in the long history of the earth is also that which excites the greatest controversy. We can deal complacently with earth-movements, mountain-thrusts, and submergences of half a continent, so long as the organisms affected by these occurrences are less specialized mammals than ourselves; but we find it hard to believe in great physical or climatic changes within the limits of our own written or unwritten history. Moreover, our knowledge of the post-Pliocene period is burdened with an excess of detail; and broad and sweeping generalizations seem at present out of the question. And, if we go one step further, we may fairly attribute our friendly agreement with regard to the conditions of the older periods to our ignorance rather than to our information.

Sir William Dawson, in the present work, summarizes several previous papers of his own, just as M. Gaudry's detailed memoirs were summarized for general use in "Les Ancetres de nos Animaux." This handy paper-bound volume deals strictly with Canada, and is in no way a "Theory of the Earth." It is moderate in tone, and forms a serious plea for a rational treatment of the glacial epoch. Whatever caused the cold conditions in the northern hemisphere, or in parts of the northern hemisphere, it is pointed out that the land-ice in Canada radiated from two local centres, and not from the hypothetical ice-cap at the pole. Readers of *Nature* will remember the evidence brought forward by Dr. G. M. Dawson as to the "Laurentide" centre of glaciation on the east and the "Cordilleran" centre on the west (*Nature*, vol. xlii., p. 650). The conditions maintained by Sir W. Dawson as most favourable to the development of glaciers are high masses of land in proximity to cold seas; and, as he properly points out, these conditions still prevail in North America to a greater extent than in North Europe. They prevail, moreover, in Greenland, but not in Grinnell Land, to cite two closely neighbouring areas.

It will be clear, then, that Sir W. Dawson urges that differential earth-movement was the main factor in the production of Canadian glaciation. The evidence of marine shells in the drift, of the bones of whales, of the character of the deposits themselves, all points to the existence of wide areas of submergence. With regard for example, to the Cordilleran centre in British Columbia, our author writes:

"The conditions were combined of a high mountain chain with the Pacific on the west, and the then submerged area of the great plains on the east, affording next to Greenland the grandest gathering-ground for snow and ice that the northern hemisphere has seen."

Of recent years it has been far too generally assumed that we have to picture the glaciers of the ice-age moving across the features of the country as we at present know them. The views of Prof. Suess with regard to earth-movements in the historic period are perhaps only fair criticism of somewhat hasty observations; but, in face of the extraordinary evidence of post-Pliocene upheavals, it is at least irrational to believe that these terminated with man's appearance on the globe. Many English "glacialists" accept a recent submergence of their country to a depth of 500 feet, and yet postulate the most catastrophic occurrences to account for marine beds at twice that height above the sea. Yet we now have, in addition to the old Lyellian instances, such as the Astian or even later beds in Sicily, which are elevated some 3,000 feet, evidence given us by Prof. Andrew Lawson of a post-Pliocene uplift of the continental coast of California to heights of from 800 to 1,500 feet; and Sir W. Dawson's requirements to explain the distribution of the Canadian drift are such as will seem moderate and natural to every rational uniformitarian.

On page 111 of the present work, the author discusses the possibility of distinguishing striations produced by the "huge ice-islands" in shallow seas from the deeper and firmer markings of true glacier-ice. Granted the submergence, which in itself assists in the formation of snow and ice, the phenomena of the distribution of boulders receive at once their simplest explanation; and in chapter v. the local details of the drifts are taken, area by area, into consideration. Our own British islands must similarly be discussed area by area. Because it seems probable that Scotland in the glacial epoch was a local Greenland, there is no reason why England should also have been lifted above the sea. The evidence accumulating in Ireland goes far in favour of long submergence of that country, with the production of an archipelago of picturesque and snow-capped islands. Hence it is that we may welcome Sir W. Dawson's summary of results in Canada as a reminder that land-ice and enormous terminal moraines are not to be left in undisputed possession of the field. We can even sympathize with him in his final sense of irritation, when he charges some glacialists with "misunderstanding or misrepresenting the glacial work now going on in the arctic and boreal regions." "These are grave accusations," he continues, "but I find none of the memoirs or other writings of the current school of glacialists free from such errors; and I think it is time that reasonable men should discountenance these misrepresentations, and adopt more moderate and rational views."

Of course Sir W. Dawson cannot resist the temptation of stating as "an inevitable conclusion" (page 289) "that the origin of specific types is quite distinct from varietal modification"; but this is a cheerful side-thrust, as it were, in a work on quite another subject. On page 36 the use of "Neozoic" as equivalent to "Tertiary" seems unusual; and on page 51 there is a sentence on the origin of fiords, quoted from an earlier paper by the author, which describes them as "often evidences of the action of the waves." They may have nothing to do with glacial excavation, but still less can they be regarded as products of marine erosion, unless the author confines himself to the cases that he has specially examined in Nova Scotia.

G. A. J. C.

Corrections.

Vol. V., No. 6, April, 1893, p. 366, line 20 from top, for "$1.60 to $2.00" read "$160 to $200."

Vol. V., No. 7, July, 1893, p. 433, in title of article and in headings of following pages, for "Cambrian-Siberian" read "Cambrian-Silurian."

ABSTRACT FOR THE MONTH OF APRIL, 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.
SUNDAY 1	.....	46.1	31.8	14.3	....	......	.....	.	...	....	....	W.	27.9	...	[illegible]		72	0.04	....	0.04	1 .... SUNDAY
2	21.37	31.8	15.0	16.8	30.1038	30.227	29 967	.260	.0658	56 7	8.8	N.W.	17.2	0.7	3	0	93	...	....	....	2
3	29.03	35.5	15.0	20.5	30.1915	30.301	30.029	.272	.0852	51.8	14.3	W.	11.5	5.0	10	0	86	....	....	..	3
4	35.82	41 0	31.2	9.8	29.7397	29.987	29.623	.364	.1888	89 5	33.0	S.	17.9	8.8	10	4	03	0.01	1.2	0.13	4
5	39.92	45.3	33.8	11.5	29.7525	29 947	29.630	.317	.1873	75.3	32.5	S.W.	21.2	8.5	10	2	07	0.01	....	0.01	5
6	32.23	36 5	28.0	8.5	30.0538	30.136	29.998	.138	.1127	61.7	20.7	N.W.	8.6	5.3	10	0	76	....	....	....	6
7	35.45	42.5	26.8	15.7	30.1070	30.162	30.065	.097	.1020	49.7	18.7	N.	6.7	4.3	9	0	47	....	....	....	7
SUNDAY 8	.....	41.4	27.8	13.6	......	.....	......	....	.....	....	....	N.	18.8	....	....	..	14	....	....	....	8 .... SUNDAY
9	36.13	46.0	28.8	17.2	30.3570	30.379	30.331	.048	.1183	56.8	22.2	N.	22.7	0.7	2	0	94	....	....	.	9
10	38.35	47.0	27.8	19.2	30.1863	30.386	30.053	.333	.1297	56.5	24 0	N.E.	17.5	3.5	8	0	78	....	....	....	10
11	39.40	49.2	30.8	18.4	29.9885	30.051	29.912	.139	.1265	53.8	23.5	N.E.	22.1	5.5	9	0	37	....	....	....	11
12	41.97	51.8	33.0	18.8	30.1113	30.130	30.080	.050	.1353	51.8	25 2	N.E.	25.0	7.2	10	0	40	....	....	....	12
13	43.70	54 0	34 0	20.0	30.0760	30.159	30.016	.143	.1198	43.7	22.2	N.E.	26.9	4.7	10	0	91	....	....	....	13
14	43 90	54.4	32 5	21.9	30 0228	30.083	29.970	.113	.1123	42.0	20.5	N.E.	22.0	0.3	2	0	89	....	....	....	14
SUNDAY........15	.....	63.5	32.2	31.3	....	......	......	....	. ..	....	....	N.	8.0	....	...	..	95	....	....	...	15 .... SUNDAY
16	46.77	59.8	33.8	26.0	30.1078	30.166	30.044	.122	.1245	41.7	22 8	N.E.	9 8	4.8	8	0	85	....	...	....	16
17	49.60	62.0	35.5	26.5	30.1612	30.179	30 150	.029	.1550	46.2	27.8	N.	13.9	0 3	2	0	94	....	....	....	17
18	52.60	66.8	35 0	31 8	30.1170	30.258	29.981	.277	.1945	51.5	33.3	S.E.	6.5	6.2	10	0	58	....	....	...	18
19	55.90	60.8	49.8	11.0	29.9197	30.041	29.849	.192	.2820	63.3	43.3	S.	11 6	9.3	10	6	03	Inap	...	Inap	19
20	58.07	68 8	54.0	14.8	29.7983	29.906	29.681	.225	.4500	90.7	55.8	S.	7.6	9.8	10	8	06	0.38	....	0.38	20
21	53.35	60.8	48 8	12.0	29 7198	29.784	29.667	.117	.3387	83.0	48.2	S.W.	11.0	8 2	10	0	00	0 01	....	0.01	21
SUNDAY 22	....	53.5	43.0	10.5	....	.....	......	....	.....	...	....	N.	12.8	....	....	..	00	....	....	....	22 .... SUNDAY
23	46.85	55.2	40.2	15.0	29.8655	29.896	29 848	.048	.2890	89.8	43.7	S.W.	6.4	9.8	10	9	00	0.14	....	0.14	23
24	47.80	55.9	42.1	13.8	30.0342	30.152	29.964	.188	.2197	66.0	36.3	N.	18 5	8.2	10	0	11	....	....	...	24
25	47.30	56.1	34 9	21.2	30.1282	30.229	30.033	.196	.1343	42.0	24.7	N.	18.3	2.2	9	0	94	...	....	...	25
26	53.65	65.0	41.0	24.0	29.9362	30.033	29.856	.177	.2270	53.7	37.0	S.W.	28.5	2.3	8	0	94	....	....	....	26
27	58.33	68.5	47.3	21.2	29.8602	29.945	29.781	.164	.2377	50.2	39.0	S.W.	23.8	3 5	7	0	78	....	....	....	27
28	55.60	64.0	43.5	20.5	29 9042	30.113	29.829	.284	.2365	51.8	37.2	N.W.	13.5	6.8	10	0	35	...	....	....	28
SUNDAY........29	.....	55.5	35.6	19 9	....	......	......	....	.....	....	....	N.	11.0	....	..	..	96	....	....		29 .... SUNDAY
30	58.68	69.5	39 5	30 0	30.2007	30.348	30.057	.291	.2257	46.0	37.3	S.W.	18.0	5.8	10	0	67	Inap	....	Inap	30
....Means	44.89	53.61	35.08	18.52	30.0177	....	......	.183	1840	58.6	30 1	N. 25⅔° W.	16.2	5.3	..	..	54.8	0.59	1.2	0.71	Sums ....
20 Years means for and including this month	39.94	48.43	32.22	16.19	29.9500	....	.....	.204	.1688	66.1	....	......	....	6.2	..	..	51.6	1.54	6.4	2.19	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	2213	3183	346	351	756	3142	969	680	
Duration in hrs .	144	164	24	38	56	172	53	58	11
Mean velocity...	15.4	19.4	14.4	9.2	13 5	18.3	18 3	11.7	

Greatest mileage in one hour was 42 on the 1st.
Greatest velocity in gusts 48 miles per hour, on the 1st.

Resultant mileage 1,908.
Resultant direction, N. 25⅔° W.
Total mileage, 11,640.
Average velocity 16.2 m.p. h.

* 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 69°.5 on the 30th; the greatest cold was 15°.0 on the 2nd and 3rd, giving a range of temperature of 54.5 degrees. Warmest day was the 30th. Coldest day was the 2nd Highest barometer reading was 30.386 on the 10th; lowest barometer was 29.623 on the 3rd, giving a range of 0.763 inches. Maximum relative humidity was 99 on the 20th. Minimum relative humidity was 17 on the 14th.

Rain fell on 8 days.

Snow fell on 1 day.

Rain or snow fell on 8 days.

Auroras were observed on 17th, 24th, 25th.

Lunar halos on 2 nights.

Lunar coronas on 1 night.

Solar halos on 7 days.

Thunder and Lightning on 1 night.

ABSTRACT FOR THE MONTH OF MAY, 1894.

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.
1	68.12	79.0	56.7	22.3	29.9192	30.060	29.816	.244	.3278	48.0	47.2	S.W.	25.2	5.7	10	0	70	....	....	....	1
2	62.82	76.0	50.5	25.5	29.8852	30.106	29.752	.354	.3913	67.7	51.5	S.W.	19.7	7.7	10	2	43	0.01	....	0.01	2
3	53.27	64.0	42.3	21.7	30.1250	30.196	30.048	.148	.2425	58.3	39.2	N.	7.4	2.2	6	0	92	....	....	...	3
4	56.92	63 8	53.8	13.0	29.9747	30.051	29.919	.132	.3922	84.3	52.2	S.	5.2	6.3	10	0	00	0.10	....	0.10	4
5	57.93	68.0	47.3	20.7	29.9700	30 076	29.806	.270	.3467	74.0	48.8	E.	6.0	5.8	10	2	59	Inap	....	Inap	5
SUNDAY...... 6	.....	75 8	57.0	18.8	....	......	......	....	.....	....	....	S.	18.9	....	....	..	24	0.39	....	0.39	6 ....SUNDAY
7	56.72	64.5	51.8	12.7	29.5170	29.601	29.436	.165	.3378	72.0	47.5	S.W.	27.3	7.0	10	0	58	0.45	....	0.45	7
8	54.62	63.4	49.0	14.4	29.6655	29.775	29.623	.152	.2473	58.0	40.0	S.W.	23.0	3.7	10	0	49	0.02	....	0.02	8
9	53.23	60.8	45.1	15.7	29.9947	30.212	29.835	.377	.2473	61.0	39.8	S.W.	19.7	5.5	10	0	52	Inap	....	Inap	9
10	53.15	62.3	41.1	21.2	30.2643	30.353	30.130	.223	.2405	59.3	39.0	E.	12.2	1.3	4	0	98	....	....	....	10
11	55.85	64.5	49.0	15.5	30.1293	30.284	30.002	.282	.2702	60.8	42.0	S.W.	27.0	4.0	10	0	55	0.12	....	0 12	11
12	58.02	68.0	46.9	21.1	30.2260	30.372	30.040	.332	.2508	52 7	40.2	S.W.	22.7	2.8	7	0	83	....	....	....	12
SUNDAY........13	.....	63.6	44.5	19.1	....	......	......	....	.....	....	....	N.W.	24.2	....	....	..	96	....	....	....	13 ....SUNDAY
14	47.52	59.0	37.7	21.3	30.1518	30.269	30.030	.239	.1285	39.3	24.0	N.W.	17.7	2.0	10	0	99	....	...	....	14
15	52.08	64.5	38.6	25.9	29.9305	30.069	29.837	.232	.1593	40.0	28.0	N.W.	17.5	0.0	0	0	99	....	...	...	15
16	56.30	68.0	47.0	21.0	29.8022	29.890	29.726	.164	.2423	52.2	38.8	N.W.	10.0	4.0	10	0	98	....	...	....	16
17	58.45	69.5	47.0	22.5	29.7333	29.799	29 664	.135	.2547	53.8	40.7	N.	6 8	9 2	10	5	00	....	....	....	17
18	56.62	63 5	53.7	9 8	29.6332	29.681	29.592	.089	.4118	89.7	53.0	S.	10 1	10.0	10	10	00	0.57	....	0.57	18
19	57.88	64.8	52.7	12.1	29.7507	29.889	29.647	.242	.4502	93.7	56.2	N.E.	11 2	10.0	10	10	00	0.12	....	0.12	19
SUNDAY 20	....	69.1	54.0	15.1	....	......	......	....	.....	....	....	S.E.	13.3	....	....	..	59	....	....	....	20 ....SUNDAY
21	58.63	68.1	47.5	20.6	30.2465	30.301	30.199	.102	.2875	59.3	44.0	E.	11.7	6.7	10	0	96	....	....	...	21
22	59.47	70.5	46.0	24.5	30 0773	30.211	29.940	.271	.2582	52.8	41.0	S.	11.7	5.8	10	0	83	....	....	....	22
23	61.55	68.8	54.2	14.6	29.8990	29.963	29 865	.098	.3793	69.5	51.5	N.E.	11.7	9.3	10	5	36	Inap	....	Inap	23
24	58.32	69.0	51.8	17.2	29.7605	29.846	29.609	.237	.4100	83.2	53.3	N.E.	13.4	9 7	10	8	16	0 09	....	0.09	24
25	53.15	56.2	50 1	6.1	29.7168	29.772	29.665	.107	.3252	80.2	47.0	N.E.	21.7	10.0	10	10	00	0.51	....	0.51	25
26	56.82	66.5	48.0	18.5	29.8340	29.884	29.790	.094	.3398	74.8	48.3	N.	9.7	7.7	10	0	68	....	....	....	26
SUNDAY........27	.....	71.0	50.6	20.4	....	......	......	....	.....	....	....	S.E.	9.1	....	....	..	74	....	....	....	27 ....SUNDAY
28	55.57	71.0	44.6	26.4	29.7768	29.839	29.704	.135	.3927	88 0	51.8	S.E.	19.2	8 3	10	0	00	0.85	....	0.85	28
29	46.53	54.2	40.0	14.2	29.8847	29 965	29.833	.132	.2367	76.0	38.8	S.W.	19 6	6.5	10	0	49	0.32	....	0.32	29
30	51.05	59.0	40.8	18.2	30.0048	30 036	29.960	.076	.2755	75.3	42.8	S.E.	5.2	6.8	10	0	25	In ap	....	Inap	30
31	52.40	57.1	49.0	8.1	29.7925	29.927	29.633	.294	.3342	85 3	48.0	E.	7.8	10.0	10	10	00	0.18	....	0 18	31
....Means	56.04	65.92	47.91	18.01	29.9135	.....	......	.197	.3030	67.0	44.2	S. 50½° W.	14.7	6.2	..	..	51.0	3.73		3.73	Sums ....
20 Years means for and including this month	54.42	63.69	45.50	18.69	29.9318	.....	......	.168	.2833	65.5	....	......	....	6.3	..	..	50.2	2.94		2.94	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............	1097	1429	634	733	1160	4255	556	1108	
Duration in hrs..	91	99	69	70	96	203	31	62	23
Mean velocity...	12.1	14.4	9.2	10.5	12.1	21.0	17.9	17.9	

Greatest mileage in one hour was 44 on the 25th.
Greatest velocity in gusts 60 miles per hour, on the 7th.

Resultant mileage 2,828.
Resultant direction, S. 50½° W.
Total mileage, 10,972.

*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 79°.0 on the 1st; the greatest cold was 37°.7 on the 14th giving a range of temperature of 41.3 degrees. Warmest day was the 1st. Coldest day was the 29th. Highest barometer reading was 30.372 on the 12th; lowest barometer was 29.436 on the 7th, giving a range of 0.936 inches. Maximum relative humidity was 99 on the 18th, 19th, 25th and 30th. Minimum relative humidity was 25 on the 13th.

Rain fell on 17 days.

Auroras were observed on 7th, 13th, & 30th.

Fog on 3 days.

Thunderstorms on 4 days.

ABSTRACT FOR THE MONTH OF JUNE, 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	50.63	55.7	46.3	9.4	29.4633	29.548	29.377	.171	.3190	86.7	46.5	S.W.	12.0	8.5	10	1	00	0.38	....	0.38	1
2	53.62	61.0	45.0	16.0	29.5860	29.600	29.567	.033	.3210	79.3	46.7	S.E.	9.9	10.0	10	10	04	0.29	....	0.29	2
SUNDAY........3	...	67.2	50.5	16.7	......	.....	......	....	.....	....	....	S.W.	15.7	....	....	..	43	0.15	....	0.15	3 ....SUNDAY
4	54.28	60.0	49.2	10.8	29.6337	29.759	29.506	.253	.3008	71.2	44.2	W.	15.9	5.5	10	0	44	0.01	....	0.01	4
5	50.15	60.0	46.8	13.2	29.7362	29.789	29.661	.128	.2947	81.5	44.7	W.	7.7	8.3	10	0	36	0.28	....	0.28	5
6	49.78	56.4	45.0	11.4	29.9015	29.943	29.845	.103	.2305	69.7	40.0	W.	13.1	3.8	10	0	64	Inap	....	Inap	6
7	55.58	65.0	44.8	20.2	29.7792	29.815	29.742	.073	.2562	59.5	40.8	W.	10.2	1.3	3	0	71	....	....	....	7
8	58.62	68.8	44.8	24.0	29.9177	29.940	29.865	.055	.3262	66.8	47.0	W.	19.0	5.0	10	0	68	....	....	....	8
9	63.23	71.4	53.4	18.0	29.9810	30.029	29.897	.132	.3830	67.3	51.5	W.	18.1	5.0	10	0	33	....	....	....	9
SUNDAY........10	.....	79.4	56.6	22.8	....	......	......	....	.....	....	....	W.	25.9	....	...		58	....	....	....	10 ....SUNDAY
11	72.80	84.0	64.8	19.2	29.9567	29.983	29.926	.057	.5405	68.3	61.2	S.W.	23.2	5.8	10	0	32	....	....	....	11
12	60.65	73.0	55.6	17.4	30.0347	30.090	30.011	.079	.4350	82.3	55.2	N.	11.5	8.3	10	0	00	Inap	....	Inap	12
13	64.63	75.8	50.4	25.4	30.1625	30.190	30.124	.066	.3635	62.7	50.3	N.	9.8	5.5	10	0	49	....	....	....	13
14	65.65	79.6	55.0	24.6	30.1362	30.213	30.048	.165	.4832	70.3	57.8	S.W.	14.3	2.5	10	0	23	....	...	....	14
15	73.48	83.0	62.0	21.0	29.9600	30.052	29.900	.152	.5777	73.3	62.8	S.W.	22.1	4.3	10	0	41	....	....	...	15
16	76.97	84.6	68.0	16.6	29.8232	29.889	29.763	.126	.6813	73.2	67.7	S.W.	23.5	0.0	1	0	34	....	...	....	16
SUNDAY........17	....	83.4	64.0	19.4	....	......	......	....	.....	....	...	S.W.	9.1	....	....	.	00	0.06	....	0.06	17 ....SUNDAY
18	69.47	82.4	64.0	18.4	29.8862	29.916	29.859	.057	.6140	85.7	64.5	N.	7.9	10.0	10	5	07	0.30	....	0.30	18
19	66.05	74.6	62.5	12.1	29.9350	29.987	29.899	.088	.6062	94.3	64.5	N.	7.5	10.0	10	10	00	0.22	....	0.22	19
20	67.98	74.0	62.8	11.2	29.9303	29.949	29.918	.031	.5830	85.5	63.2	S.W.	12.4	7.0	10	1	08	0.04	....	0.04	20
21	72.87	82.0	64.0	18.0	29.9528	30.001	29.854	.147	.6158	77.0	65.0	S.W.	8.8	7.3	10	0	31	...	....	...	21
22	75.23	84.8	67.0	17.8	29.9105	29.985	29.831	.154	.6228	72.0	64.8	S.W.	21.1	2.3	8	0	34	....	....	....	22
23	74.50	85.2	68.5	16.7	29.9210	30.018	29.863	.155	.6427	76.2	66.0	S.W.	17.2	5.7	10	0	10	0.06	....	0.06	23
SUNDAY........24	.....	82.1	60.8	21.3	....	......	......	....	.....	....	....	S.E.	12.9	....	...	..	08	Inap	....	Inap	24 ....SUNDAY
25	72.60	84.8	64.2	20.6	29.8982	29.962	29.856	.106	.6423	81.0	66.0	S.W.	19.7	8.7	10	3	35	0.30	....	0.30	25
26	73.70	82.6	70.6	12.0	29.8092	29.945	29.687	.258	.7133	86.5	69.2	S.W.	13.4	7.3	10	7	20	1.00	....	1.00	26
27	70.37	76.2	66.5	9.7	29.7482	29.808	29.723	.085	.6728	90.7	67.3	S.W.	9.8	10.0	10	10	00	0.94	...	0.94	27
28	69.45	77.8	66.0	11.8	29.9787	30.011	29.908	.103	.4943	68.8	58.7	N.	9.7	3.7	10	0	65	Inap	....	Inap	28
29	71.12	81.1	57.0	24.1	29.9480	30.011	29.877	.134	.6327	82.7	65.5	S.	11.7	5.5	10	0	22	....	....	....	29
30	75.12	82.1	67.0	15.1	29.9225	29.933	29.913	.020	.6155	71.5	64.8	S.W.	17.4	0.3	8	0	61	....	....	....	30
	....	.	.	...	....	....	...	....	.....	...	....	....	..	....	.		.	....	...	...	
....Means	65.83	75.27	58.10	17.16	29.8805	.....	.....	.113	.4991	76.2	57.5	S. 62½° W.	14.4	5.8	..	..	30.2	4.02		4.02	Sums ....
20 Years means for and including this month	64.80	73.60	56.26	17.34	29.9012	....	....	.151	.4324	69.5	....	......	....	5.7	..	..	¶52.3	3.47		3.47	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	970	156	179	466	633	4802	2751	378	
Duration in hrs	91	18	34	39	45	281	174	33	5
Mean velocity...	10.7	8.7	5.3	12.0	14.2	17.1	15.8	11.6	0.0

Greatest mileage in one hour was 36 on the 11th.
Greatest velocity in gusts 40 miles per hour, on the 11th.

Resultant mileage 6,552.
Resultant direction, S. 62½° W.
Total mileage, 10,340.

*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 85°.2, on the 23rd; the greatest cold was 44°.8 on the 7th and 8th, giving a range of temperature of 40.4 degrees. Warmest day was the 16th. Coldest day was the 6th. Highest barometer reading was 30.213 on the 13th; lowest barometer was 29.377 on the 1st, giving a range of 0.836 inches. Maximum relative humidity was 99 on the 19th and 22nd. Minimum relative humidity was 37 on the 13th.

Rain fell on 17 days.

Thunderstorms on 6 days.

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THE

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OF SCIENCE.

VOL. VI. OCTOBER, 1894. NO. 3.

Notes on the Bivalve Shells of the Coal-Formation of Nova Scotia.

By Sir William Dawson, LL.D., F.R.S.

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

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

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

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

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

Vol. X, p. 39.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Genus, NAIADITES, Dawson.

(*Anthracoptera*, Salter.)

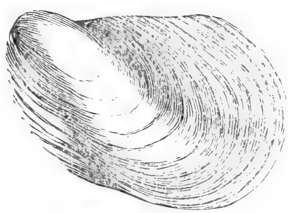
Shell Modiola-like, somewhat triangular in form, broad and rounded behind, somewhat pointed in front, beak at anterior extremity, almost terminal, and extending obliquely backward in a more or less pronounced ridge, hinge-line straight, sometimes showing delicate internal striæ, teeth rudimentary; epidermis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

1. *Naiadites carbonarius*, Dawson.

1

2

3



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

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

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

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

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

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

[1] Chicago Academy, 1880.

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

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

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

2. *Naiadites longus*, s. n.

4

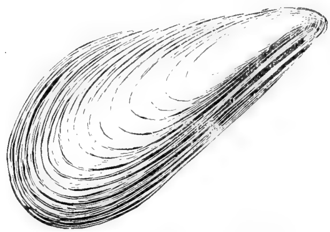


Fig. 4.—*Naiadites longus*, s. n. Middle Coal-formation, S. Joggins, enlarged, × 2.

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

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

3. *Naiadites mytiloides*, s. n.

5

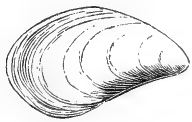


Fig. 5.—*Naiadites mytiloides*, s. n., Chimney Corner, Cape Breton, enlarged × 2.

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

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

Genus ANTHRACOMYA, Salter.

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

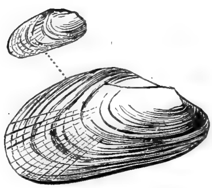
Epidermis thick and sometimes wrinkled, especially in flattened specimens, shell substance usually very thin.

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

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

1. *Anthracomya elongata*, Dawson.

6



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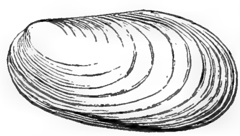

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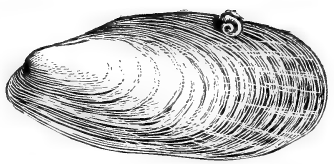


Figs. 6, 7, 8.—*Anthracomya elongata*, Middle Coal-formation, S. Joggins and Mabou, C. Breton. Fig. 6.—Small specimen ,natural size and enlarged. Fig. 7.—Large specimen, natural size. Fig. 8.—Medium specimen with spirorbis attached and anterior end slightly crushed in. Enlarged × 1½.

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

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

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

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

2. *Anthracomya laevis*, Dawson.

9

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

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

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

3. *Anthracomya arenacea*, Dawson.

10

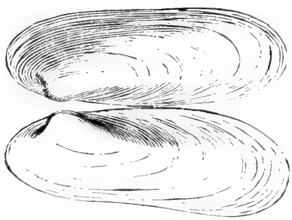


Fig. 10.—*Anthracomya arenacea*, Upper Coal-formation, Pictou, enlarged × 2.

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

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

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

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

4. *Anthracomya ovalis*, Dawson.

11

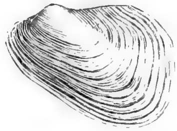


Fig. 11.—*Anthracomya ovalis*, Lower Carboniferous, Parrsboro, enlarged × 2.

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

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

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

5. *Anthracomya obtenta*, Dawson.

12

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

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

13

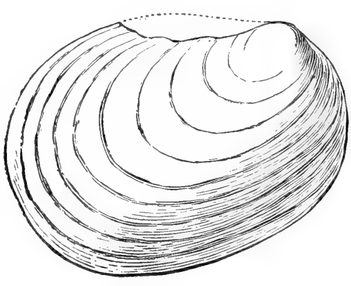


Fig. 13.—*Anthracomya obtenta*, Coal-formation, Pictou, restoration of a flattened and imperfect specimen, enlarged × 2.

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

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

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

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

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

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

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

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

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

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

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

[1] Acadian geology, chap. XI.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

CONTRIBUTIONS TO CANADIAN BOTANY.

By JAS. M. MACOUN.

III.

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

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

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

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

RANUNCULUS ACRIS, Linn.

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

RANUNCULUS BULBOSUS, L.

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

RANUNCULUS CIRCINATUS, Sibth.

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

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

RANUNCULUS CYMBALARIA, Pursh.

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

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

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

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

RANUNCULUS HEDERACEUS, L.

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

RANUNCULUS HYPERBOREUS, Rottb.

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

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

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

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

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

RANUNCULUS NATANS, C. A. Meyer.

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

RANUNCULUS PYGMÆUS, Wahl.

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

ISOPYRUM BITERNATUM, T. & G.

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

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

C. asarifolia, DC.

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

Coptis trifolia, Salisb.

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

Coptis asplenifolia, Salisb.

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

Aquilegia brevistyla, Hook.

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

Delphinium Ajacis, L.

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

Actæa spicata, L., var. arguta, Torrey.

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

Nigella Damascena, L.

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

Berberis aquifolium, Pursh.

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

PAPAVER SOMNIFERUM, Linn.

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

ESCHSCHOLTZIA CALIFORNICA, Cham.

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

CORYDALIS GLAUCA, Pursh.

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

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

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

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

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

NASTURTIUM OFFICINALE, R. Br.

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

NASTURTIUM INDICUM (L.), DC.

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

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

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

ARABIS CONFINIS, Wat.

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

ARABIS HUMIFUSA, var. PUBESCENS, Wat.

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

ARABIS LYALLII, Wat.

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

CARDAMINE BREWERI, Wat.

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

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

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

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

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

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

Sisymbrium Alliaria, L.

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

Sisymbrium officinale, Scop.

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

Sisymbrium sinapistrum, Crantz.

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

Erysimum orientale, R. Br.

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

Eryisimum parviflorum, Nutt.

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

Brassica campestris, Linn.

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

Brassica campestris, L., var. oliefera, DC.

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

BRASSICA SINAPISTRUM, Boiss.

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

BRASSICA RAPA, L.

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

BRASSICA ALBA, Gray.

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

BRASSICA NIGRA, Koch.

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

CAPSELLA DIVARICATA, Wahl.

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

LEPIDIUM SATIVUM, L.

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

THLASPI ARVENSE, L.

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

RAPHANUS RAPHANISTRUM, Linn.

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

SPIESIA OXYTROPIS BELLI, Britton, n. sp.

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

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

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

CERCIS CANADENSIS, L.

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

MYRIOPHYLLUM ALTERNIFOLIUM, DC.

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

PEUCEDANUM BICOLOR, Wat.

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

PEUCEDANUM AMBIGUUM, Nutt.

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

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

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

LONICERA CÆRULEA, Linn.

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

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

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

ANTENNARIA LUZULOIDES, Torr. & Gray.

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

LEPACHYS COLUMNARIS, Pursh.

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

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

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

LACTUCA SCARIOLA, L.

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

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

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

LINARIA CYMBALARIA, Mill.

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

LINARIA CANADENSIS, Dumont.

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

CONOBEA MULTIFIDA, Benth.

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

VERONICA CHAMÆDRYS, Linn.

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

MICROMERIA DOUGLASII, Benth.

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

PODOSTEMON CERATOPHYLLUS, Michx.

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

URTICA URENS, Linn.

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

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

SALIX ARBUSCULOIDES, Andr.

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

SALIX BALSAMIFERA, Barratt.

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

SALIX RICHARDSONI, Hook.

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

SALIX PHYLLICIFOLIA, Linn.

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

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

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

Column slightly incurved, $1\frac{1}{2}''$ long. Flowers greenish-yellow, the lip with a purplish middle, and purplish nerves radiating into the apical lobes. The flowers and column, as well as the leaves and upper stem, bear the silky hairs mentioned, some of which are 2″ long.

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

PHALARIS MINOR, Retz.

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

AGROSTIS INFLATA, Scribner, n. sp.

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

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

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

AVENA STRIGOSA, Schreb.

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

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

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

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

VISCOMETRY.

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

Assistant Analyst, Inland Revenue Laboratory, Ottawa.

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

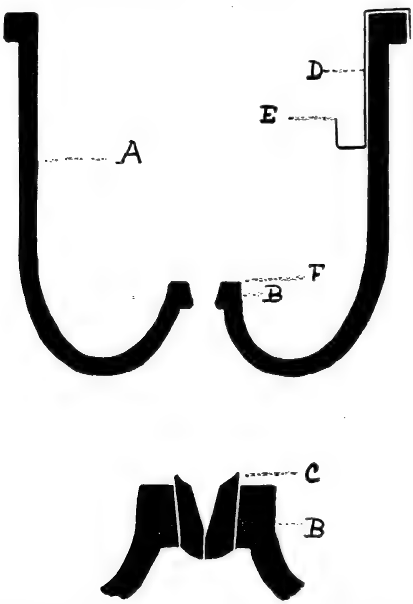
This is a better result than I have been able to get with

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

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

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

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



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

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

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

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

1. Temp. 250° F. (means)—

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

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

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

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

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

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

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

Parasitic Protozoa.

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

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

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

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

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

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

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

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

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

3. Bodies having a segmented appearance.

4. Bodies broken up into spores.

5. Crescentric bodies with pigment masses.

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

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

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

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

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

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

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

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

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

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

The Annual Field Day.

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

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

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

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

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

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

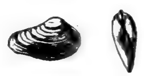
Short speeches were also made by Dr. Wesley Mills, Mr. John S. Shearer, Dr. Bigonnesse of St. Jerome and others. The society then left for Montreal, tea being served on the train. Prizes had been offered for the best collections in Natural History, and were awarded as follows : Geological collections—named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

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

Appendix to Paper on Bivalve Shells of the Coal Formation.

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

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



Carbonicola Bradorica.

Note.

The deepest bore-hole in the world is at Paruschowitz, in Upper Silesia, Germany On May 17, 1893, a depth of 2,000 meters (6,552 feet) was attained, when drilling was interrupted pending a series of thermometrical observations, for the carrying out of which the hole is being sunk. When these observations are completed, drilling will be resumed and continued as far as possible. The diameter of the hole at the bottom is 7 cm. (about 2.8 inches). The rod of the drill is composed of Mannesman tubes, without which it is doubtful if the present great depth (through hard rock) could have been reached.

Note to Paper on Viscometry.

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

Erratum.

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

ABSTRACT FOR THE MONTH OF JULY, 1894.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY.... ..1		84.2	67.1	17.1							....	S,W.	15.4	....	....	.	58	....	...	....	1 ....SUNDAY
2	78.28	89.8	66.4	23.4	29.9267	30.000	29.827	.173	.6583	63.8	66.5	S.W.	16.0	7.8	10	0	48	0 15	....	0.15	2
3	68.80	80 2	65.0	15.2	29 7513	29.811	29 706	.105	.5585	79 7	61.8	S.W.	12.4	7 3	10	1	47	0.89	....	0.89	3
4	65.58	74.2	59.8	14.4	29.7403	29.756	29.713	.043	.4897	79 0	58.3	S.W.	17.8	2 5	7	0	81	0.08	....	0.08	4
5	62.42	68 0	55 8	12.2	29.8157	29 837	29.776	.061	.4147	74.0	53 7	W.	12 5	4.3	10	0	44	0.01	....	0.01	5
6	66.58	77.0	52.1	24.9	29.7170	29.843	29 611	.232	.4648	72.2	57.0	W.	12.2	2 3	10	0	80	Inap	....	Inap	6
7	60.68	67 4	58.5	8.9	29.7547	29.879	29.658	.221	.4165	78.7	53.8	W.	15.1	9.5	10	7	41	0.23	....	0.23	7
SUNDAY........8	.....	63.2	52.0	11.2	......	.....	......	....	. ..	..	....	W.	15.2	....	...	.	22	Inap	....	Inap	8 ....SUNDAY
9	63.32	70.1	55.4	14.7	30.0402	30.064	30.022	.042	.4203	73.0	54.0	S.W.	13 7	6.2	10	0	34	0.03	...	0.03	9
10	64.67	74.5	58.6	15.9	30.0257	30.067	29.986	.081	.4403	72.3	55 5	W	12.7	6 5	10	2	31	Inap	....	Inap	10
11	67.12	76.0	56.0	20.0	29.9110	29.991	29 835	.156	.5072	77.3	59.2	S. W.	13.3	6.2	10	0	50	Inap	....	Inap	11
12	68 57	74.5	63.1	11.4	29.7355	29.899	29 691	.208	.6062	87 2	64 5	S.W.	17.0	10.0	10	10	08	0.09	....	0.09	12
13	69.00	79 9	62.0	17.9	29.6877	29.811	29.587	.224	.5733	81.0	62.8	S.W.	17.5	8 0	10	3	53	0.34	....	0.34	13
14	67.13	75.8	54 4	21.4	29.8373	29 836	29.810	.086	.4827	73.3	58.0	W.	6 0	7.7	10	0	49	....	...	....	14
SUNDAY 15	....	74 4	59.6	14.8	. ...	.....	......	...	. ...	..	....	S.E.	7 5	....	...	.	56	...	....	....	15 ....SUNDAY
16	68.12	78.1	58.1	20.0	30 0957	30.117	30.079	.038	.4318	64.2	55.5	S.W.	4.8	1.7	7	0	83	....	..	....	16
17	72 57	83.2	59.5	23.7	30.1282	30.166	30.103	.063	.4895	62.8	55.5	S.W.	6.5	3.3	8	0	90	....	....	...	17
18	74 82	85.0	62 0	23 0	30.0812	30.147	30.013	.131	.5557	65.5	61.8	S.W.	6.5	3.0	8	0	76	....	....	....	18
19	78.83	88 4	69.1	19.3	29.9282	30 006	29.870	.136	.6955	70 0	63 2	S.W.	12.8	1 2	4	0	74	.	...	....	19
20	77.48	89 5	67.8	21.7	29.8083	29.863	29 738	.125	.6402	69.0	65.8	S.W.	2[illegible] 3	3.8	10	0	76	0 13	..	0.13	20
21	62.40	70 5	57.1	13.4	29.9538	30.003	29.904	.099	.4380	77.7	55 7	N,E.	14.8	8.3	10	0	07	0 34	....	0.34	21
SUNDAY........22	.....	78 1	55.9	22.2	......	.....	......	....	....	...	..	N E	5.2	...	.	..	98	0 01	....	0.01	22 ....SUNDAY
23	72.48	82 7	60.6	22.1	30 0517	30.094	30.014	.080	.5310	67.8	60.5	S.E.	7.0	0.8	5	0	96	...	....	....	23
24	61 90	72.8	58.6	14.2	29.9322	30.039	29.852	.187	.4905	88.8	58.3	S.E.	9 8	10.0	10	10	00	0.41	....	0 41	23
25	68.38	79.0	59 9	19.1	29.9477	30.046	29.891	.152	.5297	77.3	60.5	S.W.	13.3	7.7	10	1	42	Inap	....	Inap	25
26	60.47	68.6	53.6	15.0	30.2322	30.292	30.109	.183	.3672	70 5	50.4	N.	8.6	4 3	10	0	56	..	....	....	26
27	73.32	84.5	56.4	28.1	30 0665	30.169	29.954	.215	.5785	70 2	62 2	S.W.	12.9	4 2	7	0	75	....	...	. ..	27
28	80.18	89.0	74.1	14.9	29.8785	29.950	29.802	.148	.6468	63 0	66.3	S.W.	22 5	6.2	10	0	35	...	....	....	28
SUNDAY 29	.	84.3	68 5	15 8	.....	....	....	....	.....	..	...	S.W	20 7	....	.		48	0.01	....	0.01	29 ....SUNDAY
30	71.58	82.5	62 5	20 0	29.8573	30 010	29.806	.204	.5712	74.3	62.3	S.W.	19 0	4.0	10	0	69	0 10	....	0.10	30
31	62.10	69.6	53.0	16.6	30 0520	30.100	30.008	.092	.3562	65.3	49.5	S.W.	9.6	1.5	4	0	100	....	...	...	31
....Means	68.73	77 90	60.08	17.82	29.9214	....	....	.134	.5136	73.2	59.25	S. 58½° W.	12.96	5.3		.	55.7	2.81	....	2.82	Sums ....
20 Years means for and including this month	68.82	77.31	60.70	16.61	29.8923	....	....	.140	.5002	71.1	....	......	....	5 4	..	.	¶59.0	....	....	....	20 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	502	246	85	526	420	5259	1967	635	
Duration in hrs .	47	32	13	53	50	353	139	52	5
Mean velocity...	10 7	7 7	6 5	9.9	8.4	14.9	14 2	12.2	0.0

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

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

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

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only.

The greatest heat was 89.8° on the 2nd; the greatest cold was 52°.0 on the 8th, giving a range of temperature of 37°8 degrees.

Warmest day was the 28th. Coldest day was the 26th Highest barometer reading was 30.292 on the 26th: lowest barometer was 29.611 on the 6th, giving a range of 0.681 inches. Maximum relative humidity was 97.0 on the 3rd and 24th. Minimum relative humidity was 42 on the 16th.

Rain fell on 19 days.

Auroras were observed on 1 night.

Fog on 2 days.

Thunderstorms on 4 days.

ABSTRACT FOR THE MONTH OF AUGUST, 1894.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.
1	64.75	71.2	57.6	13.6	30.0352	30.073	30 002	.071
2	65.33	71.5	60.0	11.5	29 8608	29.977	29.788	.189
3	69.43	79.3	61.0	18.3	29.7462	29.840	29 666	.174
4	60.28	65.7	56.3	9.4	29.9227	30.015	29.839	.176
SUNDAY.........5	.....	76.7	55.3	21.4	....	......	.....	...
6	69.77	79.4	61.3	18.1	30.0412	30.122	29.907	.215
7	68.33	78 2	64.1	14.1	29.9470	30.001	29.884	.117
8	67.52	80.6	56.6	24.0	29.8623	29.903	29.813	.090
9	59.07	68.6	51.8	16.8	29.9650	30.019	29.896	.123
10	60.00	68.0	52.4	15.6	30.0720	30.104	30.037	.067
11	60.33	68.5	50.5	18.0	30.1497	30.213	30.094	.119
SUNDAY........12	.....	69.1	54.2	14.9	......	......	......	....
13	63.08	70.0	58.0	12.0	29.9443	30.005	29.912	.093
14	68.25	79.5	59.2	20.3	29.9710	30 049	29.888	.161
15	64.77	70 1	59.0	11.1	29.8133	29.885	29 744	.141
16	61.80	69.5	53.8	15.7	29.9415	29.982	29 906	.076
17	60 47	69.5	52.2	17.3	30.0270	30.074	30.003	.071
18	61.32	69.5	52.0	17 5	29.9492	29.998	29.906	.092
SUNDAY.. 19	....	70.8	52.2	18.6	....	.....	......	....
20	61.30	71.5	53.0	18.5	29.9272	30.026	29.866	.160
21	52.15	60.5	49.0	11.5	30.0385	30.082	29.997	.085
22	59.68	73.1	45.0	28.1	29.9940	30.068	29.939	.029
23	66.65	75.5	58.3	17.2	29 9973	30.053	29.953	.100
24	70.73	80.5	63.1	17.4	29.9315	29 989	29 876	.113
25	68.77	77.2	64 0	13.2	29.8945	29.990	29.851	.139
SUNDAY........26	.....	64.8	44.8	20.0	....	......	......	....
27	54.48	60.2	45.6	14.6	30.0548	30.153	29.928	.225
28	58.77	65.8	52.4	13.4	29.9992	30.084	29.882	.202
29	57.83	64.2	45.9	18.3	30.0540	30.115	29.995	.120
30	58.98	66 2	53.6	12 6	29.8643	29.923	29.827	.096
31	62.30	72.6	53.0	29.6	29.8910	30.047	29.811	.236
....Means	62.82	71.55	54.69	16.86	29.9591	....	......	.129
20 Years means for and including this month	66 75	75 07	58.68	16.43	29.9421	....	.....	.133

DAY.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	WIND. 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	.3633	59.8	50.2	N.	7.7	6.5	10	0	51	Inap.	...	Inap.	1
2	.5055	79.8	58.8	S.E.	9.7	8.3	10	0	02	0 12	....	0.12	2
3	.5197	71.8	59.5	S.W.	18.6	7 8	10	1	51	Inap.	....	Inap.	3
4	.3647	70 3	50.3	S.W.	20.0	6 7	10	0	48	....	....	....	4
5	.....	....	....	S.W.	18 2	....	....	.	79	....	....	....	5 ....SUNDAY
6	.4675	64.7	57.0	S.W.	19.0	5.0	10	0	78	....	....	....	6
7	.4922	71.5	58.3	S.W.	15.3	8.0	10	0	12	Inap.	....	Inap.	7
8	.4807	71.8	57.3	S.W.	13.0	5.5	10	0	53	0.02	....	0.02	8
9	3668	74.5	50.3	N.	17.0	6.8	10	3	60	0.59	....	0.59	9
10	.3258	63.3	47.2	N.W.	11.7	4.2	7	0	80	0.01	....	0.01	10
11	.3257	63.3	47.3	S.E.	5.7	1.5	4	0	80	....	....	....	11
12	. ..	....	....	S.E.	10.0	...	...	.	10	0.40	....	0.40	12 ....SUNDAY
13	.5148	89.5	60 0	S.	6.7	7.2	10	0	00	0.11	....	0.11	13
14	.5572	81.8	62.0	S	8.4	4.3	10	0	63	....	...	..	14
15	.5335	86 2	60 7	N.W.	15 5	8.3	10	0	11	0 36	....	0.36	15
16	.3243	60.3	47.2	N.W.	12.5	1.8	10	0	85	....	....	....	16
17	.3040	58.8	45.2	N.	7.4	0.7	3	0	72	....	....	....	17
18	.4348	79.7	54.8	S.W.	10.7	5.8	10	0	06	0.02	....	0.02	18
19	.....	.	....	N.	8.2	....	..	.	44	Inap.	....	Inap	19 ....SUNDAY
20	3667	67.0	49.8	N.W.	16 4	4.8	10	0	40	0.01	....	0.01	20
21	.2452	63.3	39 7	N.W.	20.2	3.0	7	0	85	....	....	...	21
22	.3442	66.7	48.0	S.W.	24.6	5 2	10	0	38	...	....	....	22
23	.4398	67.8	55.2	S.W.	22.5	3.3	10	0	53	....	....	....	23
24	.5093	67.2	59.0	S.W.	21 2	5 8	10	0	44	...	....	....	23
25	.5288	73.5	60.0	S.W.	20.4	6.5	10	0	89	0.05	....	0.05	25
26	.....	....	....	N.	12.4	....	....	..	90	....	....	. .	26 ....SUNDAY
27	.3315	78.0	47.3	S.E.	8.4	7.2	10	0	22	0.06	....	0.06	27
28	.4102	82.2	53.7	N.W.	13 1	10.0	10	10	11	....	....	....	28
29	.3320	70.2	47.5	N.	6.7	7 5	10	0	38	....	....	...	29
30	.3978	80.2	52 7	N.E.	5.7	6.7	10	0	03	....	....	. .	30
31	.4078	73.2	53.0	S.W.	16.1	5.0	10	0	60.	0 05	....	0.05	31
Means	4146	71 7	53 04	S. 62⅔° W.	13.7	5.7	..	.	47.0	1.80	....	1.80	Sums ....
20 Years means for and including this month	.4805	72 8	....	......	....	5 4	..	..	¶54.5	....	....	....	20 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	1139	453	294	592	897	4612	657	1516	
Duration in hrs..	99	44	44	63	81	250	58	104	1
Mean velocity...	11 5	10.3	6.7	9.4	11.1	18.4	11.3	14.6	

Greatest mileage in one hour was 35 on the 3rd.

Greatest velocity in gusts 48 miles per hour, on the 24th.

Resultant mileage, 4454.

Resultant direction, S. 62⅔° W.

Total mileage, 10160.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only

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

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

Rain fell on 16 days.

Auroras were observed on 1 night

Fog on 5 days.

Earthquake on the 27th.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1894.

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

DAY	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches	Snowfall in inches.	Rain and snow melted.	DAY.
1	59.87	71.7	44.5	27.2	30.0082	30.103	29.912	.191	.3345	64.7	47.3	S.W.	16.4	6.3	10	0	46	Inap.	....	Inap.	1
SUNDAY.......2	.....	66.5	52.8	13.7	....	......	......	...	.. .	....	...	S.W.	17.4	....	....	.	00	....	....	....	2 ....SUNDAY
3	55.02	63.8	47.9	15.9	30.1868	30.253	30.102	.151	.3268	75.2	47.2	N. E.	12.1	10.0	10	10	24	....	....	..	3
4	64.40	74.2	51.0	23.2	29.9993	30.097	29.910	.187	.4837	79.5	57.7	S.	14.3	5.7	10	0	00	0.15	....	0.15	4
5	68.75	74.5	61.2	13.3	29.9808	30.069	29.917	.152	.5825	81.8	62.8	S.W.	17.5	5.5	10	0	00	0.10	....	0.10	5
6	67.10	73.6	64.0	9.6	30.0933	30.214	30.040	.174	.4307	64.7	54.7	S.W.	12.8	5.8	10	0	42	....	....	....	6
7	60.70	64.8	55.2	9.6	30.0467	30.079	29.948	.131	.4135	78.0	53.8	N. E.	10.5	6.3	10	0	50	...	....	....	7
8	58.67	65.8	47.7	18.1	29.8913	30.070	29.762	.308	.4498	88.2	55.2	N. E.	16.8	8.3	10	0	00	0.29	....	0.29	8
SUNDAY........9	.....	75.7	61.8	13.9	......	......	......	....	. ..	....	....	W.	14.0	...	...	.	61	0.01	....	0.01	9 ....SUNDAY
10	63.75	75.4	54.3	21.1	29.6583	29.816	29.532	.284	.4935	81.0	57.7	S.W.	20.2	6.7	10	0	62	0.22	....	0.22	10
11	54.15	61.1	49.6	11.5	29.9617	30.139	29.821	.318	.2968	71.5	44.7	W.	15.0	2.3	8	0	06	Inap.	....	Inap.	11
12	55.52	63.8	45.2	18.6	30.3582	30.436	30.237	.199	.3118	70.0	45.5	S.W.	9.3	0.0	0	0	96	....	....	....	12
13	60.32	69.5	47.0	22.5	30.4943	30.626	30.397	.229	.4168	79.2	53.3	S.E.	9.7	6.3	10	0	52	.. .	....	...	13
14	58.95	62.3	57.0	5.3	30.2672	30.357	30.171	.186	.4687	93.7	57.2	S.	11.6	10.0	10	9	00	0.11	...	0.11	14
15	62.85	70.4	56.9	13.5	30.0783	30.106	29.967	.199	.5302	92.3	60.5	S.E.	6.1	8.5	10	3	29	....	....	..	15
SUNDAY.......16	....	74.3	63.4	10.9	....	......	......	....	.....		....	S.W.	13.0	....	...	.	07	0.07	..	0.07	16 ....SUNDAY
17	63.27	71.3	53.1	18.2	30.0895	30.145	30.058	.087	.3997	70.5	52.7	S.W.	7.5	0.8	3	0	73	....	....	...	17
18	63.72	71.5	55.9	15.6	30.0618	30.107	30.028	.079	.4412	76.0	55.7	N. E.	6.2	2.3	10	0	55	...	....	....	18
19	60.92	67.5	53.6	13.9	30.0063	30.061	29.923	.138	.4265	79.7	54.2	N. E.	11.7	9.2	10	5	08	0.04	....	0.04	19
20	60.22	64.9	56.2	8.7	29.7015	29.828	29.560	.268	.5000	95.8	59.0	N. E.	11.2	10.0	10	10	03	1.65	....	1.65	20
21	64.23	71.3	56.1	15.2	29.8810	29.933	29.769	.164	.5110	85.8	59.3	S.W.	15.8	5.8	10	0	28	0.01	....	0.01	21
22	67.07	78.5	57.6	20.9	29.9238	29.976	29.860	.116	.5273	79.7	60.0	S.W.	15.2	1.7	10	0	34	...	....	....	22
SUNDAY........23	.....	74.5	58.9	15.6	....	......	......	....	.....	....	....	S	18.1	....	....	..	42	0.04	....	0.04	23 .... SUNDAY
24	54.03	64.1	48.6	15.5	29.9142	30.025	29.746	.279	.3455	82.5	48.8	S.W.	16.4	8.3	10	0	11	....	....	....	23
25	45.57	51.7	40.0	11.7	30.2878	30.449	30.110	.339	.2473	80.8	39.7	N.W.	7.8	6.7	10	0	00	....	....	....	25
26	45.38	53.2	35.0	18.2	30.4122	30.559	30.242	.317	.2597	84.5	40.8	S.E.	8.4	0.8	5	0	12	...	....	.	26
27	54.30	63.8	40.8	23.0	30.1305	30.213	30.073	.140	.3147	74.7	46.0	S.	11.1	5.8	10	0	70	0.04	....	0.04	27
28	58.60	69.2	47.0	22.2	30.0593	30.108	30.020	.088	.3940	81.2	52.2	S. W.	7.4	0.8	5	0	68	....	....	..	28
29	63.82	73.4	54.3	19.1	....	30.051	29.983	.068	.4667	79.0	56.7	S. W.	11.7	0.0	0	0	69	....	....	...	29
SUNDAY....... 30	.....	69.6	48.6	21.0	30.0265	......	......	.236	.....	...	....	S.E.	15.3	...		0	62	....	....	.	30 .... SUNDAY
....Means	59.65	68.40	52.17	16.22	30.0608	....	......	.192	.4141	79.6	52.91	S. 31¼° W.	12.7	5.4	..	.	33.6	2.73	....	2.73	Sums ....
20 Years means for and including this month......	58.52	66.64	50.81	15.83	30.0187	.....	......	.179	.3811	75.4	....	......	....	5.6	..	..	¶53.3	....	....	....	20 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles............	290	1105	152	1017	1462	3914	852	339	
Duration in hrs..	29	95	20	85	124	251	72	38	6
Mean velocity...	10.0	11.6	7.6	12.0	11.8	15.6	11.8	8.9	

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

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

Resultant mileage, 4254.

Resultant direction, S. 31¼° W.

Total mileage, 9131.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only

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

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

Rain fell on 14 days.

Auroras were observed on 1 night

Fog on 4 days.

Lightning on 5 days.

Severe thunderstorms on the 8th and 20th.

Heavy thunder on 3 days.

Extremely smoky atmosphere on the 2nd.

ABSTRACT FOR THE MONTH OF OCTOBER, 1894.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches	Snowfall in inches.	Rain and snow melted.	DAY
1	51.90	55.8	49.4	6.4	29.8695	29.960	29.812	.148	.3023	73.0	46.2	S.W.	14.6	10.0	10	10	07	0 10	....	0.10	1
2	49.10	54.2	44.1	10.1	29.9060	29.989	29.817	.172	.2283	65.8	38.0	N.W.	9.7	8.7	10	3	46	Inap.	....	Inap.	2
3	53.63	62.5	47.8	14.7	29.7818	29.946	29.658	.288	.3493	82.8	48.3	E.	14.9	10.0	10	10	00	0 36	....	0.36	3
4	58.12	65.5	52.5	13.0	29.7102	29.736	29.673	063	4153	86.3	53.8	S.W.	14.5	7.8	10	2	11	0.04	....	0.04	4
5	51.78	56.5	49.7	6.8	29.5707	29.639	29.532	.107	.3438	89.0	48.5	S.W.	14 2	7.7	10	0	00	0.08	....	0 08	5
6	48.42	56.5	40 0	16.5	29.8920	30.085	29 699	.386	.2428	71.3	39.0	W.	13.9	6.5	10	0	14	....	....	....	6
SUNDAY. 7	.....	51.5	39.1	16.0	......	......	....	...	.....	....	..	W.	6 3	....	....		32	...	...	....	7 ... .SUNDAY
8	54.57	62.3	42.6	19.7	29.8432	30.043	29.685	.358	.3193	75.7	46.7	S.	9.5	6.8	10	0	25	0.44	....	0.44	8
9	46.62	55.7	42.0	13.7	29.8255	29 904	29.761	.143	.2393	76.2	39.0	S.W.	11.5	7.3	10	0	00	0.01	....	0.01	9
10	44.58	48.3	40.7	7 6	29.5893	29.863	29.353	.510	.2760	92.2	42.8	N.	16.2	8.3	10	0	00	0.98	....	0.98	10
11	45.32	50 3	43.1	7.2	29.7090	30.043	29 460	.583	.2498	82.3	40.2	W.	15.0	8 7	10	6	00	0.18	....	0 18	11
12	45 75	52.2	38.1	14.1	30.1505	30.195	30.093	.102	.2247	74.0	37.5	W.	6 6	4 5	10	0	17	Inap.	...	Inap.	12
13	47.65	51.6	42.1	9.5	29 7915	29.951	29.631	.320	.3083	92.7	45.7	S.	3.1	10.0	10	10	00	0.56	....	0.56	13
SUNDAY.... ...14	....	51.5	35.0	16.5	.. ...	......	......	....	. ..	..	....	W.	12.5	...	...		00	0.10	Inap.	0.10	14 ....SUNDAY
15	37.15	47.5	34.1	13.4	29.8525	29.947	29.664	.283	.1340	60.8	24.8	W	29 0	7 7	10	1	00	....	Inap.	Inap	15
16	43.52	47.0	36.2	10.8	29.5242	29.827	29.183	.644	2570	90.5	41.0	S W.	19 7	10 0	10	10	00	0.30	..	0.30	16
17	46.60	52.7	40.2	12.5	29.3972	29 640	29.174	.466	.2268	75.2	37.7	S.W.	25.3	7.2	10	1	16	0.03	....	0.03	17
18	43 78	51.3	38.0	13.3	29 9107	30.052	29.745	307	.1958	70.0	33.5	W.	18.3	3.8	10	0	6)	....	....	....	18
19	48.03	56.9	41.1	15.8	30.0150	30.102	29 928	.174	.2605	78.8	41.8	S.W.	9 0	5.7	10	0	54	..	...	....	19
20	47.20	52.3	42.1	10.2	30.0915	30.179	29.986	.193	.2827	85.8	43.7	N. E.	8.3	10.0	10	10	00	0.01	..	0.01	20
SUNDAY.. 21	.....	55.5	40.7	14.8	. .....	.....	......	...	. ...		....	N. E,	9 7	....	....		12	Inap.	....	Inap	21 ....SUNDAY
22	48.50	58.1	40.5	17.6	30.2430	30.270	30 193	.077	.2833	82.2	43.3	N. E.	6.5	3.0	10	0	83	...	...	....	22
23	53.15	57.9	48.2	9.7	30.2187	30.264	30.176	.088	.3400	84.5	48 2	S	0 7	10.0	10	10	00	0.06	...	0.06	23
24	50.20	54 3	48.1	6.2	30.1387	30.261	30.023	.238	.3268	89.8	47.2	S.	2.5	10.0	10	10	00	Inap.	...	Iaap	24
25	48.90	56.5	47 0	9.5	30.2185	30.299	30 106	.193	3000	86.7	45 2	N.	7.3	7.5	10	0	19	Inap.	...	Inap	25
26	48.17	53.7	38.2	15.5	29.9858	30.091	29.919	.172	.2893	85.8	44.0	N.	11.8	4.3	10	0	12	0 01	....	0.01	26
27	51.12	58.5	42.6	15.9	29.9,80	30.048	29.931	.117	.3050	82.2	45 5	N.	7.0	1.7	10	0	36	....	...	..	27
SUNDAY 28	.....	60.3	42.0	18.3	....	......	......	....	....	...	....	S.W.	4 1	....	....	..	69	...	....	.	28 ....SUNDAY
29	49.85	60.7	41.0	19.7	30.0687	30.103	30.036	.067	.2962	83 3	41.2	N.	12.2	1.7	10	0	72	Inap.	..	Inap	29
30	49 43	61.7	38.0	23.7	30.1002	30.154	30.050	.104	.2588	75.3	40 8	N.	12.5	3.3	5	0	68	...	...	...	30
31	49.77	53.6	47.2	6.4	29.6915	29 995	29.375	.620	.3077	86.0	45.7	S.	20.3	8.3	10	5	00	0 77	....	0.74	31
....Means	48.62	55.37	42.30	13 07	29.8942	....	.....	.256	2801	80.7	42.57	S. 62¼° W.	11.8	7.0	..	.	21.4	4.03	Inap.	4.03	Sums ....
20 Years means for and including this month	45.56	52.57	38.87	13.70	29.9958	....	....	.211	.2455	76 6	...	.....	....	6 5	..	.	¶40.2	3.21	1 34	3.34	20 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	1083	647	434	541	686	3175	2084	151	
Duration in hrs..	108	64	45	50	89	213	133	13	29
Mean velocity...	10.0	10.1	9.6	10.8	7.7	14.9	15 7	11.6	

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

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

Resultant mileage, 3575.

Resultant direction, S. 62¼° W.

Total mileage, 8801.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 13 years only

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

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

Rain fell on 22 days.

Snow fell on 2 days.

Lunar halos on the 9th and 12th.

Fog on 3 days.

Rainbow on the 16th.

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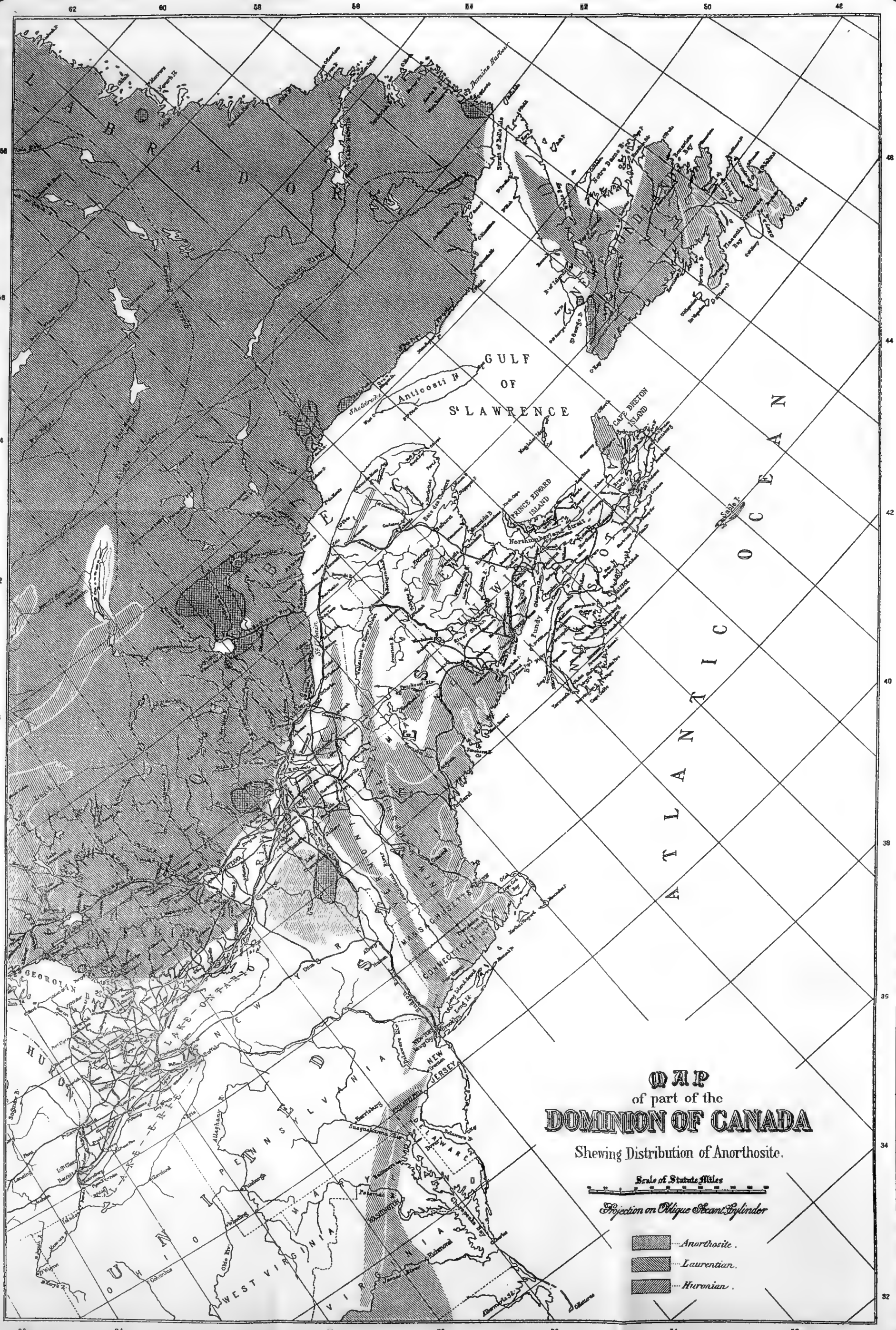
MAP
of part of the
DOMINION OF CANADA
Shewing Distribution of Anorthosite.
Scale of Statute Miles
Projection on Oblique Secant Cylinder
Anorthosite.
Laurentian.
Huronian.
LABRADOR
GULF OF St LAWRENCE
Anticosti I.
PRINCE EDWARD ISLAND
CAPE BRETON ISLAND
Sable I.
ATLANTIC OCEAN
Bay of Fundy
MASSACHUSETTS
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THE

CANADIAN RECORD

OF SCIENCE.

VOL. VI. OCTOBER, 1894. NO. 4.

On the Norian or "Upper Laurentian" Formation of Canada.[1]

By Frank D. Adams, M.A.Sc., Ph.D.

(Translated from the German by N. J. Giroux, Esq., C. E., of the Geological Survey of Canada.)

TABLE OF CONTENTS.

[1] This paper appeared in the Neues Jahrbuch für Mineralogie in 1893 (Beilage-band VIII). As it presents a somewhat exhaustive treatment of a celebrated series of Canadian rocks, it has been thought advisable to present a translation of it to Canadian readers. Since the publication of the paper further investigation has brought to light some few additional facts concerning these rocks, but it has been thought best to present the paper exactly as it originally appeared, making any necessary additions to it in the form of occasional foot notes. The editors of the Record of Science are indebted to Mr. N. J. Giroux, C.E., of the Dominion Geological Survey, for a literal translation of the paper.

The original paper in German was accompanied by two excellent maps printed in colours, from which the maps accompanying the present translation are taken. Those particularly interested in the distribution of these Norian rocks are referred to the original maps, as in these the relative position of the several areas is shown with greater clearness.

Correction in Large Map.—Owing to a mistake on the part of the lithographer, the Adirondack Archean area has been represented as Huronian. It should have been represented as of Laurentian age, since, with the exception of the Anorthosite, it consists of rocks of the Grenville series.

3. The Saguenay anorthosite area.
4. Various other anorthosite areas.
   (*a*) In Labrador.
   (*b*) In Newfoundland.
   (*c*) On the north shore of the Gulf of St. Lawrence.
   (*d*) On the north shore of the River St. Lawrence.
   (*e*) In the State of New York, U. S. A.
   (*f*) On the east coast of Lake Huron.
   (*g*) Elsewhere in Canada.
5. Age of the anorthosite intrusions and their relation to the margin of the archaean protaxis.
6. Occurrence of similar anorthosites in other countries.
7. General summary of the results.
8. Tables of analyses.
9. Literature relating to the anorthosites of Canada.

The present paper is based upon a study of the Canadian anorthosites in the field, a work which was carried out for the Geological Survey of Canada and occupied five summers, as well as upon the examination of a large number of thin sections of these rocks and a careful study of all the literature relating to them.

The petrographical part of the work was done for the most part in the Mineralogical Institute of the University of Heidelberg, and I take the liberty of expressing my hearty thanks to my teacher, Professor Rosenbusch, for his assistance and advice during the progress of the work.

I am furthermore under special obligations to Dr. A. R. C. Selwyn, Director of the Geological Survey of Canada, for permission to make use of material hitherto unpublished and which is the property of the Geological Survey Department.

I.—GENERAL STATEMENT CONCERNING THE GEOLOGY OF THE LAURENTIAN.

The nucleus of the North American continent consists, as is well known, of a large area of Archaean rocks which lie, for the most part, in the Dominion of Canada, and occupy an area of not less than 2,031,000 square miles. They form what Suess [1] calls "the Canadian shield" as well as the more mountainous district along the coast of Labrador.

[1] Suess, Das Antlitz der Erde, Bd. II., p. 42.

Speaking generally we may say that the southern limit of this area extends from Lake Superior in a north-easterly direction along the Lower St. Lawrence as far as Labrador, and north-westerly to the mouth of the Mackenzie River on the Arctic Ocean. North of these limits, as far as the coast of the Arctic Ocean, almost the whole area is composed of the old crystalline rocks, and although subordinate areas of Huronian rocks are found in these enormous tracts of land by far the greater part belongs to the lower Archaean or the Laurentian system.

This great rock complex consists principally of orthoclase gneiss, of nearly every variety, both as regards structure and composition. In many places these gneisses show only the most obscure foliation and resemble granite, in other areas, of great extent, they appear as perfectly stratified as any Palaeozoic formation and they then lie over great areas quite flat or in low indulations. A great part of the obscurely laminated gneiss is probably eruptive, and in some instances this has been established beyond doubt. On the other hand, we have good reason to believe that many of the stratified portions of the system are of sedimentary origin.

In certain areas, where the stratified gneiss occurs, we find in it bedded layers of crystalline limestone, quartzite, amphibolite and other rocks often of considerable extent. In such cases, the gneiss itself is usually richer in varieties, and certain of these varieties almost invariably accompany the limestone beds. These are chiefly garnetiferous gneiss and a peculiar sillimanite gneiss which weathers in a remarkably rusty manner. These gneisses, together with the accompanying granular limestones, quartzites, &c., Logan regarded as a higher division of the Laurentian, resting conformably upon a lower gneiss, which holds no limestone or quartzite, and possesses a more uniform character.[1]

He called this upper division "The Grenville Series" after Grenville,[2] in the Province of Quebec, where it was

[1] Logan, Report of the Geol. Survey of Canada 1863, p. 45, and earlier reports of the Geol. Survey of Canada from 1845-48.

[2] Logan, Rep. of the Geol. Survey of Canada 1863, page 839.

well developed, while the supposed lower gneiss, on account of its great development about the head waters of the Ottawa River was known afterwards by the name of "Ottawa gneiss." As a result of later investigations, in other parts of Canada, Vennor came to the conclusion that the higher division rested unconformably upon the lower gneiss. Whether therefore we have two distinct and unconformable series or not is a point which is not as yet conclusively determined. The facts hitherto collected, however, would rather indicate that the two are distinct. In the present essay these two names (Grenville series and Ottawa gneiss) will be employed to designate these two developments of the Laurentain respectively, and it may be here remarked that whether they be conformable or unconformable, considered from the economical standpoint, there is a very marked difference between them. The Grenville division with its crystalline limestones, quartzite, &c., carries apatite, graphite, iron ores, mica and in general all the important mineral deposits of the Laurentian, while the Ottawa gneiss, as far as we at present know, carries but little in the way ot valuable minerals.

In the Grenville series we find also the earliest traces of life on our planet, since the undoubted occurrence of larger as well as smaller limestone beds which so frequently alternate with the gneiss of this series can only be explained by organic agencies. The presence of a considerable admixture of graphite, which in many of these limestones occurs in a finely dissiminated condition, and is also found in many cases in the associated gneisses, is a further important testimony in the same direction. Many of these limestones resemble precisely some of younger age where these have been metamorphosed by contact with eruptive rocks. The carbon of the limestone crystallizes as graphite in these cases, and the clayey substances, take the form of small scales of mica or grains of other minerals. Veins of graphite appear likewise, though sparingly, in these Laurentian limestones and correspond to the veins and strings of bituminous and carbonaceous substances which we find filling cracks and fissures in bituminous and carbonaceous beds in more recent formations. But the chief bulk of the graphite occurs finely dissiminated through the rocks as above mentioned.[1]

It was, however, observed by the geologists who first worked on these Laurentian rocks that there occur, in many places together with the above mentioned orthoclase gneisses, &c., great areas of a rock that is principally and sometimes almost exclusively composed of a triclinic or plagioclase feldspar. They found that in many places the structure and the appearance of this rock varied considerably from place to place; it being sometimes massive, sometimes schistose, sometimes coarse grained, sometimes fine grained. But all these structural varieties agree in having the same composition.

For this reason they were all placed together in one class and called "Anorthosite Rock" or "Anorthosite," a name derived from "Anorthose," a term propósed by Delesse to designate the triclinic féldspars, and which is thus synonymous with the term "Plagioclase" now more commonly employed. This designation therefore serves to emphasize the difference between these and the predominating orthoclase feldspar rocks of the rest of the Laurentian.

The term "anorthosite" which has been often misunderstood[2] on account of its presumed derivation from anorthite, a feldspar which rarely occurs in these rocks, has hitherto found no place in the systems most generally used in the classification of eruptive rocks. But in Canada, it has been used for many years, and will here be employed to designate a certain well defined class of rocks which belong to the family of gabbros and which stand at one end of the series, being distinguished by the marked predominance of plagioclase and the marked subordination or entire absence of all coloured constituents. Their place in the family of gabbros, corresponds in a certain way to that of the pyroxenites

[1] For further evidence see Sterry Hunt, Chemical and Geological Essays, p. 272, and Sir William Dawson: "The Dawn of Life" and many other writings.

[2] Wichman, Zeit. der Deutsch. Geol. Ges., 1884 p. 496.

at the other end of the series, in which the pyroxene largely predominates and the plagioclase occurs only in very small quantity, or that of troctolite in which the plagioclase and olivine greatly predominate and the pyroxene is absent as an essential constituent.

They constitute a well defined type which both on account of its widespread occurrence and its constant character occupies an independent position in the classification and cannot suitably be included anywhere else.

These anorthosites were found by the older geologists of Canada in parts of the Laurentian widely separatad from one another, sometimes occurring in small areas and again occupying large districts. Later investigations have made known the existence of many additional areas, great and small. The literature of the subject is extensive, the bibliography comprises about a hundred titles, but these communications are for the most part short and do not enter into descriptive details.

This anorthosite has been recognized at the following localities: To begin at the Atlantic coast (see large map), one area is known (and as far as can be ascertained from observations by travellers several probably occur) on the east coast of Labrador. From this the original labradorite was obtained, as well as the specimens of hypersthene which have found their way into mineralogical collections the world over. Another locality is on the southwest end of the island of Newfoundland. Farther to the west, on the north shore of the St. Lawrence, Bayfield mentions the occurrence of labradorite and hypersthene on a point 15 miles east of the island of Ste. Geneviévre, or about 50 miles east of the Mingan Islands.[1] Selwyn[2] found the rock on the same coast at Sheldrake, between the Mingan Islands and the Moisie River, and mentions the occurrence at this place of beautiful opal-

[1] Bayfield, Notes on the geology of the north coast of the St. Lawrence. Trans. Geol. Soc. London, 2 Ser. Vol. V. 1833.

[2] Selwyn, Summary Report of the operations of the Geological and Natural History Survey of Canada 1889, p. 4.

escent labradorite. A very large area of anorthosite was found by Hind [1] on the river Moisie and on its branch, the Clearwater. This area must be very large, although its eastern and western limits are not yet well determined. The Clearwater flows through a valley estimated by Hind to be 2000 ft, deep which is cut in these rocks.[2] They likewise occur in a number of places on the north shore of the St. Lawrence between the Moisie River and the mouth of the Pentecost River.[3]

Next in order comes what is probably most extensive of all the areas, that north of Lake St. John and the upper waters of the Saguenay, which river has its source in this lake, and runs into the St. Lawrence about 125 miles below Quebec. This mass has an irregular oblong shape and its larger diameter runs parallel to the shore of the St. Lawrence, at a distance of about 80 miles. Other areas are found in the neighborhood of Bay St. Paul on the St. Lawrence River,[4] at Chateau Richer [5] below Quebec, and in the district between the latter place and Lake St. John.[6] In the Laurentian region which lies to to the north of the St. Lawrence between Three Rivers and Montreal there are no less than 11 areas, most of which are of very limited extent, but one of these which we may call the Morin area and which lies about 25 miles north of the island of Montreal has an area of 990 square miles. Still another occurrence was discovered and described long ago by Bigsby, [7] on the north shore of Lake Huron, and many other smaller unimportant areas are recorded elsewhere in the Laurentian of Canada, but deserve no further mention. There is also an

[1] Hind, Exploration in the interior of the Labrador Peninsula, London, 1863, also Ed. Cayley: "Up the Moisie." Trans. Lit. and Hist. Soc. of Quebec. New Series Vol. V. 1862.

[2] Hind, Observations on the supposed Glacial Drift in the Labrador Peninsula, etc., Quart. Jour. of the Geol Soc., Jan. 1864, and Canadian Naturalist, 1864, p. 302.

[3] Richardson, Rep. Geol. Survey of Canada, 1866-1869.

[4] Geology of Canada 1863, p. 46.

[5] " " " p. 46.

[6] Low, Summary Rep. Geol. Survey of Canada 1890, p. 35.

[7] Bigsby, A list of minerals and organic remains occurring in Canada. Am. Journ. of Science, 1 Ser., 1824, p. 66.

area of considerable extent occurring to the south in the Laurentian of the State of New York. [1]

The stratigraphical relation of the anorthosites to the Grenville and Ottawa series are as yet somewhat doubtful. In most cases these are difficult to determine because the localities where these rocks are found are generally difficult of access and the surface is often heavily drifted or covered by a dense forest growth.

Sir William Logan [2] whose views were chiefly based on an investigation of parts of the Morin area thought that they probably belonged to a newer sedimentary formation which lay unconformably upon the Grenvilie series, and which although consisting principally of anorthosite, yet included interstratified beds of orthoclase gneiss, quartzite and limestone.

This opinion was apparently supported by the observations which Richardson made on these rocks along the lower St. Lawrence, and in the atlas which accompanied the report of the Geological Survey of 1863, Logau assigned these anorthosites together with the accompanying gneisses to a distinct and higher series which he called the Upper Laurentian.

Sterry Hunt believed that these rocks were identical with the norites of Esmark and called them in consequence of this the Norian Series. [3]

No detailed study of the stratigraphical relations of these rocks has hitherto been made in the case of any of the areas, but writers other than the above have made definite statements without exact knowledge to the effect that they form a series of strata which rest unconformably upon the Grenville series.

The sequence of these rocks is, according to Logan, as follows:

Norian series = Upper Laurentian.
Grenville series = Upper division } Lower Laurentian.
Ottawa series = Lower division }

[1] Emmons, Rep. of the geology in the second district of New York, 1842.

[2] Logan, Rep, Geol. Survey of Canada 1863, p. 839.

[3] Sterry Hunt, Chemical and Geological essays, p. 279. Also Special Rep. on the Trap Dykes and Azoic Rocks of S. E. Pennsylvania. 2nd Geol. Survey of Pennsylvania 1878, p. 160.

Other observers believed, however, that the anorthosites were eruptive, among whom were: Emmons,[1] Selwyn[2] and Packard.[3]

None of the investigations on which these views rest were either sufficieutly extended or sufficiently detailed to determine definitely the true relations of the two rock series, and the question consequently remained undecided. On this account I began in the summer 1883, at the request of Dr. A. R. C. Selwyn, Director of the Geological Survey of Canada, a detailed study of the anorthosite area, discovered many years before by Richardson,[4] about Lake St. John, and the head waters of the Saguenay, and devoted the greater part of two summers to investigating and mapping this area. It proved, however, to be of much greater extent than Richardson supposed, extending back into the northern forests through a tract of country unsurveyed and almost unexplored, and which was for the most part only accessible by rivers difficultly navigable and hard to ascend, so that a very detailed investigation proved to be impossible. The southern, eastern, and western limits of the area were, however, mapped, and a good general knowledge of the character and the stratigraphical relations of the area obtained.

It was therefore thought best to select a smaller area more conveniently situated, in which to determine in detail the stratigraphical relations of these rocks. For this purpose the choice fell on that above mentioned as the Morin area, which had the advantage of being generally easy of access and which further commended itself as being the area which Sir William Logan had formerly examined, and on the study of which his opinion concerning the so-called Upper Laurentian rocks were chiefly based. A careful study of this area extending over four summers was consequently made.

[1] Emmons, loc., cit.

[2] Selwyn, Rep. Geol. Survey Canada 1879-1880, 1877-1878.

[3] Packard, On the Glacial Phenomena of Labrador and Maine. Mem. Boston Acad. Nat. Hist. Vol. 1., part 2, p. 214.

[4] Richardson, Rep. Geol. Surv. Canada 1857, p. 71.

The present essay is based on the investigation of both these large areas, and of a dozen of smaller ones, which are found in the neighborhood of the Morin area, as well as on a careful study of the literature on the whole subject.

II.—THE MORIN ANORTHOSITE AREA.

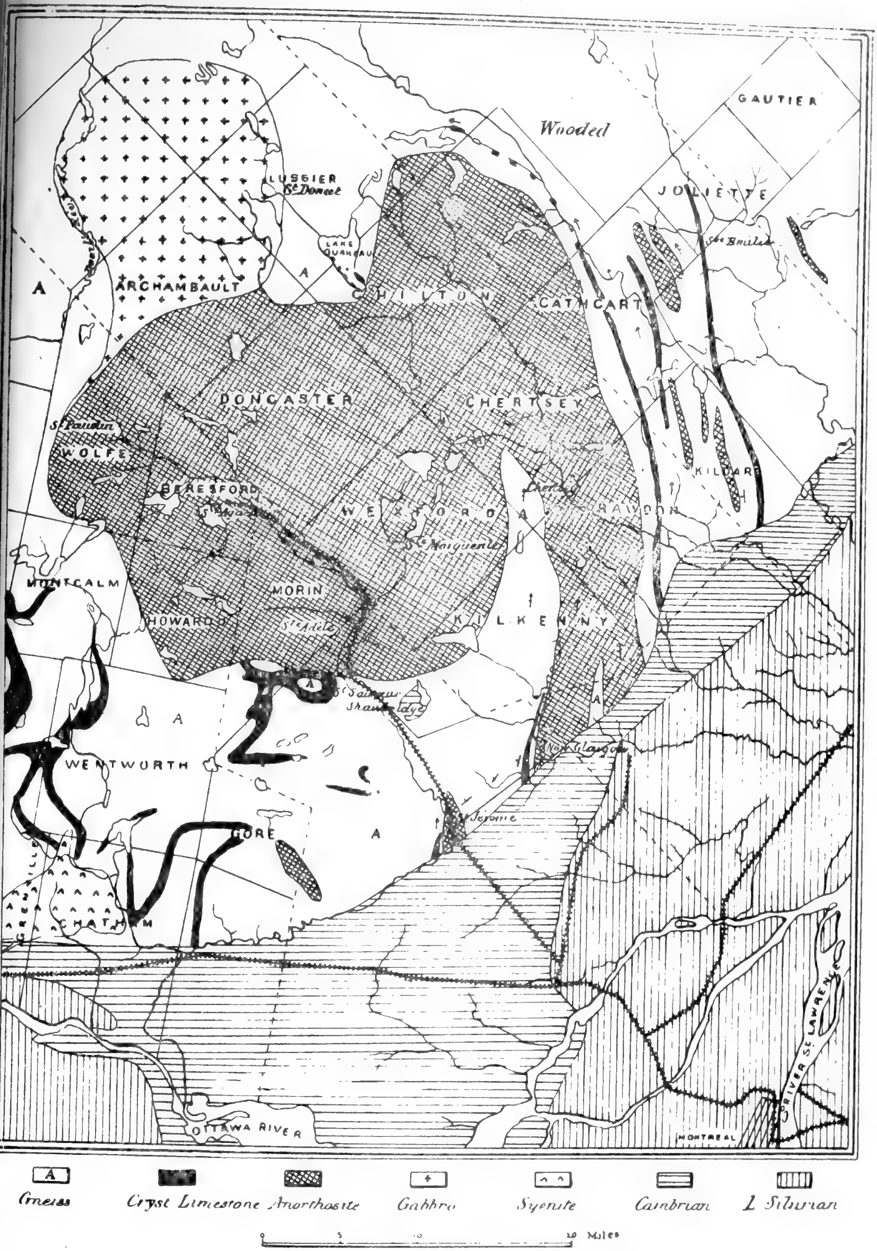
Stratigraphical Relations.

As will be seen from a study of the accompanying map[1] the Morin area consists of a mass of anorthosite nearly circular in form, from the south-east side of which a long arm-like extension projects. This mass is 37 miles in diameter and with the arm-like extension just mentioned has an area of 990 square miles. It is bounded on all sides by rocks of the Grenville series with the exception of the extremity of the arm-like extension, which stretching much farther south than the main portion of the mass, is overlaid and concealed by more recent strata of Cambrian age (Potsdam and Calciferous).[2]

The Grenville series consists, as has already been pointed out, of orthoclase gneiss, of many different varieties, with interstratified beds of quartzite, amphibolite and crystalline limestone. The gneiss is generally well foliated and in many places is distinctly banded. Its strata lie almost flat in the eastern part of the area, but to the west they are thrown up into a series of folds, which in the extreme west are very sharp. The rocks have a general northerly strike. The crystalline limestones, with the associated garnetiferous and rusty weathering gneiss, occur in many places. They are found in thin bands interstratified with the flat-lying gneisess of the eastern part of the area in the cliffs along the shores of numerous lakes in the district. In the western part of the area they often come to the surface in consequence of the folded attitude of the beds already referred to.

[1] Since the appearance of the paper the railroad has been continued past St. Agathe to St. Faustin and thence to Chûte aux Iroquois, beyond the limits of the map. Another line also extends from St. Jerôme to New Glasgow and thence north-eastward to St. Juilenne.

[2] It is probable that some of the rocks bounding it on the north-western portion of its extension should rather be referred to the Fundamental Gneiss.



Map of the Anorthosite Area of Morin.

The distribution of thsse limestones is represented on the accompanying map. Since they are much softer than the accompanying gneiss, they nearly always occur in depressions and are consequently often so concealed by glacial deposits or dense forest that it is hard tc trace them out. The limestones, however, continue just as persistently as the other members of the stratified series. Single beds may be traced for many miles, while certain horizons in the gneiss at which the limestone bands occur, sometimes quite pure, and again rendered more or less impure by the presence of various disseminated minerals or thin layers of gneiss, can be traced as far as the limits of the map. It must here be remarked that many irregularities in form presented by these limestones, must be attributed to the fact that the limestones (as every observer may perceive) under the great pressure to which these rocks have been subjected are much more plastic than the associated rocks. Thin layers of gneiss interstratified with them are often by the folding of the rocks torn asunder into extraordinarily bent and twisted ribbonlike pieces which lie isolated in the limestone so that there results a pseudo conglomerate. The fact that these limestones are now and then squeezed into cracks in the associated gneisses, led Emmons in his description of the geology of the State of New York, to express the opinion that they were of eruptive origin. The greater plasticity of the limestone as compared with other rocks has also been established, as is well known, by many direct experiments. Since, therefore, they alternate with the gneiss and follow its strike, and because they are more easily distinguishable than any other of the countless varieties of gneiss, Logan recognized that a careful study of their distribution would furnish a clew for the unravelling of the structure of this or any other Laurentian area in which they occur, and moreover that by the determination of their relations to the anorthosite rocks, very important data might be obtained concerning the stratigraphical position of the latte.. In investigating that portion of the area which lies to the west of the anorthosite (for he investigated only this region) Logan found that two of the limestone bands, one on the southwest and one farther north on the west side of the area, were cut off by the Morin anorthosite, and he therefore considered the latter as a newer formation which overlay them, observing that in case it should be proved (by an extension of the observations farther to the north than it was possible for him to carry them) that two other limestone bands which he had followed up nearly to the limit of the anorthosite were likewise cut off by it, this fact might be considered as conclusive evidence of the existence of an Upper Laurentian series reposing uncomformably on the Grenville series. A careful investigation of this northwest corner of the area which was undertaken last summer, in company with Dr. Ells of the Geological Survey, showed, however, that one of the supposed interruptions really does not exist and that the drift is so heavy in this region that even if the other limestone stone bands do come against the anorthosite the contact could not be observed. A careful examination of the contact on the southwest corner of the area in the neighborhood of the village of St. Sauveur, however, leaves little doubt that the limestone is really cut off by the anorthosite at this point. The limestone underlies a plain and protruding here and there in large exposures through the drift, whilst the anorthosite rises from this plain as a steep wall or cliff. The limestone is expo‑ed 200 yards from the foot of the anorthosite wall, but the drift covering then becomes so thick that the character of the contact itself cannot be determined. Both to the east and to the west, the associated gneiss is cut off in a similar manner.

On the northeast side of the anorthosite area there was found, moreover, another limestone band which runs through Lake Ouareau and forms in it a series of small islands. It is also well exposed on the south shore of this sheet of water. This bed disappears at the edge of the anorthosite a short distance from the south end of the lake, and no further traces of it are seen until it appears again interstratified in the gneiss at the southeast corner of the anorthosite area.

These facts together with the whole shape and character of this anorthosite area now that the mapping is completed, show that as Logan supposed, it is unconformable to the Grenville series, that is to say to the true Laurentian. But it may also be demonstrated that this unconformity is not due to superposition but to intrusion. The anorthosite does not belong, as was supposed, to a great overlying sedimentary formation, but is a great intrusive mass which cuts through gneisses with their associated limestone bands but does not overlie them.

In order to understand why Logan and other able observers who agreed with him, regarded these anorthosites as an overlying sedimentary formation, we must remember that they show here and there a more or less foliated structure. This is especially true of some places near their contact with the gneiss, and is best seen in the long arm-like extension at the south-east corner which following the line of least resistance penetrates the gneiss parallel to its foliation, and together with it is covered up by the overlying Cambrian. Moreover we find at St. Jérome a small isolated occurrence of a more or less clearly foliated anorthosite, which is included in the gneiss, and Logan, who through the lack of time could not examine the whole area, supposed this to belong to the great Morin mass, the southern boundary of which was as a matter of fact many miles farther to the north. In going from St. Jérome, therefore, at right angles to the strike of the rocks, to New Glasgow, which lies about nine miles further to the east, he passed from the gneiss over an interstratified anorthosite, then over gneiss with layers of quartzite and a limestone bed into the above mentioned arm-like extension of anorthosite, which shows a sort of schistosity parallel to the strike of the gneiss, and over this to gneiss again. Misled by this section which here is very deceptive, he decided that the whole was a great sedimentary formation of gneiss with interstratified beds of quartzite, limestones and anorthosites identical with that which to the north cut off the limestone and lay unconformably upon the Grenville series.

Instead of this, we have in reality the Grenville series throughout the entire area broken through in places by anorthosite masses which often follow the strike of the gneiss and appear to be interstratified with it.

Although at many points on the boundary between the anorthosite of the Morin area and the surrounding gneiss, both rocks come in contact without any alteration of the gneiss being visible, yet at a few places, especially between Shawbridge and Chertsey, a dark heavy and somewhat massive rock rich in bisilicates and often containing a little quartz and some unstriated feldspar appears at the contact of the anorthosite, and may possibly be a contact product. The boundary of the typical anorthosite against this rock is generally quite distinct, whereas the latter passes gradually into the gneiss of the district, so that it is difficult to decide whether it represents a distinct and abnormal variety of the gneiss, or a contact product of the gabbro. The same rock, or at least a very similar one occurs largely developed, at the northwest corner of the area, between the typical anorthosite and the gneiss, and appears here to be a peculiar variety of gabbro since it is nearly or quite massive and often shows a distinct "schlieren" structure. It cuts through the gneiss but seems to be continuous with the anorthosite. Continuous outcrops of the two rocks which would make it possible to determine their relationship have as yet nowhere been found, but there is evidence to prove that it is a part of the anorthosite mass, and not a separate intrusion, although the transition is a rather sudden one.

The anorthosite mass is cut through in many places by coarse pegmatite veins. These are especially abundant about the edge of the area where they break through the gneiss as well as the anorthosite. In mapping the anorthosite, it was frequently possible to surmise an approach to the limits of the area from the appearance of numerous pegmatite veins. They are, of course, by no means exclusively confined to the edge of the area, but also occur abundantly in certain places towards the centre. They consist of quartz, orthoclase, and often some iron ore, and are quite different in composition, and apparently independent of the anorthosite through which they cut. A number of pegmatite veins in the township of Wexford, contain the same bisilicates as the anorthosite but with quartz and potash feldspar. None of the rare minerals which frequently occur in such veins were observed with the exception of a substance resembling allanite in thin section of a single hand specimen.

About the line of contact, in the Township of Wexford, in the prolongation of the strike of the large band of gneiss which comes in between the main mass of the anorthosite, and the arm-like extension of the same, are many large masses of orthoclase gneiss enclosed in the anorthosite, an additional proof of the eruptive character of the anorthosite, if such be needed.

The anorthosite as well as the gneiss which it breaks through are also cut by numerous dykes of diabase and augite porphyry.

To sum up, we have in this area a large intrusive mass of anorthosite which cuts through the Grenville series, encloses large blocks of gneiss, sends out arms into the surrounding gneisses, and in manyplaces is bounded by what appears to be a peculiar contact product.

Mineralogical Character of the Morin Anorthosite.

The anorthosite of this area exhibits a great variation in structure and colour and in certain places even a considerable variation in composition, but is in mineralogical composition a gabbro, or norite, free from olivine and very rich in plagioclase. Hand-specimens from about fifty different places in this anorthosite area have been sliced and microscopically examined and the following description of these rocks is based on the results thus obtained. The number of minerals which the rock contains is not large, the variations in composition resulting principally from their irregular distribution. The following minerals have been observed in the rock:

Plagioclase	Muscovite and Paragonite	Epidote
Augite	Bastite	Zoisite
Hypersthene	Chlorite	Garnet
Ilmenite	Quartz	Zircon
Orthoclase	Magnetite	Spinel
Hornblende	Apatite	
Biotite	Calcite	

Of these, plagioclase, augite, hypersthene and ilmenite are by far the more important and may be considered as the essential constituents of the rock, while the others are in most cases either accessory constituents or decomposition products.

Plagioclase.—As above mentioned, Hunt gave the name anorthosite to these rocks on account of the great prevalence in many varieties of plagioclase or anorthose. He considered the type which contains only feldspar as the true anorthosite and estimated that three fourths of the anorthosites in the Dominion did not contain over 5% of other minerals.[1]

Like the other constituents of the rock, the plagioclase is quite fresh, showing but very rarely any traces of decomposition, and when it is not granulated (that is "cataclastic" in structure) presents in hand-specimens, almost without exception, a dark violet but more rarely a reddish colour. This colour is still more plainly visible in thin sections, although naturally much fainter, and is seen to be caused by the presence of an immense quantity of minute opaque black rods and extremely small opaque dark points, which give the mineral in thin sections a pecular hazy appearance. The latter probably represent in part cross sections of the rods, but are for the most part round or slightly elongated individuals of the same substance as the rods and occurring with them. Vogelsang[2] estimated, in connection with his studies of the anorthosite of Labrador, that these

[1] T. Sterry Hunt, On Norite or Labradorite Rock. Am. Journ. Sc., Nov. 1869.
[2] Vogelsang, Archives Néerlandaise T. III. 1868.

inclusions amount to from 1 to 3 per cent of the volume of the mineral and goes on to say: "Le nombre des microlites contenus dans un volume déterminé est susceptible d'être apprécié avec plus de précision; les résultats toutefois s'écarteront beaucoup entre eux, suivant l'échantillon qu'on aura choisi et le point dans lequel on l'aura examiné. Dans le labradorite violet figuré le nombre de microlites s'élève au minimum à 10,000 par millimètre cube; mais pour autres variétés jaunes et gris foncées le calcul m'a donné un nombre au moins dix fois plus considérable de sorte qu'il y avait ici, dans l'espace borné d'un centimètre cube plus de cent millions de petits cristaux étrangers." The larger rods are surrounded by a zone of clear feldspar. Some inclusions are transparent and have a reddish brown colour resembling hematite; these appear in small scales which often show a somewhat distorted hexagonal outline. Objects which closely resemble the above mentioned rods, are often seen when very highly magnified to be cavities, partly filled up by the dark material of the rods. These inclusions are pretty uniformly scattered through the feldspar individuals, and not confined to certain places, nor present more abundantly in some places than in others as is the case with the gabbros described by G. H. Williams [1] or by Judd.[2] Minute fluid inclusions may often be observed arranged in rows; in these there appears now and then a moving bubble. In one or two cases small cubes were perceived in them, and in one case it was thought that a double bubble could be recognized. In two or three localities the otherwise normal foldspar contained but few of these inclusions and consequently was almost white in colour. The nature and origin of these dark inclusions, which occur so frequently in the feldspar and other constituents of the gabbro, in the most widely separated localities of the globe, have been frequently discussed.

[1] G. H. Williams, Gabbro and associated Hornblende Rocks in the neighborhood of Baltimore, Md. Bull, U. S. Geol. Survey 28, p. 21.

[2] Judd, On the Gabbros, Dolerites and Basalts of Tertiary age in Scotland and Ireland, Q. J. G. S. 1886, p. 82.

The inclusions are so minute that they cannot be isolated and chemically examined. Their form is not defined with sufficient sharpness and constancy to enable their crystallographic character to be determined. Some investigators have endeavored to gain some notion of the nature of these small bodies by observing their deportment when treated with concentrated acids, but the results obtained are contradictory. Judd (l. c.) found that they resist concentrated hydrochloric acid. Vogelsang (l. c.) treated a small piece of feldspar from Paul's Island, Labrador, which contained them, with hot hydrochloric acid for four days. He found that the acid had strongly attacked the feldspar but could perceive no alteration in the needles, except that they had become slightly paler. Hagge [1] however found that in the same rock from Labrador, all the brown scales were dissolved when treated with the acid for a time too short to effect a decomposition of the feldspar. He considered that they were probably göthite.

They are evidently some iron compound, and the peculiar color of the transparent individuals taken in connection with the fact, that, as will be shown, under certain conditions, they unite to form small masses of titanic iron, leads to the belief that the view of Professor Rosenbusch, is correct, namely that they consist principally of titanic iron ore or ilmenite. The transparent ores have the form of the mineral known as micaceous titanic iron ore, which Lattermann [1] found intergrown with magnetite in the nephelinite of the Katzenbuckel. The peculiar color of this mineral moreover resembles perfectly that of these inclusions. The diverse results which the several investigators have obtained in the matter of the solubility of these inclusions may perhaps be explained by the fact that the titaniferous iron ore in some hand-specimens might be richer in titanic acid than in others.

In this connection it must be mentioned that titanic iron ore is a mineral which is constantly found in these anor-

[1] Hagge, Microskopiche Untersuchung über Gabbro and verwandte Gesteine, Kiel, 1871. S. 46.

Lattermann in Rosenbusch Mass. Gest., p. 786.

thosites in Canada, often in enormous quantities, so that it is considered as particularly characteristic of them, while in the Laurentian proper, the iron ores in the greater number of cases, contain no titanic acid. Lacroix, [1] who has investigated somewhat similar inclusion,s which, however, are double refracting, in certain Norwegian gabbros, thinks that they are pyroxenes, especially as they frequently appear to be grouped together, forming larger grains which may be determined as belonging to this species. He says: "Les grains en question semblent avoir attiré à eux les particules pyroxéniques en suspension dans le feldspath et les avoir incorporées à leur masse." It is quite possible that these inclusions so often found in gabbros and allied rocks consist of the heavier minerals of the rock, in some cases pyroxene and in others iron ore, which were finely disseminated through the magma while the rock was crsytallizing, or which, perhaps, separated out as the several constituents crystallized. My best thanks are due to Professor Judd for a small collection of thin sections of typical gabbros and peridotites from the north of Scotland which he has described and on which he has principally established his theory of "schillerization." An examination of these shows that nowhere in them are the inclusions in question so numerous and well defined as in the Canadian anorthosites. The peculiar arrangement of these inclusions in the Scotch rocks along cracks, fissures, etc., which Professor Judd has described and which especially supports his theory of their secondary origin, is not observed in these Canadian rocks. Their inclusions are on the contrary distributed thickly and pretty uniformly through the whole feldspar individual, generally indeed throughout the feldspar of the whole rock. They disappear as above mentioned only when it has the peculiar granulated character. This remarkable fact will be referred to again.

The uniform distribution of these inclusions does not prove that they are not schillerization products, for even

[1] Lacroix, Contributions à l'étude des gneiss à Pyroxenè, p. 141. Bull. Soc. Min. Fr. Avril 1889.

if the rock were completely schillerized these products might be quite evenly distributed in it. It may be here mentioned that only in a few places in this Morin area does the plagioclase exhibit that play of colours which is produced by these inclusions in the feldspar from Labrador and elsewhere.

The plagioclase is almost invarably excellently twinned, according to both the Albite and Pericline laws, the two sets of twin lamellæ crossing one another at right angles in the thin sections. This twinning is apparently sometimes secondary and produced by pressure, as for instance when the lamellæ appear along a certain line or crack, or when they appear in places where the plagioclase individual is twisted.

In most cases, however, they are of prmary origin. Frequently in the sections there are a few untwinned individuals of plagioclase which are probably cut parallel to $\infty P \breve{\infty}$ (010.) But in certain hand-specimens there is a considerable percentage of untwinned feldspar, resembling in all other respects the plagioclase which shows a well defined twin structure. In order to determine whether in these cases two feldspars were really present, separations by means of heavy solutions were made on material from three hand-specimens from different localities in the thin sections of which these untwinned feldspars occurred, in considerable quantity. Since, however, in a solution having a specific gravity of 2.67 all the constituents sank, these untwinned individuals cannot be more acid than labradorite, to which variety the remaining feldspars likewise belong. Similar occurrences of untwinned plagioclase have been often observed. Hawes[1] who investigated some of them, gives an analysis[2] of an ordinary specimen of typical labradorite of St. Paul's Island and adds: "Some of the anorthosites described by T. Sterry Hunt in the Geology of Canada, 1863, were proved by his analysis to be composed of pure labra-

[1] Hawes, On the determination of feldspar in thin sections of Rocks, Proc. Nat. Mus., Washington, 1881, p. 134.

[2] See table of analyses at conclusion of paper.

dorite and some sections of the same which he submitted to me for examination were found to be composed of a multitude of small grains, none of which were twinned."

An examination was likewise made of well twinned plagioclase from two other localities. The first was from a hand-specimen of a typical anorthosite which occurs five miles north-west of Ste. Adèle in the Morin district. Its specific gravity was between 2.65 and 2.67, and it had therefore, also, the composition of an acid labradorite, a fact confirmed by the values of the extinction angles measured on a small fragment separated by means of Thoulet's solution. The second was from the village of Ste. Adèle itself, which lies near the southern edge of the Morin area. Here the anorthosite has porphyritically distributed through it large plagioclase crystals which sometimes are not less than four inches long. These had the following extinction angles: on $\infty P \breve{\infty}$ (010) $24\frac{1}{2}°$ to 26°, on O P (001) = 6°. An analysis of the bluish opalescent plagioclase from the Morin district will be found in the table of analyses given at the end of this paper; here again the feldspar is a labradorite.

The plagioclase of the anorthosite from these six different localities is therefore in all cases labradorite, and there is every reason to believe that the feldspar throughout the whole area belongs to this variety. Although it was generally quite fresh, a partial decomposition was observed in one or two cases where it was changed into a mixture of calcite, epidote and zoisite as mentioned in the description of these minerals.

This occurrence was found in the village of New Glasgow, where a peculiar variety of rock having a saussuritic habitus was also observed. This latter was quite a local occurrence connected with the small zones of disturbance which here run through the anorthosite. We see in thin slices that this plagioclase (the rock is composed almost entirely of this mineral mixed with a few small grains of iron ore) has suffered a peculiar alteration. The product of decomposition is a mineral mostly of fibrous structure which appears in the plagioclase in little spots. It has the optical character of a bastite or pseudophite and the decomposed feldspar resembles therefore to a certain extent that of Waldheim in Saxony described as pyknotrope by Breithaupt. In another handspecimen of the same rock from New Glasgow the feldspar is changed into a colourless mineral which forms small feather-like clusters. It shows magnificent polarisation colours and has a distinct cleavage to which the extinction is parallel. So far as this rock could be investigated in thin sections, the mineral showed all the optical properties of muscovite. It may possibly be paragonite which cannot be distinguished from muscovite under the microscope, for one would expect a soda mica rather than a muscovite as a product of the alteration of plagioclase.

AUGITE.—This constituent is with a few exceptions, generally present in much smaller quantity than the plagioclase, but is next to it the most abundant constituent. The rhombic pyroxeneis present however in nearly if not quite equal amount. It occurs in irregularly shaped grains of a light green color which are either non-pleochroic or exhibit a scarcely perceptible pleochroism in greenish tints. In sections which are nearly parallel to the base, we see typical cleavages which cut each other almost at right angles and are characteristic of pyroxene. They are often intersected by a third more perfect cleavage which is parallel to $\infty P \bar{\infty}$ (100) as shown by its position relative to the plane of the optical axis. In the prismatic zone the mineral shows an extinction angle from 0° to 45°.

In many sections of the pyroxene there are brownish black tables or small black rods which resemble very much the inclusions of the plagioclase above described. Where these occur they are frequently parallel to $\infty P \bar{\infty}$ (100); in other cases instead of being scattered throughout the whole individual they are confined to certain spots. The augite can often be observed to have grown around grains of iron ore. It is generally quite fresh, but in many hand-specimens is decomposed. The product of decomposition consists sometimes of a finely granular mixture of chlorite, and a rhombohedral carbonate with occasional quartz grains between them, the whole constituting a grey almost opaque mass. In other specimens the augite is changed into a yellowish bastite which then fills up not only the space originally occupied by the augite but also penetrates into the small fissures of the rock and forms thread-like veins and scales even in the feldspar grains. In other specimens it is converted into a mineral resembling serpentine. When both pyroxenes occur near one another in the rock, the augite is generally intimately intermingled with the rhombic pyroxene.

Rhombic Pyroxene (Hypersthene).—This mineral, which occurs so often with augite, does not essentially differ from the latter as far as can be ascertained from its thin sections either in index of refraction, in double refraction or in color. It is however strongly pleochroic with the following colors:

$\mathfrak{a}$=red, $\mathfrak{b}$=yellowish green, $\mathfrak{c}$=green.

The absorption is $\mathfrak{a} > \mathfrak{b} > \mathfrak{c}$, the difference between $\mathfrak{a}$ and $\mathfrak{b}$ being very small.

Its rhombic character was determined by the following observations in the case of a hand-specimen from the Township of Chilton in which the mineral occurred in fresh condition and in larger quantity than usual. Sections parallel to the base showed the two cleavages of the prism which intersect almost at right angles, as well as a third more perfect set of cleavages to which small black rods are often parallel. Since the direction of the extinction is also parallel to this latter cleavage it must be in the direction of a pinacoid. In convergent light there is seen on the basal section a bisectrix but not an optic axis as in the case of a monoclinic pyroxene. When a section in which an optic axis appears is examined, the above mentioned pinacoidal cleavage is found to be parallel to the plane of the optic axes. The pinacoid in question is therefore

$\infty P \breve{\infty}$, that is to say it cuts off the acute prismatic angle as $\infty P \bar{\infty}$ does in the case of diallage. In sections which show an optic axis and only one set of cleavages to which the small rods lie parallel, the cleavage is seen to be parallel to the plane of the optic axis.

In all sections which contain the mineral, we find many grains which show only one good cleavage to which the extinction is parallel.

In general it is like the augite quite fresh, in a few sections it appears however changed into bastite, and in a few others into a serpentine like mineral. It sometimes contains the dark scales and rods so often found in hypersthene, but very often these are entirely absent. It is indeed a remarkable fact that in these Canadian rocks, the iron-magnesia minerals contain only a few of these inclusions while the associated feldspar is filled with them. We have here a state of affairs the exact opposite to that in the gabbros and associated rocks of the Scotch Highlands which have been described by Prof. Judd.

HORNBLENDE.—This mineral does not occur in the anorthosite of Morin except in a few places near the contact with the gneiss. Then we always find it in intimate association with the pyroxenes in the form of irregularly defined grains generally about the border of the granulated masses of pyroxene. It occurs as a general rule only in very small quantity. It is usually green in color but is often brown. It shows the cleavages, the small extinction angle and the characteristic pleochroism of the species. In a hand specimen from the neighborhood of the contact on Lake l'Achigan, the maximum extinction angle was found to be 15° and the following pleochroism observed:

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

The absorption was $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$.

In another hand-specimen, quite close to the contact, about six miles north of New Glasgow, a brown hornblende was likewise found in small amount. The extinction angle was 18° with the following pleochroism:

$\mathfrak{a}$=light brownish yellow, $\mathfrak{b}$=deep brown, $\mathfrak{c}$=deep brown.

The absorption is $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$.

It also occurs in the peculiar rock which was referred to above as a gabbro and was found in a number of places between the true anorthosite and the gneiss.

Biotite.—Biotite never occurs in large amount but is present rather frequently in very small amount as an accessory constituent of the normal gabbro. It is usually found with iron ores or with the hypersthene and shows the characteristic brown color, strong pleochroism and parallel extinction.

Muscovite or Paragonite.—(See under "Plagioclase.")

Chlorite.—Occasionally in small quantity as a decomposition product of pyroxene or biotite.

Quartz.—It is doubtful whether this mineral ever occurs as a primary constitutent of the anorthosite. In a hand-specimen from the west side of the Achigan River, near New Glasgow, it was noticed in the form of rather small round grains disseminated through the rock and looking like a primary constituent. But the rock is much decomposed and doubtless some secondary quartz is present as a product of decomposition of pyroxene, so that the quartz which appears to be primary at first sight may be in reality of secondary origin.

In the gabbro which occurs as above stated in many places between the typical anorthosite and the gneiss, quartz is quite frequent. But in this rock many facts point to the secondary origin of the quartz. It occurs often for example in more or less sharply defined veins made up of large individuals. When it occurs in the form of separate irregular grains these extinguish uniformly, although they are often more or less fissured, but they are by no means so much broken as one would expect, if they were primary ingredients, in view of the extremely broken condition of the feldspar and the other constituents of the rock.

Ilmenite and Magnetite.—In nearly every section of anorthosite some irregularly shaped grains of an opaque black iron ore are seen. These are usually few in number. The quantity of iron ore is considerable only in a few places, and as in these cases the percentage of pyroxene increases in the same proportion, the rock here assumes a very dark colour so that it is often taken for an iron ore. These portions of the anorthosite rich in iron ores are only few and local, and they pass over into the normal gabbro of the area which as above mentioned is very poor in iron ore.

If these iron ore grains are examined by reflected light, they are seen to be black and in a few cases they can be seen to be partly changed into a grey decomposition product, evidently a variety of leucoxene. This circumstance proves that the mineral contains titanic acid in considerable amount.

In three hand-specimens from widely separated parts of the area an intermingling of two iron ores was distinctly seen. In one of the hand-specimens which comes from Wexford, range I. lot 7, one of the above mentioned localities where the anorthosite is rich in iron ore, careful observation in reflected light showed the iron ore to occur partly as a bluish black coarse grained variety, and partly as a brownish black finely granular variety both being irregularly intermingled and distinguishable only by reflected light.

When the section was treated for about half an hour on a water-bath with warm concentrated hydrochloric acid, the coarsely granular variety was entirely dissolved and the acid became strongly coloured with iron, while the finely granular variety was apparently not at all affected. We have evidently here an intergrowth of magnetite with ilmenite or at least with a titaniferous iron ore.

In another hand-specimen (from the neighbourhood of Lake Ouareau) a similar intergrowth was observed; the grains had a banded appearance in reflected light, one variety crossing the other in a single or double set of interrupted bands. When the section was treated with cold concentrated hydrochloric acid for 48 hours, no effect was produced; but when treated with warm concentrated acid in a water-bath, one variety of iron was dissolved as before while the other again remained undissolved. We have here probably an intergrowth parallel to the face of an octahedron or rhombohedron. A similar intergrowth has been described in the iron ore in the nephelinite of the Katzenbuckel, except that here the titanic iron ore occurs in the form of micaceous titanic iron ore, not as the coarse and opaque variety found in the above mentioned rocks.

It has been the invariable experience in Canada that the large iron ore deposits in these anorthosite rocks contain so much titanic acid that they cannot be profitably worked. In order to determine whether the iron ore which is disseminated in small grains throughout the whole rock was also rich in this constituent, the iron ore of three hand-specimens of the anorthosite from different parts of the area was separated and tested for titanic acid. In every case the mineral was but faintly magnetic and gave a strong titanic acid reaction.

Two specimens of iron ore from the pegmatite veins which cut through the anorthosite and the gneiss at the contact of the two formations, west of St. Faustin, and therefore do not belong to the anorthosite, showed strong magnetism and gave only a faint reaction for titanic acid. The iron ore bed, a short distance west of St. Jérome, in the orthoclase gneiss also consists of magnetite and contains no titanic acid. We therefore find that these investigations confirm the conclusion that the iron ore of the anorthosite is very rich in titanic acid while the iron ore of the Laurentian gneiss generally contains no notable quantity of this substance.

Pyrite.—A few small grains of pyrite often occur in the thin sections of the anorthosite. They are generally found associated with the iron ore.

Apatite.—This mineral is seldom observed in the anorthosite. When it does occur it is in the form of more or less rounded grains. It is more frequently found in the varieties rich in iron ore in the Township of Wexford and other localities, than in the normal anorthosite.

Latterman in Rosenbusch, Physiographie der Massigen Gesteine, p. 786.

CALCITE.—This was found only in two hand-specimens. One of these was fresh and contained a little calcite, which might possibly be a primary constituent. The other was from New Glasgow, and in this the calcite, together with zoisite, epidote, &c., appears as a decomposition product of the plagioclase in the form of a dull finely granular mixture.

EPIDOTE.—The only locality where epidote occurs is also near the village of New Glasgow. It is found in several sections of the anorthosite from this place along with chlorite and quartz as a product of decomposition of the pyroxene, and as above mentioned with calcite and zoisite as a product of decomposition of the plagioclase. In one or two places it also occurs in small bands, cutting diagonally across the anorthosite following the line of small faults. The epidote is everywhere secondary.

GARNET.—This does not occur as a constituent of the normal anorthosite, but is often found near its contact with the surrounding gneiss. It has a pinkish color, and is seen under the microscope in small irregular masses which are often mixed with or which completely surround the grains of iron ore. In the sections of the variety of anorthosite rich in iron ore from the Township of Wexford, range I, lot 7, (and from other places above mentioned), we find a pale pink garnet which forms a small zone of uniform breadth around every grain of iron ore or pyroxene where these otherwise would come in contact with the plagioclase. Between the pyroxene and the iron ore there is however no garnet. It is quite isotropic and has grown out from the iron ore or pyroxene into the feldspar, against which it is bounded by sharp crystalline outlines. These zones of garnet are analogous to the zones of actinolite and hypersthene around the olivine of the anorthosite from the Saguenay River which will be referred to later on and which have also been described in olivine gabbros of many other localities.

ZIRCON.—This mineral is not found in the normal anorthosite but it occasionally occurs in this rock near its contact with the gneiss. It is seen only in small quantity, and especially in the peculiar contact variety which occurs, as above mentioned, in some places between the anorthosite and the gneiss. It was observed in this in many localities. It has the form of small stout prisms always with more or less rounded edges, which are characterised by a parallel extinction, high refractive index and strong double refraction.

Spinel.—Observed only in one hand-specimen, in the form of small rounded isotropic grains deep green in color occurring as inclusions in plagioclase and pyroxene.

(*To be Continued.*)

Contributions to Canadian Botany.

By Jas. M. Macoun.

IV.

Viola blanda, Willd., var. amœna (Le C.) B.S.P.

Seldom separated from the species by Canadian collectors. North Bay, Ont. (*Dr.* and *Mrs. Britton* and *Miss Millie Timmerman.*) Ottawa, Ont. (*James Fletcher.*) Wingham, Ont. (*J. A. Morton.*) The var. *palustriformis,* Gray, we consider but a larger form of the species under which we include our large stoloniferous specimens that are not certainly referable to var. *amœna.* They are from Edmonton, Ont. (*Jas. White.*) Wingham, Ont. (*J. A. Morton.*) Ottawa, Ont. (*J. M. Macoun.*)

Viola Canadensis, Linn.

Our most northern specimens of this species are from the Athabasca River. (*Miss E. Taylor.*)

Viola palustris, Linn.

Between Lake Athabasca and Chesterfield Inlet in Lat. 61° 35, Long. 103° 30. (*Jas. W. Tyrrell*). Northern limit in Canada as shown by our specimens.

Viola Selkirkii, Pursh.

Battle Harbor, Fox Cove, Labrador, 1892. (*Rev. A. Waghorne.*) Northern limit in Canada.

POLYGALA VERTICILLATA, Linn.

Sandy soil at Griswold, Man. (*W. A. Burman.*) Only station west of Ontario.[1]

DIANTHUS ARMERIA, Linn.

On rocks, Victoria Arm, Vancouver Island. Naturalized and spreading. In fruit July 21st, 1893. (*John Macoun.*) Not before recorded west of Ontario in Canada or Michigan in U.S.

DIANTHUS BARBATUS, Linn.

Escaped from cultivation and naturalized at Hot Springs, Kootanie Lake, B.C., 1890. (*Jas. M. Macoun.*)

SAPONARIA VACCARIA, Linn.

A weed in gardens at Kamloops, B.C. Roadsides, Nelson, Kootanie Lake, B.C.; Cameron Lake, Vancouver Island. (*John Macoun.*) Not before recorded west of the Columbia River.

SILENE ARMERIA, Linn.

Spontaneous in gardens at Rupert House, James Bay. (*Jas. M. Macoun.*) Our most northern record.

SILENE CUCUBALUS, Wibel.

Naturalized near Spray Falls, Banff, Rocky Mountains. (*John Macoun*). Not before recorded west of Ontario.

SILENE DOUGLASII, Hook., var, MACOUNII, Robinson, Proc. Amer. Acad. xxviii, 144.

Lychnis elata, Macoun, Cat. Can. Plants, Vol. I, p. 69.
Silene multicaulis, Macoun, Cat. Can. Plants, Vol. I, p. 494.
S. Macounii, Wats., Proc. Amer. Acad. xxvi., 124.

Our herbarium specimens of this variety are from Mt. Aylmer, Rocky Mts., alt. 6,800 ft.; Lake Louise, Rocky Mts.; Silver City, Rocky Mts.; Kicking Horse Lake, Rocky Mts., alt. 7,000 ft.; mountains north of Griffin Lake, B.C., alt. 6,500 ft. (*John Macoun.*) Mt. Queest, Shus-

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

wap Lake, B.C., alt. 6,000 ft.; Avalanche Mt., Selkirk Mts., B.C., alt. 7,000 ft. (*Jas. M. Macoun.*) Western Summit of North Kootanie Pass, Rocky Mts.; South of Tulameen River, B.C., alt. 6,000 ft.. (*Dr. G. M. Dawson.*) A part of the specimens referred to this variety are perhaps intermediate between it and the next.

SILENE DOUGLASII, Hook, var. VISCIDA, Robinson, Proc. Amer. Acad. xxvii, 145.

On slopes of high mountains at Kicking Horse Lake, Rocky Mts. (*John Macoun.*)

SILENE DOUGLASII, Hook., var. MULTICAULIS, Robinson.

S. multicaulis, Macoun, Cat. Can. Plants, Vol. II., p. 309.

Stump Lake, South of Kamloops, B.C. (*John Macoun.*)

SILENE GALLICA, Linn.

Common at Oak Bay, Goldstream and Victoria Arm, Vancouver Island. (*John Macoun.*) Introduced.

SILENE NOCTIFLORA, Linn.

A weed in gardens at Rupert's House, James Bay. (*Jas. M. Macoun.*) In waste places at Revelstoke, B.C., and Cedar Hill, Vancouver Island. (*John Macoun.*) Not before recorded from west of Winnipeg.

LYCHNIS AFFINIS, Vahl.

Between Lake Athabasca and Chesterfield Inlet. Lat. 63° 27′, Long. 102°, 1893. (*Jas. W. Tyrrell.*) Cape Prince of Wales, Hudson Strait. (*Dr. R. Bell.*)

LYCHNIS ELATA, Wats.

Our only specimens of this species are from Avalanche Mt., Selkirk Mts., B.C., alt. 7,000 ft.. (*Jas. M. Macoun.*)

LYCHNIS TAYLORÆ, Robinson, Proc. Amer. Acad. xxviii, 150.

Very slender 1 to 1½ feet high, puberulent, nearly smooth below, glandular above; stem erect, bearing 3 to 4 pairs of leaves and two or three long, slender, almost filiform 1 to 3 flowered branches; leaves thin, lance-linear, acute or attenuate both ways, finely ciliate, and pubescent upon the single nerve beneath, otherwise glabrate, 2 to $2\frac{1}{2}$ inches in length; flowers terminal or subterminal on the branches; calyx ovate, not much inflated, about 4 lines long, in anthesis but two lines in diameter with green nerves interlacing above; the teeth obtuse, with broad green membraneous ciliate margins; petals $1\frac{1}{2}$ times the length of the calyx; the blade obcordate, $1\frac{1}{4}$ lines long, considerably broader than the slender auricled claw, appendages lance-oblong.

Peel's River, Mackenzie River Delta, 1892. (*Miss E. Taylor.*)

LYCHNIS TRIFLORA, R. Br. var. DAWSONI, Robinson, Proc. Amer. Acad. xxviii, 149.

Calyx with principal nerves double or triple, joined by interlacing veinlets; the intermediate nerves beneath the sinuses inconspicuous or wanting; petals very narrow; the blade oblong, bifid, hardly to be distinguished from the narrow claw.

Gravel banks, Dease River, 100 miles north-east of Dease Lake. Lat. 59°, B.C., 1887. (*Dr. G. M. Dawson.*)

CLAYTONIA CHAMISSONIS, Esch.

Growing at high-water mark at Comox, Vancouver Island, 1893. (*John Macoun*, Herb. No. 29.)[1] These are our first authentic specimens of this species.

CLAYTONIA PARVIFOLIA, Moç.

Damp rocks, Sproat, Columbia River, B.C.; Griffin Lake, B.C.; Agassiz, B.C. (*John Macoun.*). Not before recorded between Selkirk Mts. and Vancouver Island.

OPUNTIA FRAGILIS, Haw.

This plant, of which specimens were collected by Mr. A. C. Lawson in 1884 on islands in the Lake of the Woods, was found again in 1894 by Prof. A. P. Coleman on Red Pine

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

Island, Rainy Lake, just within Canadian territory. It covered about a square rod of the eastern end of the island and grew half-buried in lichens. The Indians with Prof. Coleman did not know of its occurrence elsewhere in that region.

GALIUM PALUSTRE, L., var. MINUS, Lge.

A comparison of specimens collected by the Rev. A. Waghorne at Long Point, Labrador, with Greenland plants shows that what was at first considered a form of *G. trifidum* is in fact *G. palustre*, var. *minus*. New to Canada.

VERNONIA NOVEBORACENSIS, Willd.

The plant from Essex Centre, Ont., referred to this species, Macoun, Cat. Can. Plants, Vol. I., p. 206, proves to be *V. altissima*, Nutt. Specimens collected by Prof. Macoun in thickets at Pelee Island, Lake Erie, 1892, are *V. Noveboracensis.* We have seen no other Canadian specimens of this species.

SERIOCARPUS RIGIDUS, Lindl.

In open thickets Mount Finlayson and Cedar Hill, near Victoria, V. I. and Nanaimo, Vancouver Island, 1887. Oak Bay, near Victoria, V. I., Herb. No. 451. (*John Macoun.*) Collected in 1887 but not recorded.

HELIOPSIS SCABRA, Dunal.

In thickets, Kicking Horse River, Rocky Mts., alt. 4,000 ft., 1890. (*Jas. M. Macoun.*) Woods, Revelstoke, Columbia River, B.C. (*John Macoun.*) Probably introduced from Manitoba by the C. P. Ry. Not before recorded west of Manitoba.

MADIA GLOMERATA, Hook.

Dry ground at Revelstoke, Columbia River, B.C., 1890. (*John Macoun.*) Not before recorded west of Alberta.

MADIA SATIVA, Molina, var. RACEMOSA, Gray.

On dry banks, two miles from mouth of Kootanie River, B.C., 1890. (*John Macoun.*) Not before recorded from interior of British Columbia.

MADIA SATIVA, Mol., var. CONGESTA, Gray.

Specimens (Herb. No. 466) collected by Prof. Macoun at Beacon Hill, Victoria, Vancouver Island, Aug. 7th, 1893, and referred by him to this variety have been submitted to Dr. Robinson, who says, "a form showing characters of var. *congesta* (as to inflorescence) and var. *racemosa* (as to leaves and pubescence.)"

HEMIZONELLA DURANDI, Gray.

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

COTULA AUSTRALIS, Hook., f.

Ballast heaps at Nanaimo, Vancouver Island, 1893. (*John Macoun,* Herb. No. 476.) New to Canada.

ARTEMISIA RICHARDSONIANA, Bess.

Mount Rapho, Lat. 56° 13′, Long. 131° 36′, alt. 3,800 ft., July, 1894. (*Otto Klotz* and *H. W. E. Canavan,* Herb. No. 4,191.)

ARNICA LATIFOLIA, Bong. var. VISCIDULA, Gray.

Woods at Roger's Pass, Selkirk Mts., B.C., alt. 4,500 ft., 1890. (*John Macoun.*) New to Canada.

CENTAUREA PANICULATA, L.

Dry waysides, Victoria, Vancouver Island, 1893. (*John Macoun,* Herb, No. 552). New to Canada.

CASSIOPE STELLERIANA, DC.

Mt. Rapho, Lat. 56° 13′, Long. 131° 36′. Alt, 3,800 ft. In flower July 10th, 1894. (*Otto Klotz* and *H. W. E. Canavan,* Herb. No. 4,195.) First Canadian record.

PRIMULA CUNEIFOLIA, Ledeb.

Mt. Rapho, Lat. 56° 13′, Long. 131° 36′. Alt. 3,800 ft. In flower July 10th, 1894. (*Otto Klotz* and *H. W. E. Canavan,* Herb. 4,192.) New to Canada.

COLLINSIA VERNA, Nutt.

In woods near Plover Mills, Ont. In great abundance in one locality but not found elsewhere. Collected by R. Elliott, May 22nd, 1894. New to Canada.

PEDICULARIS PEDICELLATA, Bunge.

Mt. Head, Lat. 56° 05′, Long. 131° 08′. Alt. 4,200 ft. (*Otto Klotz* and *H. W E. Canavan*, Herb. No. 4,196.) Only authentic Canadian station.

UTRICULARIA RESUPINATA, B. D. Green.

Abundant on sand and mud both in shallow and gently flowing water, Phipps Lake, Long Reach, Kings Co., N.B., July 13th-20th, 1886. (*C. H. Livingstone*). Only Canadian station, though a plant believed to be this species was found by Prof. Macoun in Victoria Co., Ont., in 1868.

AMARANTUS, Linn.

Our herbarium specimens of this genus have been examined by Messrs. Uline and Bray who have either confirmed our determinations or made necessary corrections that are included in the following notes.

A. RETROFLEXUS, LINN.

Specimens collected by Prof. Macoun at Agassiz, B.C., and referred here are intermediate between *A. Powellii* and *A. retroflexus*.

A. HYBRIDUS, Linn.

References under *A. paniculatus* and *A. hypochondriacus*, Macoun, Cat. Can. Plants, Vol. I, p. 396, are, so far as our hebarium specimens are concerned, *A. hybridus*.

A. PANICULATUS, Linn.

Waste places, Sicamous, B.C., 1889. (*John Macoun*.) Our only specimens or this species.

A. GRÆCIZANS, Linn.

A. albus, L.; Macoun, Cat. Can. Plants, Vol. I, p. 397.

This species is well distributed throughout British North America. Specimens collected by the borders of saline ponds near Kamloops, B.C., by Jas. M. Macoun are near *A. carneus*, Greene.

A. BLITOIDES, Wat.

London, Ont. (*Millman.*) Port Colborne, Ont. (*John Macoun.*) Point Edward, St. Clair River, Ont. (*Jas. M. Macoun.*)

POLYGONUM.

All our herbarium specimens of this genus have been examined by Prof. John K. Small, who has made several important changes in our determinations. He had not our herbarium sheets at the time his revision of the *Polygonaceæ* was published so that the distribution of the Canadian species of *Polygonum* as given below will greatly extend the range of many North American species. I follow Prof. Small's arrangement of the species throughout.

(1.) P. VIVIPARUM, Linn.

Throughout Canada. Our most northern specimens are from Lat. 64° 26′, Long. 100° 45′, 1893. (*Jas. W. Tyrrell.*) and Great Bear Lake River. Lat. 65°, 1892. (*Miss E. Taylor.*)

(2.) P. PERSICARIA, Linn.

From Prince Edward Island to Vancouver Island. Abundant throughout the settled parts of Canada.

(3.) P. CAREYI, Olney.

Wet sandy banks, Moon River, Muskoka, Ont., 1878. (*Burgess.*) The only Canadian station.

(4.) *P. hydropiperoides,* Michx.

We have this species from but one locality, Belleville, Ont. Many of the references given by Prof. Macoun (Cat. Can. Plants, Vol. I, p. 411), probably refer to other species. This plant is certainly not of as general distribution in Canada as is supposed, or our herbarium would contain specimens from more stations than one.

Of this species and var. *strigosum* Prof. Small writes, "*P. hydropiperoides*, as well as the var. *strigosum*, has an almost invariable character which it seems, has never been recorded. The stem or branches always produce, at the distance of three-fourths of an inch or less above the angle of branching, a node with a leaf and ocrea, thus making an internode several times shorter than normal length."

Var. STRIGOSUM, Small.

In ditches at Gatineau Point near Hull, Que. (*John Macoun.*) In water near St. Patrick's Bridge, Ottawa, Ont. (*Jas. M. Macoun*, Herb. No. 1,503.)

(5.) P. HYDROPIPER, L.
From New Brunswick to Pacific Coast.

(6.) P. PUNCTATUM, Ell.
P. acre, Macoun, Cat. Can. Plants, Vol. I., p. 411.
Not rare in Eastern Canada. Agassiz, B.C., and Kamloops, B.C. (*John Macoun.*) Not before recorded west of Ontario.

(7.) P. PENNSYLVANICUM, L.
Common from Nova Scotia to Western Ontario.

(8.) P. LAPATHIFOLUIM, L.
Common from the Atlantic to the Pacific. Prof. Small thinks this species has been introduced wherever found. While this may be so in most cases, we have specimens from remote regions that are without doubt indigenous.

Var. INCANUM, Koch.

From Ontario to the Pacific.

(9.) P. AMPHIBIUM, L.
Tadousac, Que. (*Northrop.*) Wingham, Ont. (*J. A. Morton.*) Hastings Co., Ont.; Long Portage, Nipigon River, Ont.; Tail Creek, N.W.T.; near Victoria, Vancouver Island. (*John Macoun.*) Near Pincher Creek, Alberta. (*Dr. G. M. Dawson.*)

(10.) P. EMERSUM, (Michx.) Britt.
Most of the references under *P. Muhlenbergii*, Macoun, Cat. Can. Plants, Vol. I., p. 410, and Vol. II., p. 353, go here. Our herbarium specimens are from Wingham, Ont.

(*J. A. Morton.*) Leamy's Lake, Hull, Que.; Tail Creek, N.W.T. (*John Macoun.*) Indian Head, Assa. (*W. Spreadborough.*) Short Creek, Souris River, Man.; Belly River, Alberta. (*Dr. G. M. Dawson.*) "Arctic North America," no locality. (*Dr. Richardson.*)

(11.) P. Hartwrightii, Gray,

Salt Lake, Anticosti, Que.; Elziver, Hastings Co., Ont.; Vermillion Lakes, near Banff, Rocky Mts. (Herb. No. 1,481.); Revelstoke, B.C.; Kamloops, B.C. (*John Macoun.*) Near York Factory, Hudson Bay. (*Dr. R. Bell.*) London, Ont. (*Burgess.*) Muskeg Island, Lake Winnipeg. (*Jas. M. Macoun.*)

(12.) *P. Orientale*, L.

Ottawa, Ont. (*Dr. A. R. C. Selwyn.*) London, Ont. (*Burgess.*)

(13.) P. alpinum, All.

Peel River, Mackenzie River Delta, 1892, (*Miss E. Taylor*). The references under *P. polymorphum*, Macoun, Cat. Can. Plants, Vol. I., p. 412, probably all go with this species or its var. *lapathifolium.*

(14.) P. aviculare, L.

From Ontario to Vancouver Island.

Var. borealis, Lange.

Specimens collected on the East Main River, Hudson Bay, by A. H. D. Ross, in 1892, when compared with specimens from Greenland seem certainly referable here.

(15.) P. littorale, Link.

P. erectum, Macoun, Cat. Can. Plants, Vol. 1., p. 407 in part.

Thunder Bay, Lake Superior. (*N. L. Britton.*) Castle Mountain, Rocky Mts.; Banff, Rocky Mts., Herb. No. 1,487; near Devil's Lake, Rocky Mts., Herb. No. 1,486. (*John Macoun.*) Walsh, Assa. (*J. M. Macoun.*)

(16) P. Rayi, Bab.

P. maritimum, Macoun, Cat. Can. Plants, Vol. I., p. 408.

Turner's Head, Labrador. (*Rev. A. Waghorne.*) Brackley Point, P.E.I.; Jupiter River, Anticosti, Que.; Qualicum and Point Holmes, Comox, Vancouver Island. Herb. No. 1505. (*John Macoun.*) Bass River, N.B. (*Fowler.*) We do not believe, that this plant, "wherever found," in Canada, has been introduced. Prof. Small found among our specimens no representatives of *P. maritimum,* and as our specimens of *P. Rayi* are from widely separated and remote localities on the Atlantic and Pacific coasts, it seems probable that we have but one species in Canada, and that it is, at least in part, indigenous.

(17.) P. Paronychia, C. & S.

Beacon Hill, Vancouver Island. (*John Macoun. C. F. Newcombe.*)

(18.) P. erectum, L.

Our only specimens of this species are from Winnipeg, Man.; Banff, Rocky Mts. Herb. No. 1,485. (*John Macoun.*)

Other specimens referred here by Prof. Macoun, Cat. Can. Plants, Vol. I., p. 407, are now included under other species.

(19.) P. ramosissimum, Michx.

Petitcodiac, N,B. (*J. Britain.*) Rat Creek, Man.; Hand Hills, N.W.T.; South of Battleford, N.W.T. (*John Macoun.*)

(20.) P. Douglasii, Greene.

P. tenue, Macoun, Cat. Can. Plants, Vol. I, p. 408.

Not rare from Ontario to British Columbia. We have apparently no *P. tenue* in Canada.

Prof. Small says of this species, "*P. Douglasii* can be distinguished from its relative *P. tenue* at a glance, and is beautifully distinct, as Prof. Greene has pointed out, by its one-ribbed leaf in place of the three-ribbed of *P. tenue,* and the much longer, narrower and pedicelled, drooping fruit, instead of the short, thick, sessile, erect fruit of that plant."

(21.) P. AUSTINÆ, Greene.

South Kootanie Pass, Rocky Mts., 1883. (*Dr. G. M. Dawson.*) Near the glacier at the head of Lake Louise, Rocky Mts. Alt. 7,500 ft. (*John Macoun.*) Dr. Dawson's specimens were collected a year before Mrs. Austin's, and were named *P. tenue*, Michx., var. *latifolium*, Eng., by Prof. Macoun.

(22.) P. SPERGULARIÆFORME, Meisn.

P. coarctatum, Dougl.

From the Columbia River at Sproat, B.C., to Vancouver Island.

(23). P. MINIMUM, Wats.

South Kootanie Pass, Rocky Mts. (*Dr. G. M. Dawson.*) Roger's Pass, Selkirk Mts., B.C.; Griffin's Lake, B.C. (*John Macoun.*)

(24.) P. INTERMEDIUM, Nutt.

Summit of Mt. Mark, Vancouver Island. (*John Macoun.*)

(25.) P. IMBRICATUM, Nutt.

Hand Hills and Cypress Hills, Alberta. (*John Macoun.*)

(26.) P. CONVOLVULUS, L.

Common in fields and waste places from the Atlantic to the Pacific.

(27.) P. SCANDENS, L.

P. dumetorum, L., var. *scandens*, Gray.

From Nova Scotia to the Cypress Hills, Alberta.

(28.) P. CILINODE, Michx.

In pine woods and thickets from Nova Scotia to the Peace River, Athabasca.

(29.) P. SAGITTATUM, L.

From Prince Edward Island to the Saskatchewan.

(30.) P. ARIFOLIUM.

From Nova Scotia to Ontario.

(31.) P. Virginianum, Linn.

All our specimens of this species were collected in Ontario. Reported from Nova Scotia and Quebec.

Polygonella articulata, Meisn.

Polygonum articulatum, Willd; Macoun, Cat. Can. Plants Vol. I., p. 409.

Sand dunes, Point Aux Pins, Lake Superior, 1869. (*John Macoun.*) Specimens collected by Dr. Richardson, and labelled "Arctic North America," are probably from the same locality.

A Satisfactory Sulphuretted Hydrogen Generator.

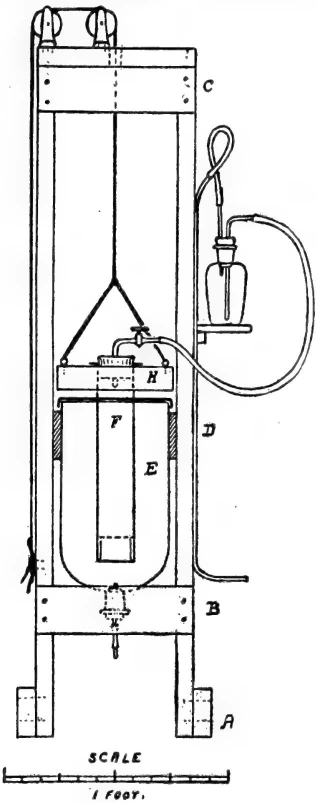
Nevil Norton Evans, M. A. Sc.

To those who have much to do with general qualitative analysis or with the quantitative determination of metals, a sulphuretted hydrogen generator which is self-regulating, economical, and always ready for use is a desideratum. Of late years there have appeared in various chemical publications suggestions for the construction or improvement of such generators, but most if not all of these still possess one serious defect: when the generator is out of action, the separation of acid and sulphide is effected wholly or in part by the pressure of the gas; the gas, however, being soluble to a considerable extent in the dilute acid employed, slowly goes into solution and, by the diffusion of this solution through the mass of liquid, the gas finds its way to the air. Thus, there is a continuous though slow disappearance of sulphuretted hydrogen and a corresponding action of the acid on the sulphide. To prevent this, and have a generator which absolutely stops working when not in use, the separation of acid and sulphide must be effected in some other way than by the pressure of the sulphuretted hydrogen.

Many years ago an excellent apparatus was devised for this purpose by Prof. Clemens Winkler of the Royal Saxon

School of Mines, Freiberg, Saxony, and is still in use in the chemical laboratory of that institution. While working there I was much struck with the thorough effectiveness of the generator and, as the pattern does not seem to be widely known, the following description of a generator, which I constructed myself, working upon the same principles, though much smaller in size, is given.

The frame of the apparatus is made of $2\frac{1}{2}$x$\frac{7}{8}$ in. pine, and is 3 feet high. Pieces seen in end section at A, serve as feet; cross pieces nailed on front and back at B and C, and a piece flat on the top, complete the frame. E is a Winchester bottle, 3 to 4 litres, with the bottom cut off, and with its neck between the cross pieces at B, which are cut away a little on the inside to allow the bottle to rest firmly; at D, on either side, a small block cut out to fit the convex of the bottle holds the latter firmly in place. Over the bottle is placed a piece of sheet lead bent down at the edges so as to fit outside the bottle and pierced centrally with a $2\frac{1}{8}$ in. hole through which the cylinder F passes. Into the neck of E is fitted a cork through which passes a glass tube carrying a short rubber tube closed by a little



piece of glass rod. F is a piece of 2 in. lead pipe 10 in. long passing snugly through a circular piece of wood H, $1\frac{1}{4}$ in. thick, over the top of which it is flanged out to prevent its slipping through. In cutting off the bottom of F, 4 projecting tongues of lead are left each 1 in. long and $\frac{1}{4}$ in. wide; these are turned up inside the pipe and upon their ends rests loosely a perforated circular piece of lead represented in the figure by the dotted line. Into the top of F is fitted a rubber cork through which a glass tube carrying a glass tap passes. (A well-greased wooden plug carrying a glass tube provided with a rubber tube and screw pinch-cock will answer.) This is connected by a rubber tube with a wash-bottle as represented, and the wash-bottle with a delivery-tube. Into H are screwed two screw-eyes to which is fastened a loop of cord which in turn passes through a loop on the end of a cord passing over the two pulleys and down to the cleat.

To set the apparatus in action, about 2 litres of dilute sulphuric acid, 1 in 10, is placed in the Winchester, and 100 grms. of iron sulphide in pieces about the size of a bean in the lead cylinder. The latter is lowered into the acid and the glass tap slowly opened until a current of gas of the rapidity desired is obtained. To put the apparatus out of action, the tap is closed and the lead cylinder raised until its bottom edge just touches the surface of the acid. If acid stronger than 1 in 10 is used ferrous sulphate crystallizes out in such quantity as to render the cleaning of the generator difficult. There are several brands of iron sulphide on the market, some of which are quite unsuitable for this generator as they are very dense and require stronger acid for their decomposition than that recommended above; a clean porous variety (sold in large lumps) is to be preferred.

The apparatus described above was employed for three months in the Chemical Laboratory of McGill College and gave the greatest satisfaction; the reason that its use was then discontinued being its replacement by a much larger "machine" working upon the same principle, and which for more than two years has given entire satisfaction. That the "machine" works economically may be seen from the fact that during the session of 1893-94, with about ninety students working in the laboratories, only about three litres of sulphuric acid were used in the production of sulphuretted hydrogen. A charge of acid and sulphide placed in the "machine" last April and used a few times remained in the apparatus during the holidays and in September, without any addition, produced a copious and steady stream of sulphuretted hydrogen. The smaller apparatus has been employed with equally satisfying results for the production of hydrogen gas.

The Apatite Bearing Rocks of the Ottawa District.

R. W. Ells. LL.D., F.R.S.C.

The present depressed condition of the foreign market for phosphate has naturally tended to lessen the interest which for some years pertained to the subject of Canadian Apatite. But while this has been true to some extent, the great amount of capital invested in this direction, and the fact that the Canadian deposits are presumably among the richest of their kind in the world, so far as yet known at least, as well as the most convenient of access, will always make the question of the availability of Canadian phosphate one of very considerable importance both to the mining and commercial communities. For while the immense deposits found in Carolina and Florida have, through their cheapness of extraction and other causes, been largely responsible for the present unsatisfactory condition of this industry, it is very doubtful if these southern sources of supply will prove to be permanent or even remunerative for any great length of time; and unless other deposits, equally extensive or accessible be found, attention must revert to the Laurentian apatites as a source of supply for this mineral fertilizer.

Much has been written from time to time on the subject of Canadian apatites and their associated rocks by experts from Canada, the United States and England, and the literature in this direction, if collected, would form a fair sized volume. Much of this has been reviewed and published in condensed form by the writer in his report on the "Mineral Resources of Quebec."[1] From these papers it is evident that a very considerable diversity of opinion has prevailed as to the origin, mode of occurrence and geological relations of this mineral. Thus while some have maintained that it is the result of organic agencies and urge in support of this view, the presence in the Laurentian of the peculiar form Eozoon, regarded by Sir Wm. Dawson, Drs. Hunt, Carpenter and others, as representing the earliest known traces of life, as well as in the presence of great beds of iron ore and graphite, others have supposed that the mineral was the result of the action of a solution, bearing fluorine and phosphorus in some unknown combination upon a bed of limestone, and that this solution was distributed by means of side fissures through the main mass of the rock in such a way that a portion of the limestone of the bed was converted into a fluor-apatite. By others again the opinion has been expressed that apatite has been derived principally from the pyroxenite in which it is generally found, presumably by a process of segregation; that the pyroxenite is of igneous origin, and formed either as submarine injections while the Laurentian rocks were being laid down or as subsequent intrusions, even though it now presents certain aspects of a bedded rock.

The eruptive origin of the apatite found in Norway has long been maintained by the Norwegian geologists Brögger and Reusch. The associated rocks in that country apparently possess many of the same characters as those in Canada, and occur under very similar conditions. Among Canadian geologists the same view as regards the Canadian mineral was strongly put forward by Mr. Eugene Coste, formerly of the Geol. Survey, in his report for 1887-88, and subsequently by Dr. Selwyn in the report for the ensuing year, who says: "There is absolutely no evidence whatever of the organic origin of apatite, or that the deposits have resulted from ordinary mechanical sedimentation processes. They are clearly connected, for the most part, with the basic eruptions of Archæan date."

[1] Rep. Geol. Sur., 1888-89, Vol, iv, p. 88-110 K.

The apparent conflict of opinions on this subject is doubtless to some extent due to the diverse views which have been held regarding the composition and structure of the Laurentian rocks themselves. These, in the early days of their study, were supposed by Sir Wm. Logan and his co-workers to be very largely sedimentary in their nature, and formed just as are the sandstones and fossiliferous limestones of more recent formations. In the stratified sedimentary complex, was included not only the crystalline limestone, gneiss and quartzite, but also the anorthosites, the pyroxenes, feldspars and many of the syenitic rocks which subsequent careful study in the field and laboratory have shown to have originated in a very different manner. That the greater part of the latter group is intrusive in the stratified gneiss and limestones is now very clearly established, while the present highly altered condition of the gneiss and associated limestone is doubtless due, in part at least, to the great processes of metamorphism which have taken place during the ages subsequent to their deposition as also, to some extent, to the action of the subsequent intrusive masses.

It is impossible here to go into any elaborate discussion as to the origin of the Laurentian rocks, further than may be absolutely necessary for a clear understanding of the subject under discussion. It may however be said from the evidence at present at our disposal that they have been produced in two ways; for while it is clear that a very large proportion, by far the largest in certain areas, possesses the characters of igneous rocks, certain well stratified areas of limestones with associated quartzite and gneiss, present very many of the features of sedimentary rocks, especially in their present arrangements, and have presumably been deposited through aqueous agencies. The evidence from organic remains usually found in sedimentary rocks, is, however, wanting, but this may be due to the absence of life on the globe in those early periods of the world's history, for, if such existed, their traces have entirely disappeared from some cause not yet definitely known.

Bearing in mind, therefore, the fact that the Laurentian rocks must be regarded as divisible into two distinct groups, we find from their study in the field, certain features in regard to the occurrence of apatite which serve to throw much light upon its early history. It may be very conclusively stated, that for the most part at least it is confined to pyroxenic rocks, although certain writers have asserted that it is found equally in the stratified gneiss and limestone formations. It may, however, be said that after a careful study of all available openings in the Ottawa district, no locality has yet been seen where apatite occurs in workable quantity, or in fact in any way except as occasional scattered crystals in either the limestone or gneiss. The conflicting statement as to its presence in the limestone seems to have arisen largely from the occurrence in many of the pyroxene dykes of masses of calcite, generally of a pinkish color, some of which are of large extent but all strictly integral portions of the pyroxene, through which scattered crystals of mica and apatite are distributed, and it is from this calcite that the most perfect crystals of both these minerals are obtained.

The confusion as to the mode of occurrence has therefore in this case presumably arisen from a lack of care on the part of the earlier observers in separating the mineral calcite from the limestone formation proper, which is entirely different in character and has evidently been formed in an entirely different manner. The reputed occurrence in gneiss can also be traced to the opinion formerly held regarding the nature of the pyroxene bands, which regarded these as of purely sedimentary origin and as constituting a regularly interstratified portion of the gneiss formation, where it was known under the name of pyroxenic gneiss. In the limestone formation proper occasional small crystals of apatite are found where small dykes of pyroxene penetrate the rock, and still more rarely crystals occur in that portion of the gneiss in close proximity to the intrusive mass.

As regards the mode of occurrence of the pyroxene itself we are forced to conclude, that, like the great masses of syenite and the numerous intrusions of dolerite, it is also of igneous origin. That it is clearly intrusive in its character is evidenced by its occurrence in dyke-like masses and bands which sometimes cut directly across the regular stratification of the banded gneiss and limestone, and at others traverse these along the bedding planes for some distance and then abruptly change their course after the manner of other instrusions. In some places a gneissic structure is perceived in the pyroxene, but this, as in the case of the syenites, is doubtless a foliation due to great pressure. The pyroxene dykes are of very varying proportions, sometimes extending for long distances as narrow belts of from one to fifty or more feet in thickness, at other times presenting the form of great hills, where they are mixed with syenitic and dioritic rocks. The apatite bearing dykes are frequently cut by later dykes of syenite, diorite, feldspar or trap, beautiful examples of this interlacing being furnished at many of the openings throughout the mining districts on the Lievre and Gatineau rivers.

Various opinions have also been expressed as to the form in which the apatite deposits occur. By some they are stated to be in beds, others assert that they present rather the features peculiar to vein structure, while yet others maintain that they partake of the nature of both beds and veins. By far the greater part of these opinions is based upon the assumption that the containing rocks are sedimentary gneiss and limestone, the intrusive character of the pyroxene being for the most part ignored. Thus Dr. Harrington in his very exhaustive report on the subject which is found in the report of the Geological Survey for 1877-78 thinks that the views of the Norwegian geologists as to the eruptive origin of apatite deposits, cannot apply to those found in Canada, and supports rather the view put forth by Sir Wm. Dawson that the mineral has been produced probably through organic agencies. In its present condition he thinks that while confined almost entirely to pyroxenic rocks, the structure of the deposits partakes more of the nature of true veins than of beds. Dr. Penrose[1] also shows that the mineral occurs almost without exception in association with pyroxenic or hornblendic rock, especially in the Quebec district, where he says "the phosphate has never yet been found without being associated with pyroxene rock and possibly often of vein origin." He also states that "the pyroxene is never found distinctly bedded, though occasionally a series of parallel lines can be traced through it, which while possibly the remains of stratification are probably often joint planes; and sometimes when the pyroxene has been weathered, apparent signs of bedding are brought out, which are often parallel with the bedding of the country rock."

Sufficient has probably been said to warrant the opinion that the pyroxenes are as truly intrusive in their character as many of the other rock masses such as syenites, diorites, &c., which are found so abundantly throughout the great Laurentian area. So strongly impressed was the writer by the study of the relations of the several rock formations as presented in the mining districts of Buckingham, Templeton, &c., that in 1892, a number of the most interesting occurrences were carefully photographed under the direction of Mr. H. N. Topley, and subsequently colored to clearly represent the different rock masses.

In this way the contrast between the generally pinkish or greyish banded gneiss, and the green massive pyroxene was beautifully shown and the abrupt contact of the two well brought out. It may be said that these colored views were exhibited by the Geol. Survey Dept. at the World's Fair, in Chicago, where they were greatly admired by those interested in this branch of geological work; the evidence thus presented being held to be most conclusive as to the intrusive character of the apatite bearing rock.

Among places in the Lievre district where these contacts can be especially well studied may be mentioned the mines of the Philadelphia Company, the North Star, the London and the Little Rapids mines on the eastern side of the

[1] See Bulletin of the U. S. Geol. Survey, 1888.

river, and the Crown Hill and High Rock mines on the west side. At the Little Rapid mine the dyke carrying the apatite cuts the surrounding well banded gneiss at an angle of thirty degrees, while on the ridge to the south another large dyke of fifty feet or more in breadth cuts the stratified rock at an even greater angle. At the North Star mine, the strike of the principal dyke is nearly with that of the gneiss, but in the most southerly pit, the gneiss has been heaved up and bent round a portion of the dyke, the contact of the two kinds of rock being very sharply defined. At the London and Philadelphia mines the intersections of the pyroxene across the strike are well shown, as also at the High Rock workings, where there is sometimes a perfect net work of dykes of different kinds, small masses of the stratified gneiss being enclosed in the intrusions. It may be remarked that at all these mines the country rock is banded gneiss of the greyish quartzose variety, or what we regard as the sedimentary portion which underlies the crystalline limestone formation.

At the Crown Hill, in the pit on the west side of the main ridge, the capping of the gneiss upon a portion of the pyroxene is well seen, the mass of the dyke being exposed at the surface of the hill, a short distance further east.

As regards the manner in which the apatite occurs in the pyroxene, it may be said that in nearly every case throughout the entire mining district the phosphate is found in that portion of the dyke contiguous to the surrounding gneiss. In certain large dykes as at the North Star it was found along both margins of the intrusion. In some cases a certain amount of regularity in its distribution was observed for a short distance, but this was not long maintained. Frequent branches or spurs are given off into the surrounding pyroxene, and the deposits as a whole are exceedingly irregular, sometimes opening out into great masses of several hundreds of tons, while at others they dwindle down to mere strings, which cannot be profitably extracted. The central portion of the dykes are for the most part barren. No defined foot-wall can be observed, the apatite having a very irregular outline, while in cases where a foot-wall was supposed to exist this was found to be due to the presence of a cross-dyke. The hanging-wall where reported consisted in most cases of the edges of the gneiss, the planes of stratification in some cases meeting the apatite bearing portion of the dyke at very considerable angle.

An important feature was observed at several of the mines, tending to show that subsequent intrusions of dioritic or doloritic rock have apparently exercised a marked influence upon the occurrence of apatite in workable quantity. Thus at the Etna mine a large dyke of pyroxene, which extends in a southwest direction towards the Emerald mine and on the prolongation of which the latter is possibly situated, is intersected nearly at right angles by a heavy dyke of dolerite. Along the line of contact considerable quantities of iron pyrites have been developed, and the apatite which has been mined at this place to a depth of not far from 200 feet is found in that portion of the pyroxene adjacent to the dolerite intrusion, along which the workable deposit of phosphate apparently extends. A somewhat similar occurrence in the case of mica was observed at the Clemow & Powell mine in the Township of Hincks, where the main mass of pyroxene which intersects crystalline limestone is in turn cut across by a dyke of syenitic rock, principally composed of feldspar and quartz, alongside of which great masses of mica crystals, often of very large size, have developed in the pyroxene. This feature of mica and apatite occurring as the apparent result of a second intrusion, has been also noticed at other points, both in the Gatineau and Lievre districts.

With regard to the age of the different intrusions, the apatite bearing pyroxene appears to be the oldest. Instances, as already noted, are frequent where this is clearly broken across by dykes of feldspar and syenite, which have been in turn cut by trappean rock. Other syenite masses are apparently of more recent date than the trap dykes, as these are in several cases observed to be cut through by the former. The syenite in places changes color and character to some extent when passing from the main mass into smaller dykes or spurs, especially where these latter traverse the crystalline limestone, in which case it often becomes a greyish white. This aspect can be well studied at Papineauville among other places.

These intrusions do not, however, carry apatite, at least in any observed case, though they often contain fine crystals of mica. When penetrating gneiss the feldspar dyke, if mica bearing, carries muscovite, while the pyroxene dyke carries phlogopite, which is often associated with apatite. This joint occurrence of mica and apatite is quite frequent at certain mines, more especially in the northern Templeton area.

The origin of the apatite itself has not yet been conclusively settled. From its manner of occurrence and associations it would appear to be due to chemical agency rather than to organic. In some of the smaller crystals which occur with mica in the pinkish calcite, the interior is frequently found to be composed of pink calcite, itself unchanged to apatite. These frequently penetrate crystals of mica, and cracks or fissures in the mica crystal also contain small quantities of the calcite. All pyroxene contains calcite in proportions varying from twenty to nearly thirty per cent., and since its intrusion into the gneiss must have occurred along lines of fracture or least resistance, it would appear reasonable to suppose that vapors, charged with some form of phosphoric and fluoric acids, ascended along such lines. Thus in certain portions of the mass in proximity to the margin of the dykes these vapors would tend to impregnate the softened rock, and in this way through chemical processes, the phosphate of lime might be produced. That the origin of the mineral is deep seated is clearly shown by its presence in the pyroxene at great depths. Thus it has been clearly shown in the working of the North Star mine that the quantity found in the lowest level at a depth of 600 feet from the surface was quite equal to that obtainable from the upper levels, while the same mode of occurrence near the margin of the dyke was found. So also at the High Rock mine apparently the most productive ground is that recently worked near the base of the hill, some 400 feet below the workings at the summit. There does not appear therefore to be any diminution of the mineral as we descend so long as the conditions for its occurrence continue favorable, and it might upon this theory be generally stated that the only limit in depth at which the mineral may be profitably mined will be fixed by the cost of its extraction.

NOTES ON CANADIAN FOSSIL BRYOZOA [1]

By H. M. AMI.

I.

Prof. Ulrich is well known to all students of North American palæozoic palæontology as being an eminent authority on Bryozoa. Ever since the year 1881 his researches and publications on the interesting material which occurs in such abundance in the Cincinnati and allied groups have been received and read with interest, inasmuch as they threw a mass of new light on a humble yet important and but little known class of fossils in America. This last contribution from the pen of Mr. Ulrich is a handsome and beautiful memoir on the Lower Silurian Bryozoa of the State of Minnesota. Whilst the 237 pages of text and the 28 excellent plates accompanying the same are devoted especially to Minnesota Bryozoa, Prof. Ulrich has not deemed it out of place to introduce here and there, for purposes of comparison and observation, certain marked forms coming from other localities. Among the latter may be mentioned a goodly number from Canadian rocks. The purpose of the present notice is to point these out for reference sake as work bearing on the palæontology of Canada.

[1] The Bryozoa of the Lower Silurian in Minnesota. By E. O. Ulrich. From Vol. III. of the Final Report of the Geological and Natural History Survey of Minnesota. 237 pp. Minneapolis 1893.

In Prof Ulrich's memoir and in this notice the various forms mentioned are classified under the following sub-orders and genera of Bryozoa:

(1.) Ctenostomata, Busk.

To which Ascodictyon of our Devonian rocks of Western Ontario belongs.

(2.) Cyclostomata, Busk.

Including the genera Stomatopora, Proboscina, Hederella, etc., from various horizons.

(3.) Trepostomata, Ulrich.

Including the Monticuliporoid genera, Monticulipora, Prasopora, Dekayia, Callopora, Stellipora, Stenopora, Amplexotrypa, Batostoma, Spatiopora, Fistulipora, Botryllopora and allied forms from various horizons ranging from the Ordovician to the Carboniferous of Canada.

(4.) Cryptostomata, Vine.

Including twelve families and eighty genera of which the following are represented in species from Canada: Ptilodictya, Clathropora, Phænopora, Graptodictya, Arthropora, Dicranopora, Pachydictya, Stictopora, Coscinium, Tæniopora, Rhinopora, Helopora, Sceptropora, Arthroclema, Thamnotrypa, Fenestella, Archimedes, Phylloporina.

(5.) Chilostomata, Busk.

Including only three genera, as yet, of which the first Paleschara, Hall, is the only Canadian form known to the writer.

Taking the forms obtained from various places in Canada which are described or figured by Prof. Ulrich in this volume we find the following :—

Lower Silurian Bryozoa from Canadian rocks.

A.—Cyclostomata, Busk.

I. Genus Stomatopora, Brown.

1. *Stomatopora inflata,* Hall, occurs in the Trenton limestone of Ottawa, Canada.

II. Genus Proboscina, Audouin.

2. *Proboscina frondosa,* Ulrich. Recorded from the Ordovician strata of Stony Mountain, Manitoba, and previously recorded in Contrib. to the Micro-Pal. of Canada, Part II., p. 28.

B.—Cryptostomata, Vine.

III. Genus Pachydictya, Ulrich.

3. *Pachydictya acuta,* Hall, p. 155.

4. *Pachydictya triserialis,* Ulrich, p. 159. This form is described " as yet known only from the Trenton limestone of Montreal, Canada." It is figured on Plate X., figs. 11 to 14.

IV. Genus Ptilodictya, Lonsdale.

Here, Prof. Ulrich classifies the known forms of Ptilodictya and gives the following Canadian species:

Section *a.—Species without monticules.*

5. *P. gigantea,* Nicholson, Corniferous, Canada.

6. *P. Canadensis.* Billings, Hudson R. group, Canada.

7. *P. gladiola,* Billings, H. R. and Anticosti groups, Canada.

8. *P.* (?) *sulcata,* Billings, Anticosti group, Canada.

Section *b.—Species with monticules.*

9. *P. Whiteavesii,* Ulrich, H. R. group, Manitoba.

V. Genus Escharopora, Hall.

10. *E. recta,* Hall, Trenton limestone, Canada.

VI. Genus Phænopora, Hall.

11. *P. incipiens,* Ulrich, from the Trenton limestone of Montreal, Canada, where it was collected by the late Mr. T. C. Curry, of the Peter Redpath Museum.

VII. Genus Arthropora. Ulrich.

12. *Arthropora bifurcata,* Ulrich. A species closely related to if not identical with this is said to have been found in the Trenton limestone of Canada, the precise locality not being indicated.

VIII. Genus Stictoporella, Ulrich.

13. *Stictoporella exigua.* Ulrich. Trenton and Canadian

are the horizon and locality respectively to which Prof. Ulrich has ascribed this species.

14. *Stictoporella proavia* (*Coscinium, Eichwald,* as of Billings) from the "Trenton" of "Canada."

IX. Genus Arthroclema, Billings.

15. *Arthroclema pulchellum,* Billings. Trenton limestone, Hull, Que.

16. *Arthroclema Billingsi,* Ulrich. This is recorded from the Trenton limestone of Ottawa, Canada.

X. Genus Nematopora, Ulrich.

17. *Nematopora ovalis,* Ulrich. Trenton limestone, Montreal, Canada.

XI. Genus Phylloporina, Ulrich.

18. *Phylloporina Trentonensis,* Nicholson. No Canadian locality is indicated in this volume, but the writer has seen several specimens of *P. Trentonensis,* Nich., from the Trenton limestone of Montreal in the Peter Redpath Museum of McGill College, and these were named by Prof. E. O. Ulrich.

C.—Trepostomata, Ulrich.

XII. Genus Monticulipora, d'Orbigny.

19. *Monticulipora Wetherbyi,* Ulrich. This species is recorded by Prof. Ulrich as coming from the limestone beds St. Andrews, Manitoba.

XIII. Genus Homotrypa, Ulrich.

20. *Homotrypa similis,* Foord. "The types are from the Trenton at Ottawa, Canada." The species was described by Mr. A. H. Foord, F. G. S., on p. 10, "Contr. to Micro-Pal. of the Cambro-Silurian Rocks of Canada," Ottawa, 1883.

XIV. Genus Prasopora, Nicholson and Etheridge, Jr.

21. *Prasopora simulatrix,* Ulrich; var. *orientalis,* Ulrich, Canada. This new var. of *P. simulatrix,* Ulrich, has been created to receive such Canadian and New York forms as showed a number of distinctive microscopic characters and

was founded on a form referred to *Monticulipora* (*Diplotrypa*) *Whiteavesii*, Nicholson. It is interesting to note that Mr. Ulrich thinks that "this species (*P. simulatrix* var. *orientalis*, Ulrich) may really be the one referred to by Vanuxem in 1842 (Geol. 3d Distr., N. Y., p. 46), when he speaks of "The puff-ball favosites (*Favosites lycopodites*) as being highly characteristic and in great numbers in the Trenton limestone of New York." Mr. Ulrich further states that "the variety *orientalis* is common in the Trenton limestone at Ottawa, Peterboro and other localities in Canada," and in the figures on p. 248 he quotes from Canadian localities a number of characteristic species which he there (*loc. cit.*) figures as follows:

21. *Prasopora Selwyni*, Nicholson (fig. 15*a* and *b*). This species is restricted, in this volume, to a particular type, such as was originally described by Nicholson from the Trenton limestone of Peterboro, Ontario, Canada, and Prof. Ulrich adds that "Foord says the species is abundant throughout the Trenton formation at Ottawa, Canada. Also that it has been found in the upper beds of the Chazy at Nepean (Hog's Back, *teste* H. M. A.) near Ottawa.

22. *Prasopora oculata*, Foord (figs. 15*c* and *d*). This interesting form, which was originally described by Foord in his "Contr. Micro-Pal. Cambro.-Silur. Rocks, Canada, p. 11," as coming from the Trenton formation at Ottawa and Hull, Canada, has been recorded by Ulrich from several localities in Minnesota.

In connection with this species another Canadian *Prasopora* is referred to as being closely related, viz.:

23. *Prasopora affinis*, Foord, also from the Trenton formation of Canada.

Prasopora affinis, Foord, is here mentioned as being closely related to *P. Selwyni*, Nicholson, the characteristic difference separating *P. oculata*, *P. affinis* and *P. Selwyni* being briefly and clearly outlined. All three species have been discovered in the Trenton and Galena shales of Minnesota.

XV. Genus MESOTRYPA, Ulrich.

This genus was been founded to receive a number of forms usually referred to the genus *Diplotrypa* by Foord, Nicholson, Ami and Ulrich himself. The following species of *Mesotrypa* from Canada are recorded:

24. *Mesotrypa Quebeoensis*, Ami (fig. 15*e* and *f*, p. 248.) The type of this species described by the writer[1] from the hard compact and indurated limestone bands of Cote d'Abraham, Quebec City, Canada, is here recorded (p. 259) from the Galena shales at Decorah, Iowa, also from "shales of the Trenton group at Burgin and Danville, Kentucky," and also from "the Trenton limestone at Trenton Falls, New York."

25. *Mesotrypa Whiteavesi*, Nicholson, sp. (fig. 15*g* and *h*). This species was originally described from the Trenton limestone of Peterboro, Ont., Canada, and is here referred by Prof. Ulrich for the first time to his new genus *Mesotrypa*. Since this species was described by Nicholson, Foord and others have discovered it in other localities in Canada, including Ottawa, Ont., and Hull, Que., in the Trenton limestone of both localities.

Besides the above species of *Mesotrypa* Ulrich mentions casually, but does not describe elaborately, as in other cases, the following species from Canada:

26. *Mesotrypa regularis*, Foord. This species was described in Contrib. Micro-Pal. Cambro-Silur. Rocks, Can., pp. 13 and 14, and obtained by Mr. Thomas C. Weston in the "Trenton formation at Ottawa."

XVI. Genus ERIDOTRYPA, Ulrich.

27. *Eridotrypa mutabilis*, Ulrich. Recorded by Ulrich from the Trenton limestone of Ottawa, Canada, and from a large number of localities in Wisconsin, Iowa, Tennessee, Kentucky and Minnesota.

XVII. Genus CALLOPORA, Hall.

28. *Callopora multitabulata*, Ulrich. Of this species, which Mr. Ulrich first described in the "Fourteenth Ann.

[1] Can. Record of Science, Montreal, April, 1892, p. 101.

Rep. Geol. Nat. Hist. Surv. Minn., Minneapolis, 1886, p. 100," the following remark is made: "The same species apparently occurs at Ottawa, Canada." From this statement I would conclude that Prof. Ulrich has amongst his material from Ottawa a form which he refers with a certain amount of uncertainty to the above species.

XVIII. Genus HEMIPHRAGMA, Ulrich.

29. *Hemiphragma Ottawaense*, Foord. This species was first described by Foord[1] as *Batostoma Ottawaense* from the Black River and Trenton formations of Canada in the Ottawa River Valley.

XIX. Genus MONOTRYPA, Nicholson.

30. *Monotrypa undulata*, Nicholson. This species is the type of the genus *Monotrypa* (pars), Nicholson, as restricted by Prof. Ulrich. In has been recorded from Canada, from the Lorraine (=Hudson River) rocks of Toronto and other localities in Canada.

31. *Monotrypa* (*? Chætetes*) *cumulata*, Ulrich. This species is for the first time described by Prof. Ulrich in this interesting memoir on pp. 307 and 308, and is recorded from the "Trenton limestone of Canada."

XX. Genus BYTHOTRYPA, Ulrich.

32. *Bythotrypa laxata*, Ulrich. This species was first described and recorded from the Trenton formation of St. Andrews, Manitoba, Canada, in "Contrib. Micro-Pal. Cambr.-Sil. Rocks Can., 1889, part II, p. 37." It was there doubtfully referred to the genus *Fistulipora*, but on examining large collections of the species Ulrich was led to regard this a new genus, which he founded upon this species as the type, a prototype of *Fistulipora* and gave it a new generic designation.

XXI. Genus DIAMESOPORA, Hall.

33. *Diamesopora Trentonensis*, Ulrich. From the Trenton limestone at Ottawa, Canada.

The text is accompanied by twenty-eight full page quarto

[1] Contrib. Micro-Pal. Cambro-Silur. Rocks Canada, Cttawa, 1883, p. 18.

plates of illustrations drawn on stone from nature and from sections by Prof. E. O. Ulrich himself. They are excellent and give, as a rule, all the necessary views required wherewith to determine the generic as well as specific characters described in the text or observed in related species described elsewhere.

It follows then from the above digest made of Prof. Ulrich's work on the Lower Silurian Bryozoa of Minnesota that thirty-three references to Canadian species are found belonging to twenty-one generic forms.

II.

In his previous elaborate work entitled : "PALÆONTOLOGY OF ILLINOIS, Part II., Section VI., PALÆOZIOC BRYOZOA, by E. O. Ulrich, pp. 283 to 688, the following is a list of species of fossil bryozoa therein recorded from Canadian localities :

1. *Protocrisina exigua*, Ulrich, Trenton, Montreal, Que. (= *Gorgonia* [?] *perantiqna*, Hall, 1847.)

2. *Leioclema minutum*, Rominger [?] Western Ontario. (= *Callopora minutissima*, Nicholson, 1875.) Devonian.

3. *Batostomella Trentonensis*, Nicholson, Trenton limestone of Ontario.

4 *Botryllopora socialis*, Nicholson, Hamilton formation, Arkona, Ontario, Canada.

5. *Arthroclema pulchellum*, Billings, Trenton of Canada.

6. *Helopora fragilis*, Hall, Clinton formation, Hamilton, Ont., Canada. (Fig. *d*, p. 643.)

These make in all twenty-seven genera and thirty-nine species from Canada.

OTTAWA, June 18th, 1894.

The Rideau Lakes.

By A. T. Drummond.

The term Rideau Canal is rather a misnomer. If we except the five miles of actual canal between the Dufferin Bridge at Ottawa and Hogsback, and. again, the one mile or more each of excavation at Poonamalie and Newboro, the whole one hundred and twenty six miles of water route between Ottawa and Kingston now comprise merely two rivers and a chain of lakes—the Rideau River, which, flowing for sixty five miles on the one side of the watershed, falls at Ottawa into the Ottawa River; the Cataraqui River, which, descending for eighteen miles on the other side, falls at Kingston into Lake Ontario; and, connecting the headwaters of these two rivers, a continuous group of nine beautiful lakes, each lying close to the next and all more or less studded with islands.

Canal journeys are slow and often monotonous. The tourist, whose memories of the beautiful in Canadian river scenery are associated with the Thousand Islands, and who when speeding down the rapids of the St. Lawrence has observed, in striking contrast, the tedious progress through the St. Lawrence canals of the returning steamers as they wend their way back again to the upper lakes, is hardly prepared for the information that, inland, on what is, officially, but, by a misnomer, known as the Rideau Canal, there is for fifty miles a succession of lake scenery more beautiful and more varied than that of the Thousand Islands. And yet it is so. These Rideau Lakes were better known fifty years ago than now. With the opening of the St. Lawrence canals and the construction of railways, the Rideau route ceased to be a main thoroughfare, and is now only locally known.

The character of the scenery here is largely due to the geological features of the country. The cañon at Kingston Mills which forms the bed of the Cataraqui River, is walled by low Laurentian hills of 150 to 200 feet in height, and shows in the bevelled edges of the gneiss near the water's edge, as well as in the worn crests of these hills, that it has been at one time the track of an ice flow. The softer sandstone cliffs skirting the same river on its southern side in Pittsburg, have had their general S 36° W direction made for them by the same great force. The islands are generally the lower peaks and crests of the Laurentian ridges which the waters of the lakes on finding an outlet have left unsubmerged. And everywhere in the immediate vicinity of the lakes these same Laurentian ridges, green with trees and shrubs to the water's edge, add attractiveness to the scenery and especially beautify the narrow passes and gorges which connect the different lakes.

The Rideau lakes are, in part, artificial. Sand, Opinicon and Indian Lakes and probably also Mud and Clear Lakes, were no doubt somewhat enlarged by the dams at the outlets of the first three lakes, whilst Cranberry Marsh which was one of the sources of the Cataraqui River, became by the construction of the Brewer's Mills dam, the long, narrow but picturesque Cranberry Lake, with every trace of a marsh effaced, and the Whitefish River became, by the erection of a dam near Morton, the equally long and narrow Whitefish Lake.

The effect of these last named dams being on the same level has been to unite Cranberry and Whitefish Lakes sufficiently for navigation purposes. How far they were originally connected has been an open question. Lieut. E. C. Frome, R.E., describing in the Royal Engineers' Reports in 1837, the original line of communication before the canal was constructed, alludes to the route being through Whitefish Lake and by a channel through a quantity of marshy land which had been flooded by dams erected at Whitefish Falls and at the Round Tail, the source of the Cataraqui River. Mr. Andrew Drummond whose personal experiences here date back to 1832 is of opinion that there was a connection between them, and he writes as follows in regard to the sources of the Cataraqui and Gananoque Rivers and to the route of the Rideau Canal here as originally projected: "I think, originally, there was a flow from Lougborough Lake into the Cataraqui through what was then known by the name, not of Cranberry Lake, but of Cranberry Marsh, which became a lake when the waters were raised by the artificial dams at Brewer's upper mill and at Whitefish Lake. The latter, as far as my recollection serves, was considered the source of the Gananoque River."

"From a mere commercial point of view, the first engineering report recommended the construction of the Rideau navigation route by the way of the Whitefish or Gananoque River, but the British Government decided that it must be built by the Cataraqui River to Lake Ontario direct, and not by an outlet on the St. Lawrence River, where vessels would be more or less subject to annoyance from the United States in time of war."

The great importance of maintaining as far as possible the level of Upper Rideau Lake, by conserving the waters of its tributary lakes, has been forcibly illustrated during the past summer. The long continued drought during August led to the waters falling so low that steamboats and barges drawing five feet constantly grounded in the long, narrow cut at Newboro, and it became a question whether navigation for the larger vessels would not have in consequence to cease over the entire system. This is a difficulty likely to occur more frequently in the future in the Rideau Lakes on account of the gradual removal of large sections of the surrounding forests by fire, and the uncontrolled cutting down of even the smaller sizes of timber there by lumbermen.

A Rideau Lakes Reserve.

What is needed here is a forest reserve around the systems of lakes which form the feeders of the Rideau Lakes. By protecting the reserve from bush fires and absolutely withdrawing it from settlement, the trees will be allowed to grow again, and the accumulations from the melted snows and from the summer rains which presently are quickly drained off, will be held back within the forests and only gradually find their way to the lakes. As in other sections of both Ontario and Quebec, the country here is now reaping the results of a past unwise Government policy under which no practical effort was made to protect the forests from fires or to punish those who carelessly or wantonly were the causes of these fires, and under which the right of cutting timber on the Crown lands has been freely sold with the object of securing for the Government a present cash return, and without the slightest effort at conserving the forests in order to make them a continuous source of revenue in coming years. Though somewhat late and only after so many of its townships had been largely burned over, an effort has been made during recent years by the Ontario Government in conjunction with the lumbermen, to limit forest fires, but more or less apathy still prevails in Quebec, and the general criminal law of the Dominion still fails to grapple practically with the subject. Nearly all forest fires are the result of criminal carelessness or of wanton destructiveness, and are therefore preventable. When will our Governments learn that by year after year showing apathy over the burning of the country's forests, they are wasting not only the country's present revenues but the revenues which would continue to be derived from timber for scores of years to come.

Heights of the Lake Levels.

Assuming the waters of Lake Ontario to be 237 feet above the sea—some authorities mention 232 feet—the heights above tide water of the different Rideau lakes and of some of the upper lakes which supply them are, as determined by the Government surveys, as follows:

	Feet.
Upper Rideau	402
Lower Rideau	398
Mud, Clear and Indian	398
Opinicon	386
Sand	377
Whitefish and Cranberry	317
Bobbs	621
Knowlton	454
Loughborough	403
Canoe	466

Distribution of Potsdam Sandstone.

The recent surveys made by the railway engineers between Rideau and Elgin emphasize the suggestion I have elsewhere made that the Potsdam sandstone has probably had a wider distribution throughout this Laurentian isthmus than was at first supposed. After leaving Rideau Station on the Grand Trunk Railway, the sandstone is met with on lot 9 in the 4th concession of Pittsburg whence it continues to lot 11 in the 5th concession. The beds furnish an excellent building stone. It appears again in the middle of lot 12 in the 5th concession and continues to lot 15 in the same concession when the gneiss again takes its place. Further on, at Brewer's Mills, a few feet of sandstone cap the low Laurentian ridge to the north of the locks, and at the outlet of and at places around, Loughborough Lake a few miles farther north, and also around Knowlton Lake, it is also found. Immediately beyond Morton, on lots 4 and 5 in the 5th concessiou of South Crosby, and at Jones Falls it reappears, at the latter place forming cliffs of about 70 feet in height. The splendid locks and dam at Jones Falls are built of sandstone. East of Morton it probably underlies the broad stretch of flat country lying between that village and Lyndhurst and thence towards Seeley's Bay. Beyond Lyndhurst about Bass Lake and on the north side of Charleston Lake, it is also met with. On the north western side of Lower Rideau Lake and continuing to Perth aud thence north to about the Mississippi River within a short distance of Lanark, there is a broad display of the Potsdam sandstone It appears also in South Elmsley, and at Portland in Bastard has been used as a building material, though the upper rocks in this vicinity may be of calciferous sand rock. Among and in the neighborhood of the Thousand Islands, the Potsdam sandstone occurs at one or two points on the St. Lawrence side of the Township of Pittsburg, at and around Gananoque, on the lower end of Howe Island, and on Hay, Tidds, and parts of Round and Wellesley Islands, whilst farther down the river, it appears near Alexandria

Bay and continues at intervals to Brockville. There is thus a widespread distribution of it in patches or small areas nearly across the Laurentian isthmus which connects the Adirondacks with the Laurentian country to the northward. And in this locality where glacial action has been so marked, we can imagine that these softer rocks may at one time have had a greater development than now appears.

LAURENTIAN ROCKS.

Writing generally of the Laurentian rocks in the Counties of Lanark, Leeds and Frontenac, the late Mr. H. G. Vennor in the Geological Survey Report for 1870, characterizes them as made up of granitoid gneisses, composed of flesh colored feldspar, with grey quartz, greenish hornblende, and some mica, and much cut up by granitic veins. They have, in places, great crystalline limestone bands which can be traced continuously through two or three townships, and sometimes they include broad areas of granitic rocks containing red orthoclase and white quartz.

The economic minerals met with in the neighborhood of the Rideau lakes are iron ore in large quantity at several points, lead and yellow sulphuret of copper but not, thus far, in paying quantities, phosphate of lime at numerous points, mica, marble, granite for paving blocks, and thick bedded sandstone for building material. The iron ore generally, has assayed from 52 per cent. to 60 per cent. of metallic iron, but is occasionally associated with 6 per cent. to 12 per cent. of titanic acid and some sulphur.

The leading physical features of the country—the lakes, the islands, the low overlooking hills—are all due to the Laurentian rocks, and to the line of direction which these hills or great ridges have taken. At Brewer's Mills on the Cataraqui River the direction is about N. 20° E. From this point to Seeley's Bay their course is about N. 34° E., whilst south-east of Seeley's Bay there are ridges lying N. 30° E. A long, conspicuous gully here which has afforded a probable opening to the engineers for location, takes, however, a course, for a considerable distance, of N. 82° E.

The general dip is towards the St. Lawrence River and the small streams south of Seeley's Bay are tributary to the Gananoque River and not to Cranberry and Whitefish Lakes.

Flora.

The flora of the country surrounding the lakes is essentially that common to Central and Eastern Ontario and to the vicinity of Montreal. Even the Western Ontario peninsula would differ from it rather by the prevalence there of western and southern forms than by the absence of species found around the Rideau lakes. Eastern Ontario is, however, the meeting ground of some outliers from floras whose centres of development are elsewhere. Among trees, *Pinus Banksiana*, the Northern Scrub Pine, has made its way from higher latitudes to the southern townships of the County of Renfrew, *Pinus rigida*, the Pitch Pine, a denizen of the Atlantic Middle States, has found a congenial home near Mallorytown and Gananoque and in the township of Torbolton, *Juglans nigra*, the Walnut, has wandered from its native wilds in the west to Ottawa and Montreal, and *Quercus Castanea*, the chestnut oak, has ventured from the Middle and Western States, as far east as Kingston. Among shrubs, *Rhus copallina*, although somewhat common in the United States, is thus far known in Canada only among the Thousand Islands, near Gananoque, where its congener *R. typhina* attains a wonderfnl development in numbers, whilst *Pyrus sambucifolia* found along the more northerly portions of the United States, occurs at Ottawa and Montreal and ranges thence northwestward to the Rocky Mountains and northeastward to Labrador. Among herbaceous plants there are also a few outliers from other floras, and one or two species like *Podostemon ceratophyllum* found at Ottawa, which have probably been overlooked elsewhere in Ontario.

Are these outliers the advanced guard of their respective species paving the way for a more extended range by becoming acclimatized, or do they constitute a stationary force which physical and climatic influences have precluded from going farther, or are they a rear guard representing what remains of a retreating force whose maximum stage of activity has been passed, whose area of distribution has been diminishing, and the individuals of whose species are being gradually reduced in numbers. The questions involved are interesting. The suggestion is intelligible that each species has its place and purpose to fulfil in life, just as the lower animals and man have, and has its development and ultimate decline in strength and activity in each individual as well as in the numbers of its species, until, in long course of time, that place is either left void or is taken by some other form or variety more suited to the changes of circumstances which time is gradually but continuously bringing about. Many plants, at the present time, are thus at their maximum stages of activity in individual growth and reproduction, and have now their maximum breadth of distribution; some are merely in the early or initial stages of this activity and at the initial points of their ultimate area of range; whilst others must be on the decline when activity in reproducing the species is lessening, and the area of distribution is being circumscribed. When the stage of decline has been reached, climatal and other causes which would in the ordinary course limit the range, would have greater effects on the species than upon others which were in the progressive stage of activity or had reached the maximum.

Lake Salmon.

One of the finest of our fresh water fishes—the lake salmon—occurs in the Lower Rideau Lake, and is the attraction every summer to many American as well as Canadian sportsmen. It is a deep water fish confined here to this lake more probably because it is the largest lake of the Rideau system and the only one which has a general depth exceeding 100 feet, than because its waters are clearer than those of others of the system. The lake salmon is caught by trolling with the live minnow at depths of 100 to 150 feet, and, like its nobler friend from the salt water, it affords to the sportsman exciting play for considerable time before it permits itself to be taken.

Care will have to be observed that this valuable fish is not exterminated in this lake. As railways render the locality more accessible, the beautiful scenery must attract tourists and sportsmen in increasing numbers and lead to extinction of the fish unless the lake continues to be periodically restocked with the fry, and fishing is permitted under stringent regulations which are not only made but are also properly enforced.

Obituary.

GEORGE HUNTINGDON WILLIAMS.

George Huntingdon Williams died at Utica, N.Y., on the 12th of July, at the age of 38. He was born at Utica, and graduated from the Utica Free Academy, entered Amherst College in 1874 and took his first degree with the class of 1878. While in college he caught his enthusiasm for geology from his teacher, Professor B. K. Emerson, and spent a year in graduate studies at Amherst.

He then went to Göttingen where he perfected his knowledge of German and studied for several semesters under Professor Klein. Leaving Göttingen he proceeded to Heidelberg where he continued his studies in minerology and petrography with Professor Rosenbusch, taking his Ph.D. degree—*summa cum Laude*—in 1882.

The following year he became a Fellow in the Johns Hopkins University, where he was subsequently appointed Associate, and in 1885 Professor of Inorganic Geology, which position he held at the time of his death.

Petrography and crystallography were the special departments of geology which he cultivated, and his textbook on crystallography is a lucid exposition of the methods of research in this line. At the time of his death he was at work on a treatise on the microscopic structure of American crystalline rocks. He was one of the best authorities on these subjects in America, and served as oneof thejudges of award in the department of minerology at the Columbian Exposition. His untiring devotion last summer at Chicago to the duties thus put on him, it is feared may have laid the foundation of the disease which overcame his otherwise vigourous constitution.

Professor Williams was an attractive teacher and had a peculiarly charming manner in both private conversation and public address, and the animated and clear descriptions he gave of even the most technical subjects went far to interest his hearers in any topic he chose to speak upon. His broad education, attractive personal qualities and thorough acquaintance with the facts of his science gave him a prominent place among his fellows, and although still a young man he was rapidly rising to honour and fame. His loss will be keenly felt by all who knew him, especially by those who had the rare privilege of belonging to the circle of his intimate friends.

Proceedings of the Society.

Montreal, Oct. 29th, 1894.

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

The minutes of the annual meeting were read and approved.

Minutes of Council meetings of May 28th, Oct. 15th and Oct. 22nd were read.

The following donations were reported:—Birch bark war canoe, donor, C.P.R., per J. Stevenson Brown; specimens of iron ores and pig iron from G. J. Drummond, also fossils from Radnor Forges, Quebec, from the Canada Iron Furnace Company; fossils from Low Bay, N.S., from J. G. Grenfell, of the Deep Sea Mission; two living snakes, the red-bellied (*Stoveria occipitamaculata*) and the garter (*Entaenia sirtalis*) from J. B. Williams; six specimens of snakes in alcohol, from Trinidad, from G. H. Fisher, per Alfred Griffin; fossil bone and geological specimens from R. Felch; Gar Pike (*Lepidostens osseus*) from James Wilson, Beauharnois, per W. Henderson; Pine Grosbeak (*Pinibola Canadensis,*) shot at the Back River, from Alfred Griffin; Barred Owl (*Syninum melulosume*) and short eared owl, (*Brachyolus lassinii*) from David Denne; sandstone from Barbadoes and infusorial earth, Fahleigh Lake, U.S., from D. Bryce Scott, per J. B. Williams; large section of elm 175 years old, containing an iron gate staple imbedded therein, from R. Elliott; a piece of the first cotton made in Canada, from the Hon. J. K. Ward.

On motion of E. T. Chambers, seconded by the Rev. Dr. Campbell, the hearty thanks of the Society were tendered to the several donors.

The Librarian reported the receipt of a large number of the usual exchanges, among them the report of the Smithsonian Institution and the Bulletins of the United States Geological Survey, also "Amphioxus and the Ancestry of the Vertebrates," and "From the Greeks to Darwin," from Messrs. MacMillan & Co., and "Bird Nesting," from E. D. Wintle.

On motion by J. S. Shearer, seconded by James Gardner, the rules were suspended, and the secretary empowered to cast one ballot for the election of the following members. Carried.

F. A. Scroggie proposed by N. C. McLachlan, and George Kearley proposed E. T. Chambers, seconded by Dr. F. D. Adams.

It was moved by J. S. Shearer, seconded by Walter Drake, that the Society accept the recommendation of the Council to hold a Conversazione. Carried.

Moved by George Sumner, seconded by the Rev. Dr. Campbell, that Dr. Mills, Justice Wurtele and Dr. Stirling be appointed a committee to wait upon His Excellency the Governor-General with the view of ascertainlng whether he can be present.

Sir William Dawson then read his paper on "Bivalve Shells found in the Coal Formation, and what they tell us of the Origin of Coal."

On motion of Dr. Smyth, seconded by George Kearley, the thanks of the society were tendered to Sir William Dawson for his interesting paper.

Dr. F. D. Adams then read a paper on "The Effects of Great Pressure on Certain Rocks."

It was moved by Dr. Campbell, seconded by E. T. Chambers, that the thanks of the society be also extended to Dr. Adams for his valuable communication.

MONTREAL, Nov. 26th, 1894.

The second 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.

Minutes of Council of Nov. 19th, were read.

The librarian reported that "The Canadian Ice Age" and "Life of Peter Redpath, Esq.," by Sir William Dawson, had been presented by the author to the library. It was moved by Mr. Chambers, seconded by Mr. Edgar Judge, that the thanks of the Society be tendered to Sir William Dawson.

Mr. G. Dunlop, proposed as an associate member Mr. E. Wintle, seconded by G. Sumner, was elected by acclamation, the rules regarding ballot having been suspended.

The president reported progress with reference to the Conversazione.

Prof. D. McEachran then presented a paper on "The Mechanism of the Horse's Foot and its Management from a Humane Standpoint." It was moved by P. S. Ross, seconded by J. A. W. Beaudry, that the thanks of the Society be given to Dr. McEachran for his interesting paper. Carried.

Dr. Wesley Mills then read a paper on the "Psychic Development of Young Animals and its Physical Correlation."

Moved by R. W. McLachlan, seconded by E. J. Chambers, that the thanks of the Society be tendered to Dr. Mills for his highly instructive communication.

Book Review.

On the Cambrian Formation of the Eastern Salt Range of India.—By Dr. Fritz Nœtling, of the Geological Survey of India. Records of the Geol. Surv. India, vol. xxvii., Part 3, pp. 71–86, August, 1894.

From researches made in the palæozoic rocks of the Eastern Salt Range of India by the Geological Survey of that country, Dr. R. D. Oldham has gathered [1] together most of the evidence obtainable regarding the succession of Cambrian strata in this region. Lists of fossils accompany the description of these lower palæozoic rocks, and include such genera as *Olenellus*, *Hyolithes*, *Conocephalites*, and *Neobolus*. Yet, the natural succession or proper interpretation of the relations of the older palæozoic zones had not been determined. In this paper, Dr. Nœtling gives a resumé of the result of his recent explorations and researches in the Salt Range. He separates the upper and middle portion of the palæozoic from the lower and Cambrian proper.

An historical sketch of the work done by Mr. Wynne, by the late Dr. Stoliczka, by Dr. Waagen of Vienna, Dr. Wartte, Mr. Middlemiss and Mr. Datta, he states that the Cambrian of the Salt Range of India is divisible into four groups, in descending order, as follows :—

4. Bhaganwalla group, or Salt Range pseudomorph zone.
3. Jutana group, or magnesian sandstone.
2. Khussak group, or Neobolus beds.
1. Khewra group, or Purple sandstone.

We note here that Dr. Nœtling has found "that at the top of the Khussak formation a fauna occurs, which is most likely the equivalent of the Olenellus of other countries, while for those fauna below it, no representative can be found in the Cambrian of other countries." [2] The Khussak group is itself sub-divided as follows in descending order :—

V. *Olenellus* zone.
IV. *Neobolus Warthei* zone.
III. Upper Annelid sandstone.
II. Zone of *Hyolithes Wynnei.*
I. Lower Annelid sandstone.

In the next higher group, the "Jutana group," Dr. Nœtling has found the following succession in descending order :—

X. Upper magnesian sandstone.
IX. Upper passage beds.
VIII. Middle magnesian sandstone.

[1] Manual of the Geology of India, Calcutta, 1893, Chap. V., p. 113 *et seq.*

[2] *Loc. cit.* p. 79.

VII. Lower passage beds.

VI. Lower magnesian sandstone.

In the lower magnesian sandstone Dr. Nœtling obtained a species of *Stenotheca*, which he correlates with but little doubt with Billings' species; *Stenotheca rugosa, var. aspera*—and an obscure *Lingulella*. The fossil remains collected during the exploration have been sent to Dr. Waagen for determination, and we are all anxious to hear what forms occur in the *pre-Olenellus* zones of India. One thing is evident, viz.: that there seems to be no new division or system to be created below the Cambrian in which to include the primordial or oldest fossiliferous strata.

H. M. Ami.

ABSTRACT FOR THE MONTH OF NOVEMBER, 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	46.87	50.5	43.2	7.3	29.8460	30.037	29.651	.386	.2413	75.5	39.5	S.W.	27.7	6.7	10	0	20	0.07	....	0.07	1
2	44.65	51.2	38.5	12.7	30.1358	30.269	29.884	.385	.2155	74.5	36.2	S.W.	13.1	3.7	10	0	00	....	....	...	2
3	47.08	53.6	40.1	13.5	29.4968	29.752	29.387	.365	.2735	82.8	42.0	S.W.	27.9	8.3	10	0	07	0.87	....	0.87	3
SUNDAY........4	.....	43.5	37.0	6.5	......	....	.....	.	..	...	....	S.W.	16.4	....	....	.	1.00	....	....	..	4 ....SUNDAY
5	33.80	39.7	32.2	7.5	29.8443	29.875	29.814	.061	.1615	83.2	29.0	N.	20.1	10.0	10	10	00	....	0.5	0.05	5
6	31.53	35.4	28.0	7.4	29.7708	29.814	29.699	.115	.1657	93.2	29.8	N.W.	22.6	9.5	10	6	23	....	....	....	6
7	28.88	31.7	25.2	6.5	29.9647	30.046	29.912	.134	.1365	85.7	25.2	W.	16.5	6.7	10	0	21	....	....	....	7
8	28.63	31.6	25.6	6.0	30.1405	30.170	30.099	.071	.1353	85.7	24.8	N.	5.2	7.7	10	3	08	....	....	....	8
9	27.37	32.6	22.6	10.0	30.0617	30.144	29.934	.210	.1262	83.7	23.0	E.	6.0	6.8	10	0	00	....	0.2	0.02	9
10	31.87	33.8	28.5	5.3	29.7350	29.860	29.651	.209	.1673	93.2	30.2	S.E.	6.6	10.0	10	10	00	....	7.1	0.64	10
SUNDAY...... 11	.....	33.7	24.3	9.4	... ...	......	......	....	..	..	....	W.	15.7	...	..	.	00	....	0.2	0.02	11 ....SUNDAY
12	21.73	27.5	17.5	10.0	30.1895	30.263	30.071	.192	.0963	83.3	17.5	W.	8.2	8.3	10	0	00	....	0.1	0.01	12
13	29.65	34.5	17.7	16.8	30.0977	30.256	29.963	.293	.1388	84.2	25.7	S.	9.6	9.0	10	4	16	...	0.2	0.02	13
14	34.47	37.4	32.0	5.4	29.7540	29.873	29.660	.207	.1765	88.8	31.3	S.	15.6	10.0	10	10	00	0.05		0.05	14
15	33.62	39.8	27.0	12.8	29.7645	29.885	29.633	.252	.1592	82.3	28.7	S.	20.2	9.8	10	9	00	....	0.4	0.04	15
16	43.05	49.8	34.8	15.0	29.7105	29.768	29.659	.109	.2173	78.2	36.2	S.W.	20.5	4.0	10	0	50	....	....	...	16
17	34.47	30.2	29.1	7.1	29.9745	30.129	29.822	.307	.1403	70.0	25.7	W.	18.7	4.8	10	0	16	Inap.	....	Inap.	17
SUNDAY...... 18	.....	34.5	22.5	12.0	......	.....	......	...	..		....	W.	11.7	....	....	..	79	....	...	.	18 ....SUNDAY
19	20.45	36.1	6.6	29.5	30.0210	30.310	29.720	.590	.0977	77.7	14.8	W.	22.4	4.8	10	0	60	....	0.7	0.07	19
20	16.38	24.8	6.4	18.4	30.4125	30.525	30.214	.311	.0697	75.0	09.8	S.W.	14.6	5.3	10	0	85	....		....	20
21	38.18	44.1	19.1	25.0	29.9987	30.094	29.920	.174	.1817	77.5	31.5	S.	17.8	10.0	10	10	[illegible]	....	....	....	21
22	32.53	39.0	25.6	13.4	30.2277	30.288	30.125	.163	.1343	73.2	24.8	S.W.	10.3	9.0	10	0	24	....	....	....	22
23	36.98	45.7	25.1	20.6	29.9567	30.099	29.755	.344	.1847	82.0	32.0	S.	19.5	9.7	10	0	13	0.48	....	0.48	23
24	32.37	36.4	28.2	8.2	29.9537	30.074	29.786	.288	.1477	80.7	27.0	W.	6.2	8.7	10	2	31	....	Inap.	Inap	24
SUNDAY........25	.....	31.6	19.7	11.9	..... .	......	......	....	....	....	....	N.	19.5	....	...	..	26	....	0.1	0.01	25 ....SUNDAY
26	17.17	20.3	12.2	8.1	30.1563	30.350	29.771	.579	.0765	80.8	12.5	S.	10.6	7.5	10	0	67	....	0.4	0.04	26
27	30.92	37.4	13.0	24.4	29.4783	29.611	29.387	.224	.1312	75.8	24.0	S.W.	21.5	7.8	10	0	19	....	1.1	0.11	27
28	16.98	31.0	14.0	17.0	30.1250	30.481	29.826	.655	.0662	70.5	09.3	W.	29.3	5.3	10	0	46	...	....	....	28
29	10.45	14.4	7.3	7.1	30.7160	30.763	30.615	.148	.0472	68.2	01.7	W.	14.7	1.7	10	0	90	....	...	..	29
30	15.93	21.5	8.1	13.4	30.4882	30.658	30.359	.299	.0712	78.2	10.5	N. E.	7.4	10.0	10	10	00	...	....	....	30
31																					31
....Means	30.23	35.98	23.70	12.27	30.0008	.....	......	.272	.1446	80.15	24.72	S. 67⅔° W.	15.89	7.5	.	.	27.0	1.47	11.0	2.10	Sums ....
20 Years means for and including this month	32.32	38.76	26.39	12.38	30.0074	....	....	.263	.1552	79.39	....	......	....	7.4	..	.	¶29.3	2.27	12.8	3.60	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..............	1276	150	311	515	1619	3155	3665	731	
Duration in hrs	96	20	37	42	107	152	209	46	11
Mean velocity...	13.3	7.5	8.4	12.3	15.1	20.8	17.5	15.9	

Greatest mileage in one hour was 42 on the 3rd.

Greatest velocity in gusts 60 miles per hour, on the 3rd.

Resultant mileage, 6088.

Resultant direction, S. 67⅔° W.

Total mileage, 11452.

*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 53.6° on the 3rd; the greatest cold was 6.4° on the 20th, giving a range of temperature of 47.2 degrees.

Warmest day was the 3rd. Coldest day was the 29th Highest barometer reading was 30.763 on the 29th: lowest barometer was 29.387 on the 3rd and 26th giving a range of 1.376 inches. Maximum relative humidity was 99 on the 2nd. Minimum relative humidity was 53 on the 29th.

Rain fell on 5 days.

Snow fell on 12 days.

Rain or snow fell on 17 days.

Auroras were observed on 17th and 25th nights.

Hoar frost on 2 days.

Lunar halos on the 6th, 8th and 11th.

ABSTRACT FOR THE MONTH OF DECEMBER, 1894.

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
1	26.77	31.1	16.2	14.9	30.2442	30.315	30.197	.118	.1273	86.2	23.5	S.W.	9.0	10.0	10	10	00	....	Inap.	Inap.	1
SUNDAY.......2	.....	31.1	19.7	11.4	......	.....	.....	..	.....	...	..	N.	12.2	....	....		00	....	0.1	0.01	2 .... SUNDAY
3	19.27	30.9	10.0	20.9	30.1115	30.194	29.970	.224	.0825	76.3	13.3	S.W.	17.9	6.8	10	0	84	....	0.6	0.06	3
4	31.47	33.8	26.8	7.0	29.9413	29.993	29.905	.088	.1587	89.3	28.8	S.W.	20.1	7.3	10	0	00	....	0.4	0.04	4
5	33.92	38.8	28.2	10.6	29.9360	30.019	29.843	.176	.1505	78.5	27.5	S.W.	14.5	9.2	10	5	29	...	....	....	5
6	32.93	38.8	25.0	13.8	29.9850	30.174	29.854	.320	.1358	71.5	24.8	S.W.	19.0	2.0	10	0	71	....	....	....	6
7	20.72	28.3	17.0	11.3	30.2207	30.252	30.202	.050	.0888	80.2	15.7	N.	7.5	6.7	10	0	39	....	0.1	0.01	7
8	21.25	26.8	16.8	10.0	30.1150	30.191	30.015	.176	.0927	81.3	16.3	N.	22.2	9.0	10	4	00	....	0.1	0.01	8
SUNDAY.... ... 9	....	20.4	14.0	6.4	......	.....	......	....	...	...	....	N.	20.8	...	..		00	....	7.5	0.75	9 .... SUNDAY
10	12.20	17.5	9.9	7.6	30.3505	30.404	30.223	.181	.0597	78.7	6.8	N.	17.9	3.3	10	0	83	....			10
11	25.40	35.2	10.4	24.8	30.3182	30.398	30.204	.194	.1165	81.2	20.7	S.E.	13.4	10.0	10	10	00	....	0.8	0.08	11
12	37.52	44.8	33.5	11.3	29.7742	30.029	29.457	.572	.2053	91.0	35.0	S.E.	22.5	10.0	10	10	00	0.55	....	0.55	12
13	32.33	44.2	26.0	18.2	29.6262	29.859	29.406	.453	.1502	81.0	27.3	W.	34.9	10.0	10	10	00	Inap.	...	Inap.	13
14	33.93	37.8	25.6	12.2	29.8460	29.864	29.821	.043	.1658	84.5	29.7	W.	25.9	9.2	10	7	00	...	Inap.	Inap.	14
15	38.85	43.9	34.1	9.8	29.9092	30.011	29.856	.155	.1928	81.5	33.5	S.W.	22.2	1.5	7	0	60	....	...	...	15
SUNDAY 16	....	46.0	31.2	14.8	......	.....	......	...	.	..	...	S.	13.7	....	...		00	Inap.	....	Inap.	16 ....SUNDAY
17	36.53	48.3	23.8	24.5	29.9533	30.182	29.783	.399	.1727	77.0	29.8	W.	29.0	7.8	10	0	00	....	Inap.	Inap.	17
18	18.35	31.0	15.0	§16.0	30.3015	30.357	30.252	.105	.0722	72.0	11.0	W.	23.5	0.0	0	0	95	...			18
19	29.45	35.4	12.1	23.3	30.0827	30.164	30.041	.123	.1227	76.2	22.3	S.	13.7	9.3	10	6	04	....	Inap.	Inap.	19
20	35.30	39.5	31.2	8.3	30.2350	30.317	30.135	.182	.1673	81.3	30.0	S.	9.6	5.0	10	0	53	....		...	20
21	37.20	45.6	29.0	16.6	30.0817	30.294	29.789	.505	.1883	83.3	32.5	S.	10.7	7.2	10	0	44	Inap.	....	Inap.	21
22	27.30	45.6	14.6	31.0	30.1178	30.383	29.800	.583	.1265	79.5	21.8	N.W.	20.2	6.7	10	0	91	Inap.	...	Inap.	22
SUNDAY.. 23	.....	18.1	1.0	17.1	....	......	......	....	...		....	N.	7.3	....	..	..	97	....	...	....	23 .... SUNDAY
24	16.97	39.8	3.6	36.2	30.1660	30.471	29.807	.664	.0895	84.5	13.3	S.W.	11.9	5.2	10	0	12	....	Inap.	Inap.	24
25	20.25	34.3	2.9	31.4	29.8980	30.226	29.645	.581	.1025	81.2	15.5	W.	17.7	5.3	10	0	37	....	1.2	0.12	25
26	3.22	7.0	0.9	6.1	30.4710	30.535	30.330	.205	.0373	73.7	— 3.7	N.	10.4	3.3	10	0	93	..	....	....	26
27	2.03	8.0	— 3.6	11.6	29.9923	30.389	29.617	.772	.0432	90.0	— 0.2	N.	35.2	8.3	10	0	00	....	11.0	1.10	27
28	— 9.52	0.8	—13.2	14.0	30.1762	30.211	30.105	.106	.0227	83.0	—13.5	W.	10.2	0.5	3	0	89	..	....	....	28
29	— 7.95	— 3.5	—14.1	10.6	30.0722	30.177	29.940	.237	.0258	86.7	—11.2	W.	1.3	1.3	4	0	55	...	...	.	29
SUNDAY.......30	.....	23.9	— 6.5	30.4	....	.....	......		.	...	....	S.	5.4	....	....		00	....	1.2	0.06	30 ....SUNDAY
31	15.03	22.8	11.0	11.8	30.1602	30.206	30.083	.123	.0758	87.3	12.0	W.	1.0	9.3	10	7	17	...	Inap.	Inap.	31
....Means	22.72	30.51	14.58	15.93	30.0802	...	....	.282	.1144	81.4	17.8	S. 78⅔° W.	16.5	6.3		.	34	0.55	23.0	2.79	Sums ....
20 Years means for and including this month	18.78	25.99	11.50	14.49	30.0269	....	.....	.289	.0983	82.2	....	....	...	7.0	..	.	¶29.3	1.29	24.0	3.64	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	3023	97	37	574	1410	3791	2880	471	
Duration in hrs .	163	14	7	41	97	204	152	30	36
Mean velocity...	18.55	6.93	5.28	14.00	14.54	18.58	18.95	15.70	

Greatest mileage in one hour was 44 on the 27th. Greatest velocity in gusts 72 miles per hour on the 27th.

Resultant mileage, 5488.
Resultant direction, S. 78⅔° W.
Total mileage, 12283.

*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 48.3° on the 17th; the greatest cold was —14.1° on the 29th, giving a range of temperature of 62.4 degrees.

Warmest day was the 15th. Coldest day was the 28th Highest barometer reading was 30.535 on the 26th; lowest barometer was 29.406 on the 13th, giving a range of 1.129 inches. Maximum relative humidity was 97.0 on the 24th. Minimum relative humidity was 54 on the 5th.

Rain fell on 5 days.
Snow fell on 16 days.
Rain or snow fell on 21 days.
Auroras were observed on 1 night.
Lunar halo on the 10th.

Meteorological Abstract for the Year 1894.

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

C. H. McLEOD, *Superintendent.*

Month.	Thermometer. Mean.	¶ Deviation from 20 years means.	Max.	Min.	Mean daily range.	* Barometer. Mean.	Max.	Min.	Mean daily range.	†Mean pressure of vapour.	‡Mean relative humidity.	Mean dew point.
January	12.99	+ 1.21	41.2	— 12.7	19.72	30.1271	30.776	29.273	.362	.0766	85.6	9.6
February	12.65	— 2.78	38.7	— 19.5	16.88	30.1033	30.833	29.462	.299	.0740	81.8	8.1
March	31.59	+ 7.20	57.0	5.0	12.34	29.9939	30.4[illegible]9	29.396	.293	.1385	74.5	24.4
April	44.89	+ 4.95	69.5	15.0	18.52	30.0177	30.386	29.623	.183	.1840	58.6	30.1
May	56.04	+ 1.62	79.0	37.7	18.01	29.9135	30.372	29.436	.197	.3030	67.0	44.2
June	65.83	+ 1.03	85.2	44.8	17.16	29.8805	30.213	29.377	.113	.4991	76.2	57.5
July	68.73	— 0.09	89.8	51.0	17.82	29.9214	30.292	29.587	.134	.5135	73.2	59.2
August	62.82	— 3.93	80.6	44.8	16.86	29.9591	30.213	29.666	.129	.4146	71.7	53.0
September	59.65	+ 1.13	78.5	35.0	16.22	30.0608	30.626	29.522	.192	.4141	79.6	52.9
October	48.62	+ 3.06	65.5	31.1	13.07	29.8942	30.299	29.174	.256	.2801	80.7	42.6
November	30.23	— 2.09	53.6	6.4	12.27	30.0008	30.763	29.387	.272	.1446	80.1	24.7
December	22.72	+ 3.94	48.3	14.1	15.93	30.0802	30.535	29.406	.282	.1141	81.4	17.8
Sums for 1894	....	...	....	....	....	....	....	...	....	....		....
Means for 1894	43.06	+ 1.27	....	....	16.24	29.9960	...	...	.226	.2630	75.9	35.3
Means for 20 years ending Dec. 31, 1894.	41.79	....	...	...	...	29.9790	....	....	....	.2507	74.5	....

Month.	Wind. Resultant direction.	Mean velocity in miles per hour.	Sky clouded per cent.	Per cent. possible bright sunshine	Inches of rain.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.	Month.
January	S. 78° W.	17.2	54.	45.	0.90	7	19.2	15	2.81	2	20	January
February	S. 50° W.	17.8	55.	47.	0.12	1	9.1	11	1.03	1	11	February
March	S. 49° W.	16.5	59.	46.	1.45	11	7.4	9	2.19	3	17	March
April	N. 16° W.	16.2	53.	55.	0.59	8	1.2	1	0.71	1	8	April
May	S. 59° W.	14.7	62.	51.	3.73	17	..	..	3.73	..	17	May
June	S. 6[illegible]° W.	14.4	58.	30.	4.02	17	...	..	4.02	..	17	June
July	S. 58° W.	13.0	53.	56.	2.82	19			2.82	..	19	July
August	S. 63° W.	13.7	57.	47.	1.80	16	....	.	1.80		16	August
September	S. 31° W.	12.7	54.	34	2.73	14	...	.	2.73	.	14	September
October	S. 62° W.	11.8	70.	21.	4.03	22	In p.	2	4.03	1	23	October
November	S. 68° W.	15.9	75.	27.	1.47	5	11.0	12	2.10	.	17	November
December	S. 79° W.	16.5	63.	34.	0.55	5	23.0	16	2.79	..	21	December
Sums for 1894		....	...	....	24.21	142	70.9	66	30.76	8	200	Sums for 1894
Means for 1894	S. 62° W.	15.01	59.4	41.1	....	....	....	..	2.57	..	17	Means for 1894
Means for 20 years ending Dec. 31, 1894.	....	*a* 15.18	67.2	§45.4	17.98	133	120.0	81	39.67	16	200	Means for 20 years ending Dec. 31, 1894.

* Barometer readings reduced to 32° Fah. and to sea level. † Inches of mercury. ‡ Saturation 100. § For 13 years only. ¶ "+" indicates that the temperature has been *higher*: "—" that it has been *lower* than the average for 20 years inclusive of 1894. 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 *a* For 8 years only.

The greatest heat was 89.8 on July 2: the greatest cold was 19.5 below zero on February 10. The extreme range of temperature was therefore 109.3. Greatest range of the thermometer in one day was 39.5 on Januuary 25; least range was 5.2 on March 22. The warmest day was July 28, when the mean temperature was 80.18 The coldest day was February 24, when the mean temperature was 12.58 below zero. The highest barometer reading was 30.833 on February 24, Lowest barometer reading was 29.174 on October 17, giving a range of 1.659 for the year. The lowest relative humidity was 17 on April 14. The greatest mileage of wind recorded in one hour was 69 on January 30, and the greatest velocity in gusts was at the rate of 84 m. p. h. on January 30. The total mileage of wind was 131,482. The resultant direction of the wind for the year is S.62° W., and the resultant mileage was 50,870. Auroras were observed on 19 nights. Fogs on 14 days, Thunder storms on 20 days. Lightning without thunder on 7 days. Lunar halos or coronas on 14 nights. The sleighing of the winter closed in the city on March 25. The first appreciable snowfall of the autumn was on November 5. The first permanent sleighing of the winter was on December 27.

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

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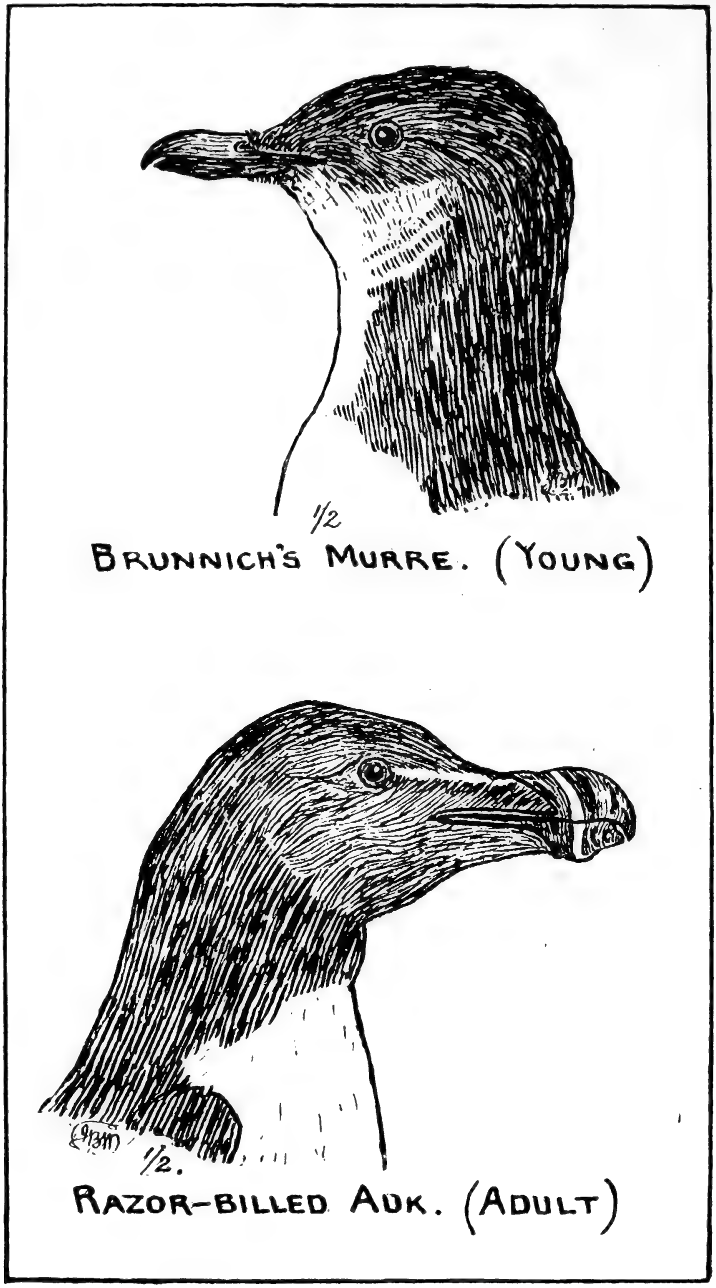

Figures of Two Specimens in the Museum of the Natural History Society of Montreal.

THE

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Remarkable Flight of Certain Birds from the Atlantic Coast up the St. Lawrence to the Great Lakes.

By E. D. Wintle.

Two most remarkable flights of Brünnich's Murres up the St. Lawrence River to the Great Lakes occurred in November, 1893, and in November, 1894, which are unprecedented with this species as far as we have any record of such occurrences. It is not uncommon for solitary individuals of various species of sea birds to wander up the St. Lawrence to the Great Lakes, but when large numbers are found so far inland, as in the case of the Murres, there must be some cause for such an unusual visitation, But it is a difficult matter to assign the true cause, although, as a rule, scarcity of food is thought to be by ornithologists the cause of unusual visitations of birds from their natural habitats. If scarcity of food was the cause of the Murres spreading so far inland, the unfortunate birds which survived the fusillade of guns must have died of starvation before the following spring, as the stomachs of several which were shot and examined did not contain any food, so that we must presume their natural food was not discovered by them in the fresh waters which they visited so foolishly, and they do not appear to have sufficient instinct to return to salt water, as numbers of them were caught alive on the ice when the water began to freeze over for the winter. They appeared to be very tame, keeping near the shores of the rivers and lakes. Some of them went up the St. Francis River as far as Sherbrooke, and the Richelieu to Lake Champlain, also up the Ottawa to the City of Ottawa; but the bulk of them appeared to have followed up the north shore of the St. Lawrence to Lake Ontario, as far as Toronto and Hamilton. Many of them were shot on the lake near Toronto. It seems strange that these birds should remain inland during the winter, to be frozen and starved to death, when we consider that it would have been an easy matter for them to return by the rivers to the sea to their natural waters; but they appear to have totally lost themselves on our inland waters, and the only reason I can assign for their unusual lack of natural instinct is, that they were all young birds, for the bills of those that were shot were not as long as those of adult birds. The fact of these birds apparently being all young birds would suggest an interesting habit in the life history of this species, and one which, I believe, has not been noticed heretofore, namely, the adult birds separating themselves from their fledged young, or, on the other hand, the latter flocking together in the fall of the year without the former's company. Another cause for the remarkable inland flight of these young Murres during the past two years in succession, might have been two unusually prolific breeding seasons, during which the young birds, seeking for food, followed the high tides up to Three Rivers, where, having followed the course of the St. Lawrence so far up it is possible, they were actuated thereby to continue further inland up to the Great Lakes, when, if they had sufficient instinct to return down the

St. Lawrence to their natural habitat, they would have become confused by finding the river frozen over, and therefore would remain on any open water they could find—lost, and finally starved to death for lack of their natural salt-water food. The food of the Murres, according to Audubon, consists of small fish, shrimps and other marine animals, and they swallow some gravel also. The specimen of Brünnich's Murre now in the possession of the Natural History Society of Montreal, is a young bird, being one of those which took the remarkable flight inland mentioned in this article. Brünnich's Murre, Uria lomvia (Linn), belongs to the Order Pygopodes—the Diving Birds—(Sub-order Cepphi), Family Alcidæ—the Auks, Murres, etc. (Sub-family Alcinæ), Genus Uria (Brisson). There are two species and two sub-species of Murres recognized as North American Birds, the first two inhabiting the North Atlantic coasts, and of the two sub-species, one is found on the Pacific coast of North America, and the other one on the coasts and islands of Behring's Sea. In general appearance the Murres closely resemble one another, both in size and plumage. Habitat of Brünnich's Murre is the Arctic Ocean and coasts of the North Atlantic, south, in winter, to New Jersey; breeding from Gulf of St. Lawrence northward. (*See Ridgway's Manual of North American Birds.*)

Unusual Occurrence of Razor-Billed Auk at Montreal.

By E. D. Wintle.

David Denne, Esq., has been kind enough to draw my attention to the taking of the Razor-Billed Auk in the vicinity of Montreal, and on further enquiry I learn that four were observed, on the 10th of November (1893), swimming about on the river at St. Lambert, one of which was shot by a man named Leclaire. I saw this specimen after it was mounted, and, judging by its bill, which is not fully developed, it is a young bird, as the bill of the adult, as seen in the specimen in the collection of this Society, has grooves, crossed about the middle by a white bar, whereas, the bill of the young is smaller, without grooves, and lacks the white bar. I believe this is the first record of the Razor-Billed Auk occurring in the district about Montreal. This species is the only one of its genus found in North America. It is common in the Gulf of St. Lawrence, and breeds there on the Bird Rocks in company with the Murres, a closely allied species, and as the latter bird, in November, 1893, passed up the St. Lawrence river in remarkable numbers, it is very likely that a few of the former species were induced to follow them far inland, out of their natural habitat. The Razor-Billed Auk, Alca torda (Linn), belongs to the Order Pygopodes—the Diving Birds (Sub-order, Cepphi), Family Alcidæ—the Auks, Murres, etc., Genus Alca Linnœus. Their habitat stretches along the coasts of the North Atlantic, south, in winter, to southern New England, breeding from Eastern Maine northward. (*See Ridgway's Manual of North American Birds.*)

Notes on Special Migrations.

By J. B. Williams.

There are several instances of irregular migrations on record, which are worthy of notice in connection with the two described in Mr. Wintle's paper.

Their cause has been usually ascribed either to a great increase in numbers, or to a sudden scarcity of food.

The migrations of the Leming (*Mus lemmus*) in Lapland, which occur every ten or twelve years, are probably examples of the first, while the descent of Antelopes from the interior of Africa to the cultivated districts around Cape Colony, which, before the country was explored, used to take place every three or four years, was, perhaps, an example of the second of these causes, though neither of them seem sufficient to explain some of the special bird migrations.

Pallas' Sand Grouse (*Syrrhaptes paradoxus*) visited Europe in great numbers in the summer of 1863, and again, twenty-five years later, in 1888. On both occasions many of them reached the British Isles, and a few of those that came in 1888 remained and reared young in the summer of 1889. A climate, however, so different from their native one in the deserts of Tartary, was not likely to suit them, and I believe none of them survived the change for very long.

An immense flock, numbering thousands, of the Rose-Colored Pastor (*Pastor roseus*), a bird allied to the starling, came from the bird's native haunts in Armenia, and visited Bulgaria in the summers of 1877 and 1889. They were very tame and could easily be caught, but as they fed mainly on grasshoppers, they were regarded rather as a blessing, and were thus saved from much persecution.

The Evening Grosbeak (*Coccothraustes vespertina*), a bird which usually resides in the North-West and Rocky Mountain district, came east in numerous flocks during the winter of 1890. They reached Toronto about the middle of January and Montreal about the end of that month. Some flocks went south of the Great Lakes and visited Pennsylvania and New York States. Others went on to the New England districts, where they had never before been seen. Nearly all of them returned to the North-West in March or April, though it was said that a few lingered until the middle of May, but there has been, as yet, no repetition of the visit.

The Pine Grosbeaks (*Pinicola enucleator*), some of which visit Montreal nearly every winter, accompanied the

Evening Grosbeaks in unusual numbers in this migration of 1890, though they probably came from the North rather than the West. Flocks of both birds were seen in many places feeding together on the berries of the same mountain ash tree, and all of them were remarkably tame and unsuspicious.

Notes on Recent Canadian Unionidæ.

By J. F. Whiteaves.[1]

The present paper is intended as a contribution to our knowledge of the geographical distribution of the Unionidæ in North America. It consists of a list of all the species from Canadian localities that are now represented in the museum of the Geological Survey at Ottawa, and is based almost exclusively upon specimens that were either collected by members of the Survey staff or presented by friends interested in its museum. So far as the writer is aware, however, the *Unio tenuissimus* of Lea, which was collected by Dr. G. M. Dawson in 1873, in the Souris River, Manitoba, is the only species of Unionidæ known to occur in Canada that is not represented in the Survey museum. Specimens of most of the nominal species of *Anodonta* and of a few of the more difficult species of *Unio* enumerated in this list have been kindly compared by Mr. Charles T. Simpson, of the United States National Museum, with Dr. Lea's types of North American Unionidæ now preserved in that institution, and identified as correctly as the small number of shells sent from each locality and the incompleteness of his studies of the family would permit. The nomenclature employed throughout this list is that which is now in general use among students of this group in North America, as it is still quite uncertain which of the earlier names of Rafinesque,

[1] Communicated by permission of the Director of the Geological Survey Department.

Lamarck and others, will ultimately have to be retained for some of these shells.

ANODONTA, Lamarck, 1879.

ANODONTA BENEDICTII, Lea.

Specimens which appear to have been identified with this species by Dr. Lea have already been recorded by Dr. R. Bell[1] as having been collected by himself, in 1860, at Batch-ah-wah-nah Bay, Lake Superior; in the St. Mary River, near Sugar Island, and on the north shore of Lake Huron, at Lacloche Island. Professor Macoun has recently (1894) collected it at Rondeau, near Point aux Pins, on the Ontario side of Lake Erie, and a few specimens, which Mr. Simpson thinks are probably referable to *A. Benedictii*, were collected by Dr. R. Bell, in 1883, at Lake Winnipeg, between Fort Alexander and Elk Island. Mr. Simpson is inclined to believe that *A. Benedictii* may be only a variety of *A. ovata*, Lea.

ANODONTA DECORA, Lea.

Eight full grown specimens and one immature shell of a very large *Anodonta*, which Mr. Simpson refers to *A. decora*, were collected by Mr. Law, of Chatham, at Rondeau, Ontario, and presented by him to the Museum of the Survey, through Professor Macoun, in 1884. One of the adult shells from this locality, a fairly average specimen, measures 6.6 inches in length, 4 inches in height and 3.1 inches in breadth or thickness. The umbones of each are remarkably ventricose and prominent. The test is rather thick, the hinge line short, and the cardinal angles are rounded in front and obtusely angular behind. The writer has long been under the impression that these shells could be identified with the typical form of *A. grandis*, Say, as they do not correspond at all well with Lea's figures or measurements of *A. decora*,

1 In Canad. Nat. and Geol., Vol. VI., p. 269.

the "breadth" or, as it would now be called, the length of which is stated to be 3.9 inches. The recent receipt from Mr. Simpson of outline drawings of specimens from Dr. Lea's collections, labelled "*A. decora,* from the canal at Cincinnati, Ohio," has, however, convinced the writer of the correctness of Mr. Simpson's determination, though it is very generally believed that *A. decora* is not more than a mere variety of *A. grandis.*

ANODONTA EDENTULA, Say. (*A. undulata,* Lea, et auct., but possibly not of Say; *A. Pennsylvanica,* Lamark, and *A. areolata,* Swainson.)

Dr. R. Ellsworth Call has expressed the opinion that *A. edentula,* Say, is peculiar to the Mississippi drainage system, and *A. undulata,* Say., to those waters that drain into the Atlantic, but the writer has never been able to see any tangible difference between these two shells. In a recent letter to the writer, Mr. Simpson says, "*Anodonta undulata* is no doubt the small form which we have here in the Potomac. Though Say gives no locality, he speaks of it as 'thin and fragile, length near half an inch; breadth seven-tenths.' The figure fairly well represents our shell. This may run into *A. edentula,* but I have never yet been able to connect it with that. The material in Lea's collection, under the name of *A. undulata,* Say, is merely a form or forms of *A. edentula.*"

Under one or the other of these names this shell has previously been recorded as having been collected in Lake Matapedia, P.Q., by Dr. R. Bell in 1857; in a small lake in the valley of the Riviere Rouge, P.Q., by W. S. M. D'Urban, in 1858; in the St. Charles River, near Quebec city, by the writer, in 1861, and at Brome Lake, P.Q., by Mr. R. J. Fowler, in 1862.

More recently, it has been collected by Dr. R. Bell in 1883, at Lake Winnipeg, between Forts Alexander and Simpson, and by Professor Macoun, in 1894, in Ontario, at Rondeau, on Lake Erie, and in the east and west branches of the Grand River at Galt and Ayr.

In another letter to the writer, Mr. Simpson makes the following remarks upon this species, "The so-called Anodontas of which this is the type, have more or less perfect cardinals and occasional vestiges of laterals. They group with *Margaritana Elliotti*, *M. Spillmani*, *M. Raveneliana*, etc. The genus *Margaritana* is a medley of forms, which, for the most part, are more nearly related to various groups of *Unio* than to each other. I believe that *Margaritana* should be merged into *Unio*, and with it the Anodontas of the *edentula* group."

ANODONTA FERUSSACIANA, Lea.

L'Orignal Creek, Ottawa River, Dr. R. Bell, 1855 (as *A. pavonia*, Lea). Ponds at the Mile End, Montreal, Dr. R. Bell, 1858, and J. F. Whiteaves, 1862.

ANODONTA FLUVIATILIS, Dillwyn. Sp. (*A. cataracta*, Say.)

Several specimens of this common eastern species, which has previously been recorded as occurring at many localities in the Province of Quebec and neighbourhood of Ottawa, were collected by Dr. R. Bell, in 1883, at Flying Post Route, 100 miles north-east of Michipicoten, and, in 1889, from a small lake near Proudfoot's north and south line, in the Sudbury district of Ontario. A single specimen, which may be referable to this species, was collected by Professor Macoun, in 1884, at White Fish River, north of Lake Superior.

ANODONTA FOOTIANA, Lea.

Specimens which are said to have been identified with this species by Dr. Lea were collected by Mr. W. M. S. D'Urban, in 1858, from three small lakes tributary to the Riviere Rouge, P.Q. Since then, specimens, which Mr. Simpson refers to *A. Footiana*, have been collected in

Ontario, by Professor Macoun, in 1884, at White Fish River, north of Lake Superior, and at Lake Hannah, on the Nepigon River; by Dr. A. C. Lawson, in 1886, at Rainy Lake ; by Mr. W. Spreadborough, in 1894, from the Muskoka River, near Georgian Bay; and in Manitoba, by Dr. R. Bell, in 1883, at Shoal Lake, Red River. Mr. Simpson also is of opinion that specimens collected by Mr. R. J. Fowler in the Lachine Canal at Montreal, in 1863, and referred by the writer to *A. Lewisii*, Lea, are young shells of *A. Footiana.*

ANODONTA FRAGILIS, Lamark. (*A. lacustris*, Lea.)

This shell was apparently first collected in Canada by Mr. D'Urban in 1858, associated with *A. Footiana*, in three small lakes in the valley of the Riviere Rouge, and identified shortly afterwards by the late Dr. Isaac Lea with the *A. fragilis* of Lamarck. Specimens collected by Professor Macoun in 1885, from a lake six miles up the Becscie River, Anticosti, were identified with *A. fragilis* by Mr. F. R. Latchford, of Ottawa, and similar shells have long been known to occur at Meach's Lake, near Ottawa. Some of these Anticosti specimens were sent to Mr. Simpson, who thinks that they are essentially similar to shells labelled *A. fragilis* in Dr. Lea's collection, but cannot see how these latter are to be distinguished from *A. lacustris*, Lea, and does not pretend to be always able to separate *A. fragilis* from *A. fluviatilis.*

ANODONTA IMPLICATA, Say.

Lake Winnipeg, between Fort Alexander and Elk Island, Dr. R. Bell, 1883; and Souris River, near Roche Percée, Dr. A. R. C. Selwyn, 1890 ; a few specimens from each of these localities, which have been identified with this species by Mr. Simpson. It had previously been recorded as occurring in the St. Charles River, near Quebec, where it was collected by the writer in 1861.

ANODONTA MARRYATTANA, Lea.

Lake Hannah, Nipigon River, and east side of Lake Nipigon, Ontario, Professor Macoun, 1884; and Fairford River, Manitoba, J. F. Whiteaves, 1888; as identified by Mr. Simpson.

ANODONTA NUTTALLIANA, Lea. (*A. Oregonensis*, Lea.)

Okanagan Lake, B.C., A. J. Hill, 1882; two specimens of the variety *Oregonensis.* Near Victoria, V. I., James Fletcher, 1885, and Rev. G. W. Taylor, 1889. Nicola Lake, B.C., Dr. G. M. Dawson, 1889; three specimens of the typical form and one of the variety *Oregonensis.* Salmon Arm, Shuswap Lake, B.C., Dr. Dawson, 1894; several examples of both forms of the species. Stream entering Clayoquot Sound, V. I., at Stubbs Island, W. Spreadborough, 1894.

ANODONTA OVATA, Lea.

Coulée No. 5, Vermilion River, Alberta, J. B. Tyrrell, 1886.

ANODONTA PEPINIANA, Lea.

Specimens which Mr. Simpson refers to this species were collected by Dr. R. Bell, in 1883, from the Winnipeg River, Manitoba, and in 1886, from the Attawapishkat River, in the Severn district, which now forms the eastern part of Keewatin. Two left valves of a shell which may be referable to this species were collected by Mr. J. B. Tyrrell, in 1884, at the Lake of the Woods. Mr. Simpson is of the opinion that *A. Pepiniana* may be merely a variety of *A. Simpsoniana*, Lea.

ANODONTA SIMPSONIANA, Lea.

In Ontario this species was collected by Dr. A. R. C. Selwyn in 1883, at Black Bay, Lake Superior; by Prof. Macoun, in 1884, at the north end of Lake Nipigon, in

1885, at Port Dover, Lake Erie, and in 1890, at Port Colborne, on the same lake.

In Manitoba it was collected by Dr. R. Bell in 1878, at the outlet of Lake Winnipeg and from Lake Winnipeg between Fort Alexander and Elk Island. It occurs, associated with *A. Marryattana*, Lea, in the Fairford River, and is the only species of *Anodonta* that the writer was able to find in Lake Manitoba (in 1888).

In the district of Saskatchewan one perfect specimen was collected by Dr. R. Bell, in 1882, at Buffalo Lake, near Methy Portage.

Mr. Simpson, to whom the writer is indebted for the identification of specimens from most of these localities, is convinced that *A. Dallasiana* and *A. Kennicotti*, of Lea, are both synonyms of *A. Simpsoniana.*

ANODONTA SUBCYLINDRACEA, Lea.

Widely distributed in the provinces of Quebec and Ontario, from Lakes Metapedia and St. John to the eastward, to creeks, rivers and bays at the east end of Lake Superior and north side of Lake Erie to the westward. Mr. Simpson, however, regards *A. subcylindracea* as a mere synonym of *A. Ferussaciana*, Lea.

MARGARITANA, Schumacher, 1819.

MARGARITANA CALCEOLA, Lea. (*M. deltoidea*, Lea.)

Lake Erie, at Fort Dover, Professor Macoun, 1890. Grand River, at Belwood, Ontario, J. Townsend, 1892. East and west branches of the Grand River at Galt and Ayr, Professor Macoun, 1894.

MARGARITANA COMPLANATA, Barnes.

Manitoba. Upper Assiniboine River, Dr. R. Bell, 1874; Souris River, Dr. A. R. C. Selwyn, 1882 and 1884; Shoal River and near Elk Island, Lake Winnipeg, Dr. R. Bell, 1883; Swan River, J. B. Tyrrell, 1887, and Assiniboine River, J. B. Tyrrell, 1884.

Keewatin. Nelson River, Dr. R. Bell, 1878.

Saskatchewan. Shell River (township 50, range 2 and 3, west of third Initial Meridian) north of the north Saskatchewan, O. J. Klotz, 1890.

Alberta. Battle River, three miles above Grattan Lake, J. B. Tyrrell, 1885.

Margaritana margaritifera, L.

From the Province of Quebec this species has already been recorded as having been collected by Dr. R. Bell (in 1857) in the Green and Rimouski rivers, at Lake St. John and both the Metapedia Lakes, and by the writer, (in 1861) in the River St. Charles, near Quebec City. More recently it has been collected in that province by Dr. H. M. Ami, in 1883, in the Assumption River, near Rawdon; by N. J. Giroux, in 1892, at the Lac de la Ferme, Riviere du Loup, en haut, and in that river; also by A. P. Low, in 1894, in the Romaine River.

In British Columbia, small and thin but characteristic specimens were found by Dr. G. M. Dawson, in 1885, in small streams entering Malaspina Strait, on the mainland side; also, in 1890, in Kakwous Lake, the source of the Bonaparte River, at an altitude of about 4,000 feet.

Margaritana marginata, Say.

The small and typical eastern form of this shell is common in the province of Quebec and in eastern Ontario. A few specimens of the large western variety known to students of the Unionidæ as *M. truncata*, Say (M. S.) were collected by Professor Macoun, in 1894, at Galt and Ayr, from the east and west branches of the Grand River

Margaritana rugosa, Barnes. (? = *M. costata*, Rafinesque, sp.)

This species is widely distributed in the provinces of

Quebec and Ontario. In the latter province unusually large and thick specimens, measuring five inches and a half in length by three inches in height, were collected by Prof. Macoun, in 1894, in the east and west branches of the Grand River, at Galt and Ayr. The species has been recorded by Dr. G. M. Dawson as occurring, though rarely, in the Roseau River, Manitoba.

MARGARITANA UNDULATA, Say.

St. Lawrence River, at Montreal and Quebec, J. F. Whiteaves, 1861. Near Ottawa City, G. C. Heron, 1879.

UNIO, Philipsson, 1788.

UNIO ALATUS, Say.

Widely distributed throughout Ontario. The most easterly locality at which it has been collected is the Ottawa River at L'Orignal, as recorded by Dr. R. Bell, in the Canadian Naturalist and Geologist for June, 1859 (Vol. IV., p. 219). In Manitoba it has been collected in the Red River by Dr. G. M. Dawson, in 1873, and by T. C. Weston, in 1884.

UNIO BOREALIS, A. F. Gray.

A pair of specimens of this species, from the Ottawa River, at Duck Island, the typical locality, was presented to the museum of the Survey by Mr. F. R. Latchford, of Ottawa, in 1886.

UNIO CANADENSIS, Lea.

Two specimens, from the Ottawa River, near Ottawa, which are believed by the donor to be referable to this enigmatical species, were presented to the Museum of the Survey by Mr. Latchford, in 1893.

UNIO CIRCULUS, Lea. (? = *U. subrotundus*, Rafinesque.)

Lake Erie, at Kingsville, Ontario, J. McQueen, 1880, two specimens. Thames River, at Chatham (several specimens) and Detroit River, below Sandwich, Ontario (one specimen), Professor Macoun, 1894.

UNIO COCCINEUS, Lea.

Grand River, Cayuga, Ontario, Professor Macoun; one "fairly typical specimen," (C. T. Simpson).

UNIO COMPLANATUS (Solander ?) Lea. (*U. purpureus*, Say.)

Abundant in Nova Scotia, New Brunswick, Quebec and Eastern Ontario. Collected by Dr. R. Bell, in 1859, in creeks, rivers and bays on the north shore at the east end of Lake Superior, along the entire north shore of Lake Huron, also in the St. Mary River. Lake Nipissing, Dr. A. R. C. Selwyn, 1884 (whence it had previously been recorded by Dr. Bell, in 1859). Montreal River, Lake Temiscaming, Ontario, Dr. R. Bell, 1887.

UNIO CORNUTUS, Barnes. (? = *U. reflexus*, Rafinesque.)

Grand River, Cayuga, Ontario, Professor Macoun, 1890; a perfect and fresh left valve.

UNIO ELEGANS, Lea. (*U. truncatus, as of Rafinesque.*)

Thames River, at Chatham (Ontario), Professor Macoun, 1894; one dead but perfect specimen.

UNIO ELLIPSIS, Lea. (? = *U. olivarius*, Rafinesque.)

Ottawa River, opposite L'Orignal, R. Bell, 1854, and near Ottawa, G. C. Heron, 1879 (as *U. olivarius*, Rafinesque). St. Lawrence River, at Montreal, R. Bell, 1858, and near Quebec, J. F. Whiteaves, 1861. Missisaugi River, on the north shore of Lake Huron, Dr. R. Bell, 1860. Lake Erie, at Port Colborne, and Detroit River, near Windsor, Professor Macoun, 1885.

UNIO GIBBOSUS, Barnes. (? = *U. dilatatus*, Rafinesque.)

This species, which has long been known to be abundant in the St. Lawrence and Ottawa rivers, has recently been collected by Professor Macoun in Lake Erie, at Port Colborne, in the Grand River at Cayuga, and its two branches at Galt and Ayr, also in the Detroit River, at Windsor.

UNIO GRACILIS, Barnes. (? = *U. fragilis*, Rafinesque.)

Collected by Professor Macoun, in 1885, from Lake Erie, at Port Colborne, and the Grand River, at Cayuga; in 1890, at Port Dover, Ontario, and in 1894, in the River Thames, at Chatham.

UNIO LACHRYMOSUS, Lea. (Probably = *U. quadrulus*, Rafinesque.)

In Ontario, Professor Macoun collected specimens of this species in the Grand River at Cayuga, in 1885, and in the Thames River, at Chatham, in 1894.

In Manitoba it was found to be abundant in the Red River, by Dr. G. M. Dawson, in 1873, and Professor J. Fowler has presented to the museum of the Survey a specimen, which he collected at Emerson in 1887.

UNIO LIGAMENTINUS, Lamarck.

Grand River, at Caledonia, Ontario, J. Townsend, 1885, and at Cayuga, Professor Macoun, 1890. Thames River, at Chatham, Professor Macoun, 1894. Roseau River, Manitoba, Dr. G. M. Dawson, 1873, and Assiniboine River, at Millwood, J. B. Tyrrell, 1888.

UNIO LUTEOLUS, Lamarck.

Common almost everywhere in Canada east of the Rocky Mountains, though its exact range east of Ontario is a little uncertain, owing to its close resemblance to *U. radiatus.* Dr. Lea, in 1862, records it as occurring in Great Slave Lake, Lake Athabasca, and near the mouth of Moose River, Hudson's Bay. In Manitoba it was collected by Mr. J. B. Tyrrell, in 1887, from the Swan River;

in 1888, from the Assiniboine, and in 1889, from the Red Deer River. It appears to be the only *Unio* in Lake Manitoba, where it was collected by the writer in 1888, and from the Fairford River. In Alberta, Mr. Tyrrell collected it, in 1885, in the Blind Man, Battle and Medicine Rivers.

UNIO NASUTUS, Say.

Two fine specimens of this species, from Toronto Bay, were presented to the museum of the Survey, by Mr. Latchford, in 1886, and since then numerous specimens of it were obtained by Professor Macoun (in 1894) at Rondeau, on Lake Erie.

UNIO NOVI-EBORACI, Lea. (Perhaps = *U. iris,* Lea.)

Grand River, at Cayuga, Professor Macoun, 1890 ; one perfect specimen. Thames River, at Chatham (two specimens) and Detroit River, below Sandwich (one specimen), Professor Macoun, 1894.

UNIO PHASEOLUS, Hildreth. (? = *U. fasciolaris,* Rafinesque.)

Detroit River, at Windsor (one specimen) and Lake Erie, at Port Colborne (two specimens), Professor Macoun, 1885. Lake Erie, at Kingsville, Ontario (one specimen), J. T. McQueen, 1890, and Thames River, at Chatham (one specimen), Professor Macoun, 1894.

UNIO PRESSUS, Lea.

Boulder River, one of the upper branches of the Attawapishkat River, west of James Bay (in lat. 52° 30′ and long. 87° 30′), Dr. R. Bell, 1886 ; a perfect and fresh right valve. West branch of the Grand River, at Ayr, Ontario, Professor Macoun, 1894,a slightly distorted but living shell. This species has long been known to be common in the Rideau Canal and river, near Ottawa, where it was first noticed by the late E. Billings, about the year 1856 or 1857.

UNIO PUSTULOSUS, Lea. (? = *U. bullatus*, Rafinesque.)

Grand River, Caledonia, Ontario, J. Townsend, 1885; one specimen. Thames River, at Chatham, Professor Macoun, 1894; two specimens.

UNIO RADIATUS (Gmelin), Lamarck.

No new localities are to be recorded for this common eastern species, which has long been known to range from Nova Scotia to at least as far to the westward as Ottawa.

UNIO RANGIANUS, Lea. (Perhaps a var. of *U. perplexus*, Lea.)

Lake Erie, at Kingsville, Ontario, J. T. McQueen, 1890; one perfect specimen of the shell of the female.

UNIO RECTUS, Lamarck.

Common in the St. Lawrence and Ottawa rivers, and in western Ontario. In Manitoba, it was collected by Dr. G. M. Dawson, in 1873, from the Roseau River, and by Mr. J. B. Tyrrell, in 1888, in the Assiniboine River at Millwood.

UNIO RUBIGINOSUS, Lea. (? = *U. flavus*, Rafinesque.)

In Ontario this shell has been collected by Professor Macoun, in 1890, in the Grand River at Cayuga, and in 1894, in the Thames River, at Chatham. In Manitoba, it was found by Dr. G. M. Dawson, in 1873, in the Red and Roseau Rivers, and by Dr. R. Bell, in 1883, in Lake Winnipeg, between Fort Alexander and Elk Island.

UNIO SUBROTUNDUS, Lea.

Grand River, Caledonia, J. Townsend, 1885, one specimen, which "approaches *U. ebenus*" (C. T. Simpson). Port Dover, Lake Erie, a specimen "which approaches *U. solidus*, Lea," (C. T. Simpson), and Rondeau, Lake Erie, one specimen, Professor Macoun, 1894.

UNIO TRIANGULARIS, Barnes. (? = *U. triqueter*, Rafinesque.)

Collected by Professor Macoun, in 1885, at Port Colborne, Ontario, and in 1894, at Rondeau and in the Thames River at Chatham.

UNIO TRIGONUS, Lea. (? = *U. undatus*, Barnes.)

Port Dover, Lake Erie, Professor Macoun, 1890, two perfect but worn specimens, which were identified with this species by Mr. Simpson.

UNIO UNDULATUS, Barnes. (? = *U. costatus*, Rafinesque.)

Ontario. Sable River, at Thedford, Mr. Bissell, 1883, per Dr. H. Ami. Grand River, Caledonia, J. Townsend, 1885. Lake Erie, at Port Colborne, and Detroit River, at Windsor, Professor Macoun, 1885. Grand River, at Cayuga, Professor Macoun, 1890, and Thames River, at Chatham, Professor Macoun, 1894.

Manitoba. Black River, Lake Winnipeg, Dr. R. Bell, 1883, two specimens, with the umbonal regions much eroded. Emerson, Professor J. Fowler, one specimen of a small form which approaches *U. plicatus* (Le Sueur, MS.S.) Say.

UNIO VENTRICOSUS, Barnes. (*U. occidens*, Lea, female, and *U. subovatus*, Lea, male: ? = *U. cardium*, Rafinesque.)

Common in the St. Lawrence and Ottawa rivers and throughout Ontario. In Manitoba it has been collected in the Red and Roseau Rivers by Dr. G. M. Dawson, in 1873, and at Lake Winnipeg, between Fort Alexander and Elk Island, by Dr. R. Bell, in 1883.

OTTAWA, November 30th, 1894.

CONTRIBUTIONS TO CANADIAN BOTANY.

By JAMES M. MACOUN.

V.

THALICTRUM VENULOSUM, Trelease.

In thickets, Seven Persons' Coulee, Medicine Hat, Assa.; Crane Lake, Assa.; Cypress Hills, Assa., 1894. (*John Macoun,* Herb Nos. 2952, 2953, 2954.[1]) Our only records between Lake Manitoba and the Rocky Mountains.[2]

RANUNCULUS ABORTIVUS, Linn.

Lake Petitsikapau, Hamilton River, Labrador, 1894. (A. P. Low, Herb No. 4331.) Most northern record for Eastern Canada.

RANUNCULUS HISPIDUS, Michx.

Our only specimens of this plant are from Wesley Park, Niagara, Ont. (*John Macoun.*)

RANUNCULUS COOLEYÆ, V. & R.

Mount Rapho, Lat. 56° 13′, Long. 131° 46′. Alt. 3,800 ft. July, 1894. (*Otto Klotz* and *H. W. E. Canavan.*) Only Canadian record. First collected near Juneau, Alaska, by Miss Grace Cooley, in 1891.

ACTÆA SPICATA, Linn, var. RUBRA, Ait.

Lake Michikamau, Labrador, 1894. (*A. P. Low.* Herb. No. 4331.) Northern limit in Eastern Canada.

NYMPHÆA PYGMÆA, Ait.

New stations for this rare plant are Loon Lake, C. P. Ry. east of Port Arthur, Ont., and Petobi Brook, Gull Bay, Lake Nepigon, Ont., 1894. (*Wm. McInnis.*)

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

2 The geographical limits given in these papers refer to Canada only.

BARBAREA VULGARIS, R. Br.

Lake Petitsikapau, Hamilton River, Labrador, 1894. (*A. P. Low.* Herb No. 4340.) Not before recorded from Labrador.

VIOLA PALUSTRIS, Linn.

Ashuanipi branch of Hamilton River, Labrador. (*A. P. Low.* Herb. No. 4343.) Not before recorded from Labrador.

CERASTIUM VISCOSUM, Linn.

C. glomeratum, Thuill.

Burrard Inlet, B.C., and many places in vicinity of Victoria, Vancouver Island. (*John Macoun.*) Not found anywhere in Eastern Canada, all references but one, under *C. viscosum,* in Prof. Macoun's Catalogue of Canadian Plants going with *C. vulgatum.*

CERASTUM VULGATUM, Linn.

C. viscosum, Macoun, Cat. Can. Plants, Vol. 1., page 77, in part.

Widely distributed throughout Eastern Canada. Revelstoke, B.C. (*John Macoun.*) North of Finlayson Lake, B.C., Lat. 59°. (*Dr. G. M. Dawson.*)

CERASTIUM NUTANS, Raf.

Sproat, Columbia River, B.C., 1890. (*John Macoun.*) Cherry Creek, east of Lake Okanagan, B.C. (*Jas. McEvoy.*) Only British Columbia stations.

CERASTIUM ARVENSE, Linn., var. OBLONGIFOLIUM, H. & B.

C. oblongifolium, Torrey; Macoun, Cat. Can. Plants, Vol. I., p. 77.

A narrow-leaved form of this variety was collected at Truro, N.S., by Prof. Macoun, July, 1883. Only station east of Ontario.

CERASTIUM ALPINUM, Linn.

Arctic America, from Labrador to Alaska. References under var. *Fischerianum,* Macoun Cat. Can. Plants, Vol. I., p. 498, go here. This variety is confined to the Pacific Coast.

CERASTIUM ALPINUM, Linn., var. BEERINGIANUM, Regel.

Arctic America, and on many of the higher Rocky Mountains.

STELLARIA AQUATICA, Scopoli.

The only stations for this species in Canada are Stratford, Ont. (*Burgess*). Roadsides and ballast heaps, Nanaimo, Vancouver Island, 1893. (*John Macoun.*)

STELLARIA NITENS, Nutt.

Dry slopes, Agassiz, B.C.; Kamloops, B.C., 1889. (*John Macoun.*) Not before collected on mainland of British Columbia.

STELLARIA LONGIPES, Goldie, var. LÆTA, Wats.

S. longipes, Goldie, var. *Edwardsii,* T. & G.; Macoun, Cat. Can. Plants, Vol. I., pp. 76 and 498, in part.

From New Brunswick and Labrador to British Columbia and throughout Arctic America. Our herbarium specimens are from Petitcodiac, N.B. (*Brittain.*) Pack's Harbor, Labrador. (*Rev. A. Waghorne.*) Ford's Harbor, Labrador; Digge's Island, Mansfield Island and Nottingham Island, Hudson Bay. (*Dr. R. Bell.*) Lat. 62° 03′, Long. 103° 15′. (*J. W. Tyrrell.*) Summit of South Kootanie Pass, Rocky Mts. (*Dr. G. M. Dawson.*) Saddle Mountain, Banff, Rocky Mts.; Kicking Horse Lake, Rocky Mts., alt. 8,000 feet; Stewart's Lake Mountain, B.C. (*John Macoun.*) Mountains at Roger's Pass, Selkirk Mts., alt. 7,500 ft.; Mount Queest, Shuswap Lake, B.C., alt. 6,500 ft. (*Jas. M. Macoun.*)

STELLARIA LONGIPES, Goldie, var. EDWARDSII, Wats.

From Labrador to British Columbia and northward to the Arctic regions. Our only specimens of this variety are from Quesnelle, B.C. (*John Macoun.*)

STELLARIA GRAMINEA, Linn.

In sandy woods, Fort George, Hudson Bay. (*Jas. M. Macoun.*) Probably indigenous. Only record north of Nova Scotia.

STELLARIA ULIGINOSA, Murr.

This species is confined to the Atlantic slope and is not of as wide distribution as is given it by Prof. Macoun, Cat. Can. Plants, Vol. I., pp. 75 and 497. Our specimens are from Hunter's River, Prince Edward Island, and Point Pleasant, near Halifax, N.S. (*John Macoun.*)

STELLARIA BOREALIS, Bigel. var. COROLLINA, Fenzl.

S. borealis, Bigel. var. *alpestris,* Gray; Macoun Cat. Can. Plants, Vol. I., p. 74.

Dr. Robinson places the eastern limit of this variety at Lake Superior. We have, however, specimens from Brackley Point, Prince Edward Island. (*John Macoun.*) Lake Mistassini, N.E.Ter. (*Jas. M. Macoun.*) The only western reference for this variety given by Prof. Macoun is Yale, B.C. Later collections show it to be a common plant in many parts of the Northwest and British Columbia, and especially abundant wherever collections have been made on Vancouver Island.

STELLARIA CRASSIFOLIA, Ehrh.

S. gracilis, Rich., Macoun Cat. Can. Plants, Vol. I, p. 75.

Pelly Banks, Lat. 61°, Yukon District. (*Dr. G. M. Dawson.*) Not before recorded west of the prairie region.

STELLARIA HUMIFUSA, Rottb., var. OBLONGIFOLIA, Fenzl.

Blinkinsop Bay, B.C., 1885. (*Dr. G. M. Dawson.*) Not before recorded from Canada. Referred to *S. uliginosa*, by Prof. Macoun, Cat. Can. Plants, Vol. I, p. 497.

STELLARIA OBTUSA, Engelm.

Near MacLeod's Lake, B.C. (*John Macoun.*) South Kootanie Pass, Rocky Mts. (*Dr. G. M. Dawson.*) The only Canadian stations.

ARENARIA CILIATA, Linn. var. HUMIFUSA, Hornem.

Cerastium trigynum, Macoun Cat. Can. Plants, Vol. I., p. 498 in part.

Stellaria humifusa, Macoun Cat. Can. Plants, Vol. I., p. 498 in part.

Mount Albert, Gaspé, Que. (*Allen. Porter.*) Lake Mistassini, N.E.Ter. (*Jas. M. Macoun.*) Specimens collected at Kicking Horse Lake, Rocky Mts., and on the summit of Mount Aylmer, Banff, Rocky Mts., alt. 8,300 feet, have been doubtfully referred here by Dr. Robinson.

ARENARIA CONGESTA, Nutt., var. SUBCONGESTA, Wats.

Gravelly banks, Lewis River, Lat. 62°, Yukon District. (*Dr. G. M. Dawson.*) Not before recorded west of Alberta.

ARENARIA SAJANENSIS, Willd.

A. arctica, Macoun, Cat. Can. Plants, Vol. I., p. 71.

A. biflora, Wats., var. *obtusa*, Wats.; Macoun, Cat. Can. Plants, Vol. I., pp. 71 and 496.

A. verna, Macoun, Cat. Can. Plants, Vol. I., p. 496 in part.

A. verna, var. *rubella*, Macoun, Cat. Can. Plants, Vol. I., p. 72 in part.

Mount Albert, Gaspé, Que. (*Porter. Macoun.*) These specimens were referred to *A. arctica* and *A. verna*, var. *rubella*, by Prof. Macoun. Cape Chudleigh, Hudson

Strait. (*Dr. R. Bell.*) Referred to *A. verna* by Prof. Macoun. Common on mountains throughout British Columbia.

According to Dr. Robinson *A. arctica,* Stev., is not found in British America.

ARENARIA STRICTA, Fenzl.

A. Michauxii, Hook., Macoun, Cat. Can. Plants., Vol. I., pp. 72 and 496.

Dr. Robinson makes Minnesota the western limit of this species. It is not uncommon in the Rocky Mts. near the line of the Canadian Pacific Railway, our specimens being from several stations in and near the National Park at Banff.

SAGINA OCCIDENTALIS, Wats.

Gordon Head and Cedar Hill, Vancouver Island. (*John Macoun.*)

SAGINA LINNÆA, Presl.

Mount Aylmer, Rocky Mts., alt. 8,300 ft.; Kicking Horse Lake, Rocky Mts., alt. 8,000 ft.; Roger's Pass, B.C.; between Sproat and Nelson, B.C.; Burrard Inlet, B.C.; Nanaimo, Vancouver Island. Herb No. 19. (*John Macoun.*) Summit of South Kootanie Pass, Rocky Mts.; Queen Charlotte Islands. (*Dr. G. M. Dawson.*) Mountains north of Griffin Lake, B.C.; Mount Queest, Shuswap Lake, B.C. (*Jas. M. Macoun.*)

S. CRASSICAULIS, Wats.

Gordon Head, Esquimault, and Goldstream, near Victoria, Vancouver Island; Comox and Nanaimo, Vancouver Island. (*John Macoun.*)

Note.—The references under these three species are in part in addition to those given by Prof. Macoun under *S. occidentalis* and *S. Linnæa,* Cat. Can. Plants, Vol. I., pp. 79 and 499, and the arrangement now given is intended to take the place of that in the catalogue.

HYPERICUM CANADENSE, Linn.

In sandy soil at Kamloops, B.C.; wet ground, Sproat Lake, Vancouver Island. (*John Macoun.*) Not before recorded west of Alberta.

MALVA PARVIFLORA, Linn.

M. borealis, Macoun, Cat. Vol. II., p. 313.

Specimens of this plant were collected on ballast heaps at Nanaimo, Vancouver Island in 1887, by Prof. Macoun, and called *M. borealis.* It was again found by him at the same place in 1893 (Herb. No. 46) and correctly determined by Prof. Greene.

MALVA ROTUNDIFOLIA, Linn.

Waste places at Beacon Hill, Vancouver Island, 1893. (*John Macoun,* Herb. No. 47.)

SIDALCEA MALVÆFLORA, Gray.

Common at Revelstoke. (*John Macoun.*) Not before recorded from interior of British Columbia.

MALVASTRUM COCCINEUM, Nutt.

On dry soil, 7 miles from the mouth of Deadman River, near Kamloops Lake, B.C. (*Jas. McEvoy.*) Not before recorded west of the prairie region.

LINUM LEWISII, Pursh.

A white-flowered procumbent form of this plant was collected in Lat. 56° on the west side of Hudson Bay, by Jas. M. Macoun, in 1886. No plants with blue flowers were seen.

GERANIUM ERIANTHUM, DC.

Alice Arm, Observatory Inlet, B.C,. July 7th, 1893. (*Jas. McEvoy.* Herb. No. 60.) Southern limit.

GERANIUM PUSILLUM, Linn.

Agassiz, B.C. (*Macoun.*) We have no other record of this plant between Ontario and the Pacific Coast.

GERANIUM RICHARDSONI, Fisch. & Mey.

In open woods at Botanie, near Spence's Bridge, B.C., Alt. 3,500 ft. (*Jas. M. Macoun.*) Not before recorded west of the Rocky Mountains.

LIMNATHES MACOUNII, Trelease.

First collected by Prof. Macoun at Victoria, Vancouver Island, in 1875. Found again by him in May, 1893, in abundance in ditches and swampy places near Victoria. No other stations for this species are known.

FLŒRKEA PROSERPINACOIDES, Willd.

Wet places near springs, Casselman, Ont., in flower, May 14th, 1891. (*John Macoun.*) Only record from Eastern Ontario.

OXALIS CORNICULATA, Linn.

On ballast heaps, Nanaimo, Vancouver Island, 1893. (*Macoun,* Herb. No. 54.) Only record from British Columbia.

OXALIS CORNICULATA, L., var. STRICTA, Sav.

In dampish spots near Indian Head, Assa., 1892. (*W. Spreadborough.*) Not before recorded west of the Red River.

IMPATIENS PALLIDA, Nutt.

Anstey Creek, Shuswap Lake, B.C., 1889. (*Jas. M. Macoun.*) Agassiz, B.C. (*John Macoun.*)

CEANOTHUS SANGUINEUS, Pursh.

Sicamous and Revelstoke, B.C., 1889. (*John Macoun.*) Eastern limit.

RHAMNUS PURSHIANA, DC.

In woods at Revelstoke, Columbia River, B.C. (*John Macoun.*) Eastern limit.

ACER SACCHARUM, Marshall.

A. saccharinum, Wang., Macoun Cat. Can. Plants, Vol. I, p. 99 in part.

A. saccharinum, Wang., var. *nigrum*, T. & G.; Macoun Cat. Can. Plants, Vol. I., p. 99.

Bark gray; internodes mostly slender and elongated, commonly glossy and reddish.; buds gray, conical, slender and acute; petioles, little dilated at base, not concealing the mature buds, without stipules; leaves, thin, typically large (usually 4 to 7 inches broad), flat, dull, usually light green above, the lower surface grayish, glabrous to pubescent, or exceptionally quite hirsute when young, isodiametric, truncate at base to slightly cordate with an open sinus, or broadly cuneate, rather deeply 5-lobed, except for some smaller 3-lobed leaves near the ends of the branches, with typically narrow sinuses, the three larger lobes with parallel sides or dilated upwardly and each with a slender apical acumination often sinuously bidentate on the sides, and two similar lateral acuminations, or the lateral lobes merely sinuate on the upper margin, the smaller outermost lobes mostly sinuously 1 to 2 toothed on the lower margin; fruit, large (6 to 10 mm.), the outer lines of the large wings (8 to 12 x 16 to 28 mm.), nearly parallel or spreading to something less than a right angle.

From Nova Scotia to Lake Superior.

ACER SACCHARUM, var. BARBATUM (Michx.), Trelease.

A. saccharinum, Wang.; Macoun, Cat. Can. Plants, Vol. I., p. 99, in part.

Bark, gray to almost black; internodes often shorter and stouter, commonly dull but reddish; buds gray, pubescent or dark, conical ovoid, often obtuse; petioles as in the last and without stipules; leaves firm, of medium size (usually about 4 in. broad), flat, somewhat glossy and of various shades of green above, pale or glaucous and downy to glabrous beneath, mostly broader than long, cordate with shallow open basal sinus to truncate, 3-lobed, with very open round sinuses (the upper margin of the lateral lobes often spreading nearly in a straight line), the lobes sinuously narrowed from the base to a single acumination, or the median line sometimes dilated by a pair of blunt shoulders, one or two similar dilations also on the lower margin of each lateral lobe, and exceptionally developed into short complementary lobes; fruit as in the last.

This tree ranges in the United States from Connecticut to Missouri and Michigan, and probably grows in many parts of Eastern Canada. Specimens intermediate between this variety and *A. saccharum* from Belleville, Ont. (*John Macoun*), and Niagara Falls, Ont. (*Jos. Schrenk*) have been referred here by Dr. Trelease. These are the only Canadian specimens of this variety in our herbarium.

ACER SACCHARUM, var. NIGRUM (Michx. f.), Britton.

Bark, nearly black; internodes, stout, sometimes short, dull, buff; buds, dark, ovoid, often obtuse; petioles dilated at base so as, usually, to cover the buds, with adnate triangular or oblong foliaceous stipules; leaves soft but of heavy texture, large (usually 5 to 6 in. broad), with drooping sides, dull and dark green above, clear green and usually persistently downy below, isodiametric, the larger deeply cordate with often closed sinus, 3 to 5-lobed, with shallow broad sinuses from which the lobes are undulately narrowed to an acute or acuminate point, rarely with short lateral acuminations; fruit, as in the last.

Ranges in the United States from New York to Missouri and Michigan, but not known certainly to occur in Canada, though frequently reported.

Note.—These descriptions of the several forms of Sugar Maples have been reprinted from Dr. Trelease's Monograph in 5th Annual Report of Missouri Botanical Garden, and space is given to them as they change very materially our knowledge of these trees, and by printing the descriptions in full it is hoped that Canadian botanists will be led to carefully observe the sugar maples in their vicinity.

RHUS GLABRA, Linn.

R. glabra, L., var. *occidentalis,* Torrey; Macoun, Cat. Can. Plants, Vol. I., p. 505.

Deer Park, Lower Arrow Lake, B.C.; Kamloops, B.C., and Spence's Bridge, B.C. (*John Macoun.*) Only references west of Ontario.

RHUS COPALLINA, Linn.

Rocky hillsides at Lansdowne, Ont. (*Rev. Chas. Young.*) Very rare in Canada.

LUPINUS ARCTICUS, Wats.

Additional stations for this species are Upper Liard River, Lat. 60°, Yukon District; forks of Stikine River, B.C. (*Dr. G. M. Dawson.*) Fifty miles below Lower Ramparts, Mackenzie River. (*R. S. McConnel.*) Fort Good Hope, Mackenzie River. (*Miss E. Taylor.*) Specimens collected at Medicine Hat in flower, May 31st, 1894, have been referred here by Dr. Robinson. (*John Macoun,* Herb. No. 4190.)

SAXIFRAGA TOLMÆI, Torr. & Gray.

On Mount Head, alt. 4,200 ft., Lat. 56° 05′, Long. 131° 09′, 1894. (*Otto Klotz* and *H. W. E. Canavan,* Herb. No. 4197.) First authentic record for Canada.

TILLÆA SIMPLEX, NUTT.

In mud in a mill pond at Mount Stewart, Prince Edward Island, 1888. (*John Macoun.*) New to Canada.

Œnothera micrantha, Horn.

On ballast heaps at Nanaimo, Vancouver Island, 1893. (*John Macoun*, Herb. No. 249.) Introduced from the south. New to Canada.

Phacelia hispida, Gray.

On ballast heaps, Nanaimo, Vancouver Island, 1893. (*John Macoun*, Herb. No. 654.) Introduced from the south. New to Canada.

Krynitzia ambigua, Gray.

On ballast heaps at Nanaimo, Vancouver Island, 1893. (*John Macoun*, Herb. No. 672.) Introduced from California. New to Canada.

Amsinckia barbata, Greene, Erythræa, Vol. II., No. 12. p. 192.

Stout and coarse, erect or decumbent, the branches loosely floriferous throughout, all excepting the uppermost pedicels subtended each by a broad ovate-lanceolate amplexicaul foliaceous bract; sepals 4 or 5 lines long, nearly linear, without rufous or fulvous pubescence, but densely white-hirsute along the margins, sparsely hispid with whitish bristles an the back; corolla small; nutlets ovate-acuminate, closely muricate-tuberculate, without transverse rugosities, but with an elevated and toothed dorsal ridge.

Collected at Cameron Lake, Vancouver Island, 15th July, 1887, by John Macoun. Type specimen in the herbarium of the British Museum. Distributed by Prof. Macoun as *Amsinckia lycopsoides.*

Zannichelia palustris, Linn.

In the Spullamacheen River at Enderby, B.C., 1889. (*Jas. M. Macoun.*) Not before recorded west of the Saskatchewan.

NAIAS FLEXILIS, Rostk. & Schmidt.

Enderby, B.C., 1889. (*Jas. M. Macoun.*) Kamloops, B.C. (*Jas. McEvoy.*) Revelstoke, B.C. (*John Macoun.*) Not before recorded from interior of British Columbia.

ZOSTERA LATIFOLIA, Morong.

Z. marina, Macoun, Cat. Can. Plants, Vol. II., p. 90, in part.

Burrard Inlet, B.C.; Esquimalt, Vancouver Island, (*John Macoun.*)

PHYLLOSPADIX TORREYI, Wats.

Amongst rocks below half-tide, Stubb's Island, west coast of Vancouver Island, 1893. (*W. Spreadborough,* Herb. No. 4502.) New to Canada.

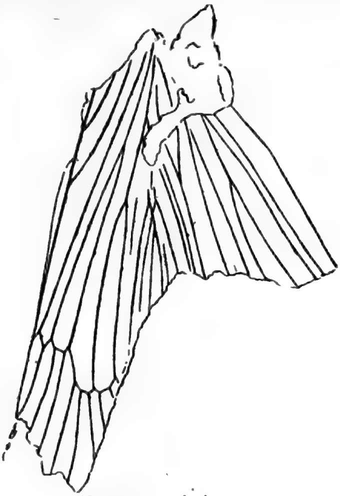
BECKMANNIA ERUCÆFORMIS, Host., var. UNIFLORA, Scrib.

Sea's Farm, near Victoria, Vancouver Island, 1893. (*John Macoun.*) Not before recorded west of the Rocky Mountains. Perhaps introduced.

A CADDIS-FLY FROM THE LEDA CLAYS OF THE VICINITY OF OTTAWA, CANADA.

By SAMUEL H. SCUDDER.

The few insects that have been hitherto found in the Leda clays or in similar horizons in America have all been Coleoptera. The present specimen, of which a figure is here given, enlarged six diameters, is a caddis-fly, one of the Neuroptera. It was found by Dr. Henry M. Ami, of the Geological Survey of Canada, in the nodules of Green's Creek, near Ottawa, and sent me for examination. It is of a glistening, dark, smoky brown color, with black veins which are followed with some difficulty, especially where two wings overlap. The clearest and most important part of the neuration is in the upper portion of the fore-wing; but unfortunately it exhibits in full only the principal cells. These are enough to show that it is a caddis-fly, and that it falls near, if not in the genus Phryganea proper, but it differs in important points from all the species I have examined in the Museum of Comparative Zoology at Cambridge, containing the large collection of the late Dr. Hagen. The differences consist principally in the great length of the thyridial area and of the median cellule, so that the distal termination of the lower cellules is much farther removed from the base of the wing than is that of the upper. It represents a tolerably large species, the preserved fragment being 10 mm. long, and the probable original length of the forewing at least 15 mm. It may be called *Phryganea ejecta.*



Phryganea ejecta, n. sp.

On the Norian or "Upper Laurentian" Formation of Canada.

By Frank D. Adams, M.A.Sc., Ph.D.

(Translated from the German by N. J. Giroux, Esq., C.E., of the Geological Survey of Canada.)—*Continued.*

The Structure of the Morin Anorthosite and a Comparison of the same with the Structure of Certain Rocks in other places.

If a large smooth weathered surface of anorthosite, as it is found in the "Roches Montonnées" throughout the Morin area, be examined, leaving out of consideration for the present the arm-like extension and that part of the main area adjacent to it, it will be noticed that the rock which is coarsely granular and of a deep violet colour, has not the regular structure which we find in a typical granite, but exhibits a more or less irregular structure. At times this is scarcely noticeable, but at other times it is very distinct, and is due to the fact that the bisilicates and iron ores are much more abundant in some parts of the rock than in others. The portions richer in bisilicates form either very large irregularly-bounded spots, which appear here and there, or a large number of small spots. In some cases they occur abundantly in the rock, while in others they are entirely wanting. The coloured portions are sometimes so arranged that instead of irregular spots they form undulating stripes, whose direction is sometimes sufficiently continuous to give a kind of strike to the rock. In other cases, however, they are irregular. Between these spots or stripes, which are comparatively rich in bisilicates, and badly defined against them lies the chief mass of the rock. It contains only very little and sometimes even no bisilicates, and in it there lie large broken crystals of plagioclase, often heaped up in certain places or especially numerous in certain directions. In intimate connection with this irregular distribution of the constituents of the rock, and sometimes also quite independent of it, there occur local variations in the size of grain which are likewise exhibited in spots or stripes. The accompanying drawing (see Fig. 1), made from a photograph, represents a weathered surface of a variety which is unusually rich in coloured ingredients. An irregular structure produced by one or

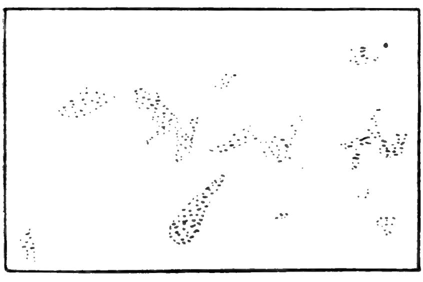


Fig. 1.

other of the above-mentioned causes is exhibited more or less distinctly by the rocks of all the anorthosite areas that have been investigated; but it is not confined to these, since it has been observed in many gabbros and basic plutonic rocks allied to them in districts widely separated from one another.

Dr. Geo. H. Williams, for example, says, in his treatise on "The Gabbros and Associated Hornblende Rocks occurring in the neighbourhood of Baltimore, Md.,"[1] on p. 25: "The most striking feature in the texture of the unaltered Gabbro is the repeated and abrupt change in the coarseness of the grain which is seen at some localities. It was undoubtedly caused by some irregularity in the cooling of the original magma from a molten state, for which it is now difficult to find a satisfactory explanation. The coarsest grained varieties of the Baltimore Gabbro occur in the neighbourhood of Wetherville, and there these sudden changes in texture are most apparent. Irregular patches of the coarsest kinds lie imbedded in those of the finest grained without any regard to order. In other cases a more or less pronounced banded structure is produced by an alternation of layers of different grains or by such as have one constituent developed more abundantly than the others. Such bands are not, however, parallel, but vary considerably in direction and show a tendency to merge into one another as though they had been produced by a motion in a liquid or plastic mass."

Similar and very coarse-grained portions are also found in the gabbro-diorite which is quarried at Kühlengrund, near Eberstadt, in Hessen, a rock which is otherwise quite massive and of an even texture. Other occurrences might easily be adduced.

The most remarkable example which I have observed, and especially notable for the reason that it shows the transition from a perfectly normal massive rock through

[1] G. H. Williams, Bulletin 28, U.S. Geol. Survey.

one showing those irregular coarse-grained patches to one with an imperfect banding like that observed in the Morin area, is found in the Saguenay anorthosite area along River Shipshaw, which, coming from the north, empties into the Saguenay about seven miles above Chicoutimi.

Along this stream many large smooth surfaces or "Roches Montonnées" of anorthosite are exposed which has been superficially etched by the atmospheric agencies and whose vegetable growth has completely been removed by forest fires, so that the structure of the rock is excellently displayed. This series of exposures is limited on the north by a colossal dyke of gabbro, nearly half-a-mile wide, and which cuts the anorthosite, enclosing fragments of it. The exposures can be studied for a distance of eight miles in a straight line down the Shipshaw River to a point which is three miles distant from its mouth in the Saguenay.

At first the rock is coarsely granular, and over the whole extent of the large exposures is quite massive and of uniform composition. It is exposed thus for about half-a-mile, and then spots or patches, which must be designated as very coarse-grained, commence to appear. In these coarse-grained portions the individual grains are an inch or more in size, while they are much smaller in the rest of the rock. Both show a very distinct ophitic or diabase structure, that is to say, the plagioclase occur in lath-shaped forms whose interstices are filled up with augite. The structure continues for four miles, with, in places, an additional irregularity caused by local variations in the relative proportion of certain of the constituents. There are, for example, considerable exposures where the rock consists entirely of plagioclase, while in other places much diallage is present in masses as much as 1½ foot in diameter. Large masses of almost pure plagioclase or diallage also occur in places in the normal rock.

After an interval of one mile, where outcrops are wanting, we come to another set of exposures extending over one mile, with well-developed ophitic structure, as before, except that the rock is irregularly striped or banded. This results from the fact that the above-described irregularities in grain and composition are no longer exhibited in spots, but in long undulating stripes, into which the former are drawn out, as described by G. H. Williams, in the passage quoted on page . Farther down stream these stripes assume by degrees an almost parallel position, so that the rock exhibits a distinct strike, while at the same time the ophitic structure gradually disappears. Here then is a case where a rock of undoubted eruptive origin perfectly massive and with a well-developed ophitic structure gradually changes into a striped rock, the banded structure being produced by variations, not only in size of the grains, but in the relative proportion of the constituents.

This coarse banding, which is a common structure in many parts of certain anorthosite areas, was formerly considered as an indication of imperfect bedding. But from the above-mentioned facts, it is evident that it was probably produced by movements in a granular, eruptive rock.

The next question which presents itself is, whether this structure originated in a movement before the rock was completely crystallized, or whether it was developed after consolidation. In the exposure above described, facts were found, by repeated and careful study in the field, which point to a movement while the rock was in a molten state. The irregularity in the size of the grains is of primary origin, and was certainly not produced by pressure. The stripes or irregular bands do not assume a definite direction from the start, but wind about at first as if the mass had moved when in a pasty condition, and only became more evenly arranged when, for some reason, the movement was determined in a definite direction.

This is the most probable explanation of the facts, and is furthermore supported by the absence of lines of motion or fracture, and as far as can be ascertained by a careful microscopic investigation, also by the absence of those minerals which are generally found along such lines in rocks that have been squeezed. No clear proof of any dynamic action is observable.

We find, moreover, elsewhere, similar striped and banded structures in certain basic intrusive masses which certainly have not been affected by pressure. The theralite from Mount Royal, at the foot of which lies the city of Montreal, is an example of this. This theralite breaks here through the flat-lying silurian limestone of the Trenton age, and probably forms the nucleus of an old palaeozoic volcano.

Although it cannot be maintained that the striped and irregular banded structure which is so often found in various basic rocks is never produced by dynamic action, it may yet be shown that it often results from movements in the mass before consolidation. It is probable that the structure usually originates in this way; but cases are rare where the conclusion that the structure results from dynamic action is quite excluded. It may be here also remarked that no satisfactory reason can be assigned for the sudden alterations in the size of grain which we so often observe in gabbros and allied rocks. This can hardly be accounted for by irregular cooling, as the temperature must have been practically the same in adjacent parts of the magma. The cause may perhaps be looked for in the great abundance of moisture in certain places. If such be the case, however, we must reject the theory so frequently held that the presence of "agents mineralisateurs" exerts a slighter influence in the crystalline development of basic magmas than on that of the acid ones in which such an alteration in the size of the grain does not usually occur to such an extent.

In carefully examining the anorthosite rocks of the Morin area we usually, if not invariably, observe in con-

Fig. 2.

nection with the striped and irregularly banded structure a peculiar fracturing or granulation in the constituents of the rock. This structure is frequently very well exhibited on large weathered surfaces. The accompanying sketch (Fig 2) of an exposure near the village of St. Marguerite shows this phenomenon. The banding is still distinct, but in nearly every part of the area the rock itself, even where no striping is visible, presents this peculiar brecciated structure. Fragments of plagioclase and ot her constituents lie in a kind of ground mass, which consists of smaller grains. The apparently porphyritic elements are only in a few cases idiomosphic plagioclases, but are, on the contrary, almost invariably allotriomorphic fragments

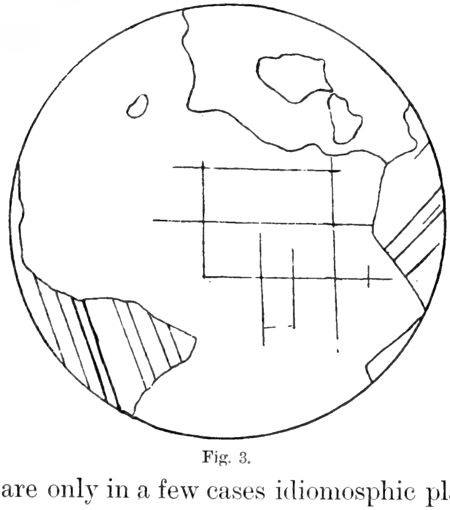


Fig. 3.

of this mineral. In some places these fragments of crystals make up the greater part of the rock, while elsewhere they are very rare. The larger individuals can often be observed in the very act of breaking up, in which case the fragments are but very little separated from one another. In a microscopical investigation we hardly find a hand-specimen of a coarse granular variety which does not show to a certain degree the clastic structure, and in studying a large number of hand-specimens, we can follow step by step the transition from a rock which exhibits no cataclastic structure to one which consists almost entirely of broken grains in which there remain scarcely any traces of the original individuals.

Fig. 4

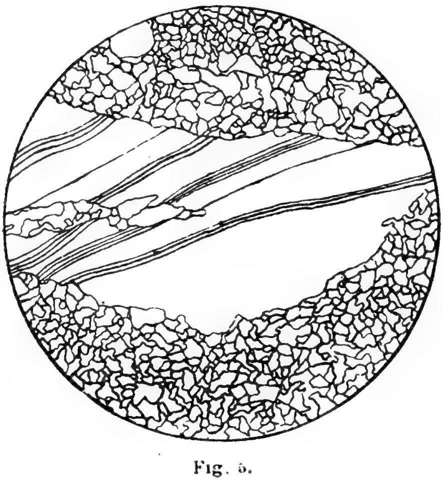


Fig. 5.

Figures 3, 4 and 5 are made from microscopical photographs of sections which were taken from three different places in the area; they show the progress of the granulation as seen under the microscope.

A very remarkable fact which was mentioned in speaking of the composition of these anorthosites is that the large fragments of crystals have a deep violet colour, while the broken material is white. The contrast is observed with especial distinctness on a weathered surface or in a thin section under the microscope. The difference of the colour is due to the fact that the small inclusions which abound in the large plagioclase individuals are wanting in the granulated portion of the rock. They have evidently gathered themselves together into small masses of titanic iron ore, which are enclosed in the broken plagioclase, but are not found in the large individuals. The contrast of these colours is so marked that in a section containing plagioclase in both conditions, we can predict at once under the microscope, from the colour exhibited, how much of it is in a granulated condition and how much is not, even before the structure has been actually brought out by means of polarized light.

This seems at first sight to point to a complete recrystallization of the granulated parts, but there are no facts which make this probable. The feldspar does not change its composition. In many sections we can actually observe the origin of the fine grained material from the outer portion of the larger individuals. This process begins in an irregular extinction of a part of the periphery, which is followed by the breaking off of the fragments. It is also observed that so soon as a fragment is separated from the larger mass it becomes colourless. It would seem then, that the granulation in some way or another gives free scope to the agent by which the accumulation of the material of the small inclusions into the larger masses is brought about. This question we shall consider again in considering the anorthosites of the Saguenay River.

Wherever we find an anorthosite, as in a portion of the Morin area, which is composed entirely of finely granular material, it can hardly be distinguished by its appearance from white granular limestone, if, as is generally the case, it is almost pure plagioclase.

The peculiar white granular variety of the anorthosite with comparatively few large individuals, forms in the Morin area, the greater part of the above mentioned arm-like extension at its south-east corner. In this the anorthosite protrudes from the drift in every direction in hundreds of smooth white bosses, which give a very peculiar appearance to the country. It is also met with and largely developed in the Saguenay area and other anorthosite areas in the Province of Quebec. It was furthermore described by Dr. Albert Leeds[1] as occurring in the county of Essex, New York; by Vogelsang[2] in Labrador, as well as by other observers, and may therefore be considered as being present to a certain extent in most of the areas of this kind of rock. In the Morin anorthosite area (and the same applies to the Saguenay area), we find the most granular varieties near the sides and especially on the east side, as if the pressure had been exerted from that direction. In the arm-like extension of the Morin area, this fine granular variety is quite clearly seen. and since the district is easily accessible by roads and pathways, its structure and other characters may be studied with comparative ease. This arm has an average breadth of nearly six miles, and is of a nearly equal width throughout. At the southern end, before it is covered by the unconformable Cambrian beds, it becomes a little broader, owing to the fact that it has been split longitudinally by a wedge of gneiss. As has been already mentioned, it runs into the gneiss parallel to the stratification or foliation of the latter, so that it appears here as if it formed an instratified layer.

The white granular anorthosite, moreover, is in this off-

1 A. Leeds, Notes upon the Lithology of the Adirondacks. 13th Annual Report of the New York State Museum of Nat. Hist., 1876.

2 Vogelsang, Sur la Labradorite coloriée de la Côté du Labrador, Archives Néerlandaises III, 1868.

shoot everywhere more or less distinctly foliated, as the bisilicates and the iron ores are arranged in more or less distinct parallel streaks or strings (Figs. 6 and 7). The latter are evidently nothing else than the rounded spots rich in bisilicates which are shown in fig. 1, which, however, are drawn out by a movement in the rock. The fragments of plagioclase and the portions of the rock, distinguished by the difference in their size of grain, are likewise arranged in the same direction. We most clearly see this foliation where the bisilicate and iron ores are comparatively abundant. In places where these ingredients are wanting, as is often the case, and where the rock presents an almost even size of grain, it resembles a white marble and no traces of foliature can be seen even in a weathered surface. In general, however, the foliation is quite distinct, and runs parallel to the longer direction of the arm, that is to say, to the strike of the gneiss. Like the gneiss itself, the apophysis dips towards the west and is therefore overlain on the west side by the gneiss, but the angle of the dip is very different in different places. In some places it is almost horizontal, in others it dips at high angle. Along the western limit of the arm the strike is very regular and uncommonly well developed. It is well seen near New Glasgow, but it

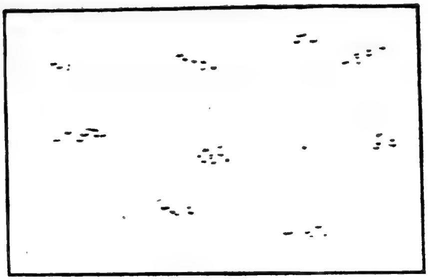


Fig. 6.

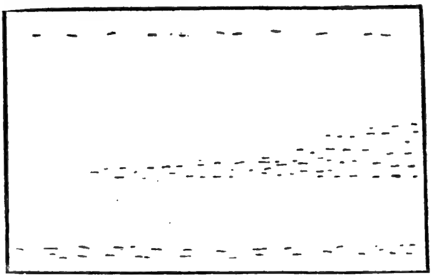


Fig 7

is especially distinct at the same contact a little further to the north on the road between the villages of Chertsey and Rawdon. The rock here shows in an exposure of considerable size, a very fine foliated structure due to an alternation of thin bands of pure plagioclase with others of pyroxene. The pyroxene layers might better be denominated leaves, since they are very thin and appear in cross sections often as mere parallel lines. The latter, as well as the plagioclase layers, frequently show in thin sections under the microscope, grains or fragments of large individuals, with tails of small broken granules, which extend in both directions from them, producing the foliated structure. This progress of granulation can be seen with astonishing distinctness; for, as just mentioned, the large crystals can be observed in the very act of breaking up. In doing so, they often break along certain lines, in which the broken material is arranged. It can furthermore be observed quite frequently that these grains are the remnants of very large fragments which were broken apart almost exactly in the direction of the foliation. They are thus often very narrow but of considerable length. It even happens sometimes that such fragments are twelve times as long as they are wide.

At the upper end of the arm, where it passes into the main area, the foliation becomes much less distinct, and the rock gradually assumes the finely brecciated, irregular streaked structure whose character and origin have been already referred to. When the main area is finally reached, definite strike ceases, except in a few places quite near the limits.

A cataclastic structure which is similar in many respects to that which we have described, and in which the grains of plagioclase are twisted and broken, and likewise exhibit the granulation on their periphery, is found in some of the distinctly striped hand-specimens of the theralite of Mount Royal as above mentioned. We must here consider them as the result of a movement which took place before complete consolidation, and as an example of what Brögger[1] designates as "protoclastic structure." It is here, however, found only locally, and is not noticeable in many sections of the rock. Yet its occurrence is of interest for the reason that it proves that its mere existence is not always an infallible sign that the rock has been exposed to great pressure, and has been crushed.

Although in the anorthosite this granulation, with its accompanying phenomena, are without doubt caused by the pressure to which the rock had been subjected, the effects of this pressure are quite different from those generally observed.

In a foliated structure caused by shearing, as Lehmamm and others have so excellently shown, in many instances the breaking takes place along certain lines. Along these lines or stripes, which sometimes are quite wide, and at others quite microscopical in size, the rock is finely broken up, so that it forms what Heim calls "Rutschmehl" in cases where it has not again become thoroughly compacted. Between these shearing planes we often find comparatively few indications of pressure. Especially along the lines of movement, and when these are absent, through the whole rock, in places where extensive dynamic effects have occurred, certain peculiar alterations in the constituents of the rock are observed.

Of these the following deserve special mention:—The alteration of the pyroxene into hornblende and of the plagioclase into a mixture of zoisite, albite, and other minerals, which is known under the name of saussurite. As far as could be ascertained no undoubted case has as yet been observed among the crushed gabbros and associated rocks where uralite and saussurite have not been found.

[1] Brögger, die Mineralien der Syenitpegmatitgänge der südnorwigischen Augit und Hephelin--Syenite. Zeitschr, für Kr. Bd., 16, 1890, p. 105.

These Canadian anorthosites, on the contrary, show with the cataclastic structure the following peculiarities:—

1. This structure occurs not along definite lines, but throughout the rock.

2. Where it occurs there is neither saussurite nor uralite. However granular the plagioclase may be, no trace of saussurite can be seen. In like manner, no uralite is detected, even though the granulation of the pyroxene is so far advanced that only the smallest remnants of the original individuals remain. Now and then some small grains of compact hornblende occur with the pyroxene in the neighbourhood of the contact with the gneiss, exactly as in many normal gabbros. But even these are by no means invariably present; the finely foliated rock, consisting of alternate layers of unaltered pyroxene and plagioclase, while remnants of the large individuals of both are constituents, from which the granulated portion has originated are still seen. The only place in which saussurite occurs is, as above mentioned, near New Glasgow. It forms here, like epidote, strings and veins, which have no relation with the foliation of the rocks, but represent small crushed zones, which have originated at another much later period. These very occurrences show most distinctly how different the products of the normal dynamic agencies are from the structure now under consideration.

3. In the main portion of the area, the granulation is not accompanied by foliation, and we can observe in the large weathered surfaces, plagioclase individuals which are in the act of breaking in every possible direction. It is evident, therefore, that they were not acted upon by forces, such as would result from movements in a mass of a more or less pasty consistency. In the arm-like extension from the south-east part of the area where the rock, as already mentioned, is often distinctly foliated, this foliated structure originated, as shown by a careful study,

from the movement in one direction of a mass, whose colored ingredients are irregularly distributed, and especially concentrated in some places (see fig. 1). The more or less rounded spots where the colored ingredients are abundant, became pulled out into irregular, ill-defined streaks, and parallel to these run portions of the rock, which still contain large numbers of the fragments of plagioclase crystals.

The most probable explanation of these phenomena is that the movements were caused by pressure.

1. When the rock was still so far beneath the surface of the earth, and so weighted down by the overlying beds that breaking and shearing with the movement of the resulting masses was impossible. The alterations in the character of the mass were probably induced very slowly, the constituents were granulated, and the small broken parts moved one over another. This granulation progressed with the duration and intensity of this movement to a certain point. Such a motion would present certain resemblances to that of a very tough pasty mass.

2. While the rock was still very hot and perhaps even near its melting point. This would explain why pyroxene, which, according to the experiments of Fouqué and Michel-Lévy, represents the stable form of the molecule at a high temperature, is not easily changed into amphibole, which represents the more stable form at a low temperature, as is usually the case in crushed and pulverized rocks. It is perhaps owing to the same cause that no saussurite is formed; still, the conditions necessary to the formation of these minerals are so little known that opinions on this point cannot be ventured upon as yet.

The Anorthosite Beds Interstratified with the Gneiss and Alternating with it.

We find in many places in the neighbourhood of the Morin area, as was already mentioned, anorthosite bands alternating with the gneiss. Their width varies from one to several hundred yards, and their length from one-half to eight English miles. Some of the larger bands are represented on the accompanying map. The character of the anorthosite varies somewhat in the different bands, but on the whole it resembles that of the Morin area. In general these bands are sharply defined against the gneiss, with the exception of that near St. Jérôme, where the surrounding anorthosite appears to gradually pass into the gneiss. As distinguished from that of the main mass, the anorthosite of these bands often contains more or less hornblende, biotite and garnet. In one place scapolite also appears in considerable quantity, probably as a product of the alteration of plagioclase, as in the case of the well known spotted gabbros of Norway. These anorthosite bands, moreover, present a more or less distinct arrangement of the constituents in the direction of their long axis.

Under the microscope the above described granulation of the constituents is seen excellently developed. Together with these anorthosite bands which have the character and the appearance of eruptive rocks, we find in many places in the Laurentian gneiss, particularly on the east side of the Morin mass, interstratified layers of a dark pyroxene gneiss which gradually passes into the ordinary gneisses. These have quite a different appearance from anorthosite, being much richer in coloured constituents. They contain augite, hypersthene and plagioclase in quantity, very often biotite, hornblende, a little quartz, and considerable quantities of an untwinned feldspar which probably consists mostly of orthoclase. We also meet these so-called "basic gneisses" in many other widely separated districts of the Laurentian, but neither these nor the anorthosite bands have been as yet thoroughly examined from a mineralogical standpoint. In a report on the district to be published before long by the Geological Survey of Canada they will be more fully discussed.

Resumé of the Results obtained from a Study of the Morin Area.

The Morin area is a large eruptive mass of anorthosite, that is to say, of a gabbro very rich in plagioclase. This breaks through Laurentian rocks, and cutting off the different members of the formation. It contains inclusions of gneiss, sends out off-shoots into the gneiss, and is surrounded in many places by a zone, which exhibits many characteristics of a contact zone. The mass shows in many places an irregular arrangement of the ingredients and often variations in the size of grain, a peculiarity often noticed in allied plutonic rocks. It exhibits, moreover, a peculiar and unusual kind of cataclastic structure, which, where it occurs in a very marked manner, induces a schistosity in the rocks. This structure is caused by pressure, acting under peculiar conditions. This schistosity is by no means a proof of an original sedementary origin, and it is likewise evident that all other arguments for the existence of a large independent sedementary complex of which the anorthosite is supposed to form part, are inconclusive. The gneisses and the limestone with which it is said to alternate really belong to the Grenville series. and the apparent interstratification of the anorthosite is the result of intrusion. The anorthosite, moreover, is unconformably overlaid by flat lying unaltered beds of Cambrian age (Potsdam and Calciferous) and, like the Laurentian rocks through which it cuts, must have already possessed the characters which it now exhibits in Cambrian times.

III.—THE SAGUENAY AREA.

As far as we now know, the largest area of anorthosite rocks is the one situated about the region of Lake St. John, where the Saguenay river has its source. This river, which is famous for the remarkable character of its scenery, flows throughout its whole course in a deep gorge in Laurentian rocks, and empties into the St. Lawrence River about 120 miles below the city of Quebec. The southern limit of the anorthosite in question is about 100 miles north of that city. It embraces an area of not less than 5,800 square miles, and is almost completely covered with forest, being one of the wildest districts of the Dominian of Canada. The southern corner of the area is level and inhabited. Here the rocks have there been carefully investigated, whilst towards the north explorations were made only on the three rivers Peribonka, Little Peribonka, and Shipshaw, which run parallel to the longitudinal direction of the area, one on each side of it, and one through the centre. The rocks have been traced along these rivers considerably more than 100 miles north of the southern limits of the area. The Peribonka was explored to its forks, while the Shipshaw and Little Peribonka were followed up through the rough mountainous country to their sources without reaching the northern limit of the anorthosite area. Mr. Low, however, found no more anorthosite on his exploratory trip to Lake Mistassini, during which he crossed[1] the head waters of the Peribonka and examined the district directly to the north of the one investigated by myself. But he did find some on the Betsiamites and afterwards on Rat River, a tributary of the Mistassini. We therefore know within narrow limits the course of its northern boundary. The Shipshaw and the Little Peribonka, which flow respectively on the east and west side of the area, are several times crossed by the contact of the anorthosite with the gneiss; they consequently mark the breadth of the former. We thus possess a good general knowledge of the extension of the area. The only previous geological examination of the district was that made by Richardson, which was cursory and confined to

[1] Low, on the Mistassini Expedition, Report of the Geological Survey of Canada, 1885, D.

the southern part of the area. The results were published in the Report of the Geological Survey of Canada for the year 1857. Abbé Laflamme likewise gives a brief description of a few exposures in the Geological Survey Report for 1884. Richardson gives a general description of the anorthosite of the southern part of the area, but his statements concerning the western limit as well as his estimate concerning its extension towards the north are erroneous. He, however, pointed out in his work the resemblance of the character of these rocks to those of other parts of Canada, and thus increased by one the number of such areas already known in other parts of the Laurentian.

The anorthorsite of this "Saguenay area," as we shall call it, consists, like that of the Morin area, of a basic plagioclase. The latter is sometimes labradorite, sometimes bytonite. Augite, hypersthene, and at times also hornblende and biotite are other constituents; they are in every respect identical with the corresponding minerals of the Morin area, and therefore require no special description. The rock is of medium grain, but the coarseness of grain varies considerably and often quite abruptly from place to place. The crystals of the coarse granular varieties frequently increase in size till the plagioclase individuals reach a foot or more in diameter.

A difference between this anorthosite and that from the Morin area consists in the fact that the former often contains olivine. This mineral occurs often in considerable quantity, so that there results a plagioclase-olivine rock or Troctolite, in which all other iron-magnesia compounds are wanting, with the exception of those forming the zones of corrosion at the contact of the olivine with the plagioclase. These zones, which occur so frequently in the gabbro, have nowhere else been observed in a more perfect development. Even in the field, an orange weathering constituent invariably surrounded by a narrow green rim was frequently observed. Having prepared thin sections and examined more carefully the nature of these zones, attention was drawn to them in a short paper.[1] They have also been studied by a number of other investigators.[2] The examination of a large number of additional hand-specimens from this area has, however, brought to light many additional facts concerning this remarkable phenomenon.

The most massive variety of anorthosite in the whole area is found on the east shore of Lake St. John, one to two miles south of the head of the Saguenay River, where it forms large exposures.

Although the same irregularity in the size of grain as well as in the proportion of the constituents, which so often presents itself in gabbros and other basic rocks, appears in many places, yet nothing like banding in the rocks could be discovered. Distinct sets of cracks cutting the anorthosite cause it to split up into small cubic blocks, as in the case with granite and other plutonic rocks.

On the examination of thin sections under the microscope, olivine and feldspar are seen with the above-mentioned zones around the former. Some small grains of horneblende, ilmenite and pyrite are likewise generally present. Like the olivine, the plagioclase is quite fresh and contains no products of decomposition. It has a specific gravity of 2.70 to 2.71. The maximum extinction was determined in many thin sections and showed $32\frac{1}{2}°$ on either side of the twinning line. The mineral is, therefore, bytonite. It is almost black, being filled with the

[1] Adams, Notes on zones of certain silicates occurring about the olivine in anorthosite from the Saguenay District—Am. Nat., Nov., 1885.

[2] J. G. Bonney, Troktolite in Aberdeenshire—Geol. Mag., Oct., 1885. J. H. Hatch, Notes on the Petrographical characters of some rocks collected in Madagascar, Q.J.G.S., May, 1889. J. W. Judd, Chemical Changes in Rocks under Mechanical Stresses.—Journ. Chem. Soc., London, May, 1890. A. E. Törnebohm, Uber die wichtigeren Gabbro—und Diabas-Gesteine Schwedens. Neues Jahrb. für Min., etc., 1877, 383. G. H. Williams, Peridotites of the Cortlandt Series.—Am. Jour. of Sc., Jan, 1886.

minute inclusions above described. While one can observe the cataclastic structure in the anorthosite in other parts of the area, here there is scarcely a sign of pressure. Broken individuals were never observed, and the feldspar showed only in a few sections an occasional irregular extinction. In most of the sections no trace of pressure is discoverable. It is, moreover, 12 miles from the nearest contact with the surrounding gneiss. The zones around the olivine are very wide and perfectly developed. The olivine seldom shows approximate crystal forms; it either occurs in single individuals or in aggregates, which in that case, form larger grains. A single individual forms at times a very irregular elongated strip. The olivine crystallized before the plagioclase and became enclosed in the latter. Notwithstanding that a considerable number of thin sections were examined, the two minerals were never found directly in contact, every grain of olivine being invariably completely surrounded by a double zone of other silicates and thereby separated from the plagioclase.

The first zone around the olivine is colourless, or nearly so, but often shows a weak pleochroism in green and red colours. It is formed of many small individuals which are closely grown together, and are elongated in a direction at right angle to the surface of the olivine. It often shows the two sets of cleavages crossing at right angles, which are characteristic of pyroxene, and in sections, perpendicular to an optic axis, the revolving bar of a biaxial crystal is seen.

The individuals being so small and the cleavage is very imperfect, it is very dificult to determine accurately the character of this pyroxene. Similar zones, however, are found in hand-specimens from other parts of the area in which the crystals of the inner zone are developed on a larger scale. In these the parallel extinction, trichroism of red, green and yellowish colours, and also the other optical properties point to a rhombic pyroxene, which mineral occurs in the anorthosites of this as well as in those of other areas.

The outer zone, that is to say, the one bordering on the plagioclase, consists of a bright green actinolite in very thin needle-shaped crystals, which form a rim around the pyroxene, from which they project in a radiating manner into the feldspar. This zone is considerably wider than the pyroxene zone, and the actinolite individuals always stand perpendicular to the surface of the latter. The mineral is frequently more massive near the pyroxene than it is farther away from it.

In a hand specimen from the north shore of Lake Kenogami the hornblende of the outer zone is full of small inclusions of spinel. These have a dark green colour, are isotropic, have a high index of refraction and no cleavage. They occur mostly in portions of the horneblende zone nearest the pyroxene. We find them at times in the form of grains, but generally in peculiarly bent sheaf-like forms, resembling the quartz in fine-grained pegmatites or granophyres. These are arranged within the horneblende crystals or between them in a direction perpendicular to the surface of the inner pyroxene zone. This spinel often occurs in the horneblende in lines parallel to the surfaces of the prisms, while some small individuals fork in such a manner that they run parallel to the two prismatic cleavages. A quite similar case was described by Lacroix as occurring in the olivine-norite of the Heias mine near Tredestrande, in Norway.[1] In this rock the olivine is surrounded by a double zone, the inner one consisting of hypersthene and the outer one of amphibole, in which occur scattered grains of green spinel, which frequently give rise to a kind of pegmatitic (granophyric) structure. According to Becke[2] the kelyphite which

[1] Lacroix, Contributions à l'étude des Gneiss a Pyroxene et des Roches à Wernerite. Bull. soc. min. Fr., Avril, 1880, p. 149.

[2] F. Becke, Min. u. Pet. Mitth., VII., p. 250.

forms similar zones around the garnet of some peridotites consists likewise of a mixture of spinel and amphibole.

The olivine and the minerals which form the zones around it are quite differently orientated; the width of the zones, as we observe them in the thin sections, has no definite relation to the size of the grains of olivine, especially as it varies greatly with the direction in which the crystal is cut. The zones have apparently originated from the interaction of the molecules of silicate of lime of the plagioclase and of the basic silicate of magnesia and iron of the olivine, giving rise to silicates of intermediate composition, that next to the olivine being a more acid silicate of magnesia and iron, which is followed, nearer to the plagioclase, by an acid silicate of lime and magnesia. The edges of the original grains of olivine are evidently the sharp lines which separate the rhombic pyroxene from the hornblende, and the latter undoubtedly penetrates the plagioclase. On the other hand one can often observe the augite starting from this line and growing into the olivine, especially where the olivine remaining has the form of a narrow wedge-like grain which runs out into a line, on either side of which can be found the pyroxene individuals.

The opinion has been expressed that these zones were produced by dynamic forces which have acted upon the rock. This may be so elsewhere, but here there are no facts which favor this view.

They are well developed, even in places where the rock, as above mentioned, is quite massive, and there are no facts observed which point to dynamic action. They are found just as well developed in other parts of the anorthosite area, which likewise show no trace of dynamic action. They certainly occur in some localities in the district under consideration accompanied by a cataclastic structure, but this must necessarily be the case if the zones existed before the development of the structure. A single case of their occurrence unaccompanied by phenomena of pressure has more weight than a hundred where distinct signs of pressure are found, since the latter may have been developed subsequently; nor can they be considered as contact phenomena, since they are found everywhere about the olivine wherever the latter occurs in the rock. The occurrence above described is, for example, as already mentioned, 12 miles distant from the nearest contact with the gneiss. Lacroix has also pointed out this phenomenon in some French olivine gabbros which he investigated. It would seem therefore, that their origin is to be referred to the influence of the plagioclase magma upon the olivine before complete solidification. The so-called opacite rims which occur about the horneblende and biotite in so many eruptive rocks are evidently phenomena of a somewhat analagous nature.

In many places in this anorthosite area ilmenite deposits were found, some of them of considerable extent. The largest of these is on the north shore of the Saguenay and about 15 miles in a straight line from Lake St. John, where it forms a series of low hills. The ore contains also olivine and plagioclase irregularly distributed through it, and forms three irregular bands, which are intimately associated with a rock resembling diabase. The most easterly of these three iron ore bands has a width of not less than 80 paces. Judging from its mode of occurrence and composition this iron ore is in all probability of igneous origin, as in the case of the iron ore of the Morin area, which has been already described, the well known ores of Taberg in Sweden, as well as those of Cumberland, Rhode Island.[1]

We here find again all the structural varieties that were described in the discussion of the Morin area, namely: The massive rocks with a uniform size of grain, the massive rocks with variations in the size of grain

1 M. E. Wadsworth, Bull., Mus. Comp. Zool., Harvard, May, 1881.

from place to place, the brecciated variety with a white granular ground mass in which are enclosed irregularly shaped fragments of dark blue plagioclase with some streaks of pyroxene, but without distinct banding, and more rarely, the streaked and distinctly banded varieties. All these occur and pass into one another. The perfectly banded and schistose varieties occur, indeed, only exceptionally, yet one can observe indications of banded structure in most places if large exposures are examined. The more granular varieties occur principally on the east side, exactly as in the Morin area. On Lake Kenogami, at the south-east corner of the area, cliffs of the granular white anorthosite occur which attain a height of 400 feet or more, and which, through the entire absence of pyroxene and iron ore, appear like great cliffs of marble.

It must here be observed that during the process of granulation by which the large plagioclase individuals were crushed into the granular ground mass, no alteration took place in the chemical composition of the mineral. The material acquired a much lighter colour through the loss of the inclusions, but the composition of the feldspar was not changed. This is evident from the fact that the difference in the specific gravity of the two feldspars, which was determined in the anorthosite of Mount Williams, on the Shipshaw River, near the eastern limit of the area, amounted only to 0.015. The large dark-coloured fragments of crystals were naturally a little heavier on account of the numerous dark inclusions which they contain. Both feldspars were labradorites.

The same fact was established still more clearly by analyses made by Sterry Hunt of both crystals and the ground mass of another anorthosite from the Chateau Richer area. These will be given in the table at the conclusion of this paper, under Nos. I., II. and III. It will be observed that the composition and the specific gravity of the two are identical. Leeds showed the same to be true in an anorthosite of Essex county, New York, and Sachsse[1] in a "Flaser-gabbro" from Rosswein, in Saxony, but the material analysed in these two cases was not quite pure.

The gneiss which immediately surrounds the area has a uniform character, and contains no crystalline limestone as in the Morin area. It has, in fact, an older appearance, and Logan would probably have classed it with the the lower or fundamental gneiss of the Ottawa division. This gneiss has, irrespective of local deviations, a strike of N. 20° to 60° E. Along the southern limit of the area it strikes directly towards the anorthosite and is cut through or overlaid by the latter. The line of contact of the anorthosite with the gneiss forms a series of large curves, which are interrupted at times by straight lines. The latter most probably indicate faults. On the east and west sides of the area the line of contact crosses several times the Little Peribonka and the Shipshaw respectively, so that it repeatedly cuts the direction of the strike of the gneiss. What deserves notice is the fact that when the anorthosite (which is mostly massive and has for that reason no strike) shows any indication of streaked or foliated structure (and examples of this structure are clearly exhibited on the east side of the area where the granular anorthosite is principally found with broken fragments of plagioclase) this is identical in direction with the strike of the gneiss, and is not affected by the intersecting line of contact. This is no longer true, however, in the central portion of the area, through which the Peribonka flows, in the northern portion of its course, often between cliffs 1,000 feet high. Wherever the anorthosite exhibits a strike in this part of the area, a thing which only exceptionally occurs, this differs from that of the gneiss as well as from that of the anorthosite on either side, being N.

1 R. Sachsse, Uber den Feldspathgemengtheil des Flasergabbros von Rosswein.—Ber. d. naturf., Ges. in Leipzig, 1883.

40° to 80° W., and on the upper part of the Peribonka, N. 10° to 20° W. The fact that the strike of the gneiss and that of the anorthosite near the limit of the area coincide, notwithstanding that it is crossed several times by the line of contact, can easily be explained as caused on the east and the west side by a series of cross faults, if it be assumed that the foliation of the anorthosite here originally coincided with the direction of the boundary. It is almost certain that such faults exist. The condition of things, however, at the southern boundary where the contact may be more accurately investigated, but where, unfortunately, the foliation of the anorthosite and of the gneiss is mostly very indistinct, rather points to the fact that this conformity is the result of a pressure, which was exerted upon the anorthosite in a direction almost at right angles to the ordinary strike of the gneiss. The greater predominance of the granulation on the east side of the area suggests that the pressure came from that direction. The less definite indications of foliation or streaked structure which were observed here and there in the usually massive anorthosite of the interior of the area, and which do not coincide in direction with that of the gneiss and anorthosite about the edge of the area, probably belong to the original structure, due to movements in the magma before consolidation. This view is supported by a series of larger exposures of anorthosite at the east end of Lake Tschitogama. The rock there is distinctly striped, bands of plagioclase almost free from bisilicates alternating with others in which the latter are quite abundant. The bisilicates are disposed in elongated masses or in short dashes which are parallel to one another, but have a different direction from that of the

Fig 8

bands, generally forming with the latter an angle of about 60° (see fig. 8). In another place nearly a quarter of a mile distant, the banding was horizontal and the foliation of the bisilicates perpendicular. In these cases both the original rude banding, the result of movements in a heterogeneous magma, as well as the subsequent foliation of the bisilicate masses, resulting from pressure, are to be observed in the same exposures.

In a large area covered by forest, such as this, the actual line of contact cannot usually be seen, but where they can be observed, both rocks are cut through by pegmatite dykes; indeed, the gneiss itself often appears to send out an arm-like extension into the anorthosite as if it were an intensive rock and had not been broken through by the anorthosite. As it has been shown that the granulation of the anorthosite in all probability originated when the rock was still very hot, it is quite possible that these arm-like offshoots are portions of the gneiss which were pressed into cracks in the anorthosite while the latter was in a more or less plastic condition. This explanation is supported by the remarkable fact which is observed in hundreds of cases in different parts of the Laurentian, that wherever orthoclase gneiss and amphibolite alternate with one another, and the whole mass is squeezed, the bands of amphibolite without exception break apart into fragments, between which the gneiss is pressed. A species of breccia is thus formed, which may be followed in the direction of the strike into a regular series of alternating and undisturbed bands. Under the influence of pressure, probably accompanied by intense heat, the basic rock is always more brittle than the acid one.

The gneiss may indeed, often result from a later eruption, since it is almost massive, as already mentioned, and belongs in all probability to the lower or Ottawa gneiss, in which much intrusive material undoubtedly exists.

In some places on the south and west contact and between the typical anorthosite and the gneiss there occurs a dark basic gneiss similar in appearance to the supposed contact product of the Morin area.

In this great Saguenay area, therefore, the supposed "Upper Laurentian" consists of an enormous mass of gabbro, norite and troctolite with plagioclase preponderating, presenting the same structural varieties as those found in the Morin area. Like the latter it probably owes its unconformity to its igneous origin, and finally, as in the Morin area, the anorthosite is overlaid by horizontal unaltered beds of Cambrian age, so we find also in many places upon the anorthosite of the Saguenay area small areas of horizontal unaltered Cambro-Silurian limestone and shales of Trenton and Utica age. The fact that these are in no wise altered by the anorthosite proves clearly that the latter is much older.

WHERE TO FIND "AMŒBAE" IN WINTER.

By W. E. DEEKS, B.A., M.D.

Nothing will try the patience of a person more than to be compelled to search over a great many slides, and then often in vain, in the attempt to find a single *Amœba* for demonstration purposes.

Circumstances such as these induced the writer to try and find the conditions under which they flourished, and might without difficulty be found.

During the summer season they can be readily obtained by scraping the under surface of a floating weed or in the superficial ooze along the bottom of any fresh water pond. During the winter this climate necessitates aquaria, and of these a certain amount of care is necessary to keep them in a living condition, whence they can be quickly obtained. The conditions necessary are: First, a proper temperature. That most suitable for them is between 45° and 70° F. Along with them are usually found the *Heliozoa,* the stalked *Ciliata* and some of the *Flagellata.* If the temperature is raised to about 80° F., the *Amœbae* quickly disappear and in their place countless numbers of the free-swimming *Ciliata* make their appearance. The water also becomes putrid. The method at present adopted of securing and keeping them during the winter months is the following:—In the Autumn the superficial ooze from some fresh water pond is skimmed and placed in a dish, the mouth of which is covered almost completely to prevent too rapid evaporation. Along with the ooze some decaying vegetable matter and also some living water plants. Of these I prefer *Anacharis,* although *Chara* and some other common forms will do. A considerable quantity of this is necessary to keep the water fresh.

The aquarium is then placed in a bright place where there is plenty of light (though preferably not direct sunlight), and in a cool place, best about 60° F. This then can be left any length of time, and when they are required, by squeezing a little of the decaying vegetable matter on a glass slide, I have never failed to find one or more of these interesting creatures.

The conditions then, required, may be thus summarized:

1. Some decaying vegetable matter.

2. A sufficient amount of plant life to keep the water from becoming putrid.

3. A sufficiently low temperature which will also prevent the bacteria of putrefaction from developing too rapidly.

By observing the above conditions one will seldom fail to find *Amœbae.*

The New Director of the Geological Survey.

The recent appointment of Dr. G. M. Dawson as director of the Geological Survey of Canada, as successor to Dr. A. R. C. Selwyn, will give universal satisfaction, and the Government of Canada are to be congratulated on having secured one of the ablest geologists as well as administrators to conduct this most important branch of the public service. His long connection with the department, both as assistant director, and, in the absence of Dr. Selwyn, as acting director, will enable him to understand perfectly the requirements of the office. The scientific staff of the department regard the appointment as a well-deserved and fitting promotion, and feel sure that under his able and energetic management the Survey's sphere of usefulness will be enlarged, and, at the same time, its already eminent scientific standing fully maintained. The mining community in general may rest assured that the practical part of the Survey's work will not be neglected, as Dr. Dawson has ever evinced a deep interest in economic geology.

Dr. George Mercer Dawson, C.M.G., F.R.S., A.R.S.M., F.G.S. (L. & A.), etc., etc., was born at Pictou, N.S., August 1st, 1849, and is the eldest son of Sir J. William Dawson, late principal and vice-chancellor of McGill University. He was educated at McGill College and the Royal School of Mines, London, where he was admitted as an Associate in 1872. He obtained the Duke of Cornwall's Scholarship, given by the Prince of Wales; also the Edward Forbes Medal in Palæontology and the Murchison Medal in Geology. His marked scientific zeal and ability early attracted the attention of European geologists, and in 1873 he was appointed as geologist and naturalist to Her Majesty's North American Boundary Commission. As such he investigated the geology and natural resources of the country between the Lake of the Woods and the Rocky Mountains in the vicinity of the 49th parallel.

The report in connection with this work appeared in 1875, and at once attracted world-wide attention. In July, 1875, he accepted a proffered appointment to the Geological Survey of Canada. His field work has been mainly confined to the North-West Territories and British Columbia, in which district his name has become a household word. The many valuable reports on these regions are to be found mainly scattered through the reports of the Geological Survey or in the various Scientific Journals of Canada, Great Britain and the United States. In 1892 he was awarded the Bigsby Medal by the Geological Society of London, "as an acknowledgment of eminent services in the department of geology, irrespective of the receiver's country." His more recent work in connection with the Behring Sea matter is so fresh in the mind as to need only a passing mention. Suffice it to say that for these eminent services the Imperial Government rewarded him with a C.M.G.

The latest honour, his appointment to the directorship of the Geological Survey, is but a fitting tribute to a man who has devoted his whole life and talents to the cause of science. His whole heart is in the work, and his scientific co-laborers feel that Canada has given a just reward to one of her most eminent sons.

Proceedings of the Natural History Society.

Montreal, Jan. 28, 1895.

The third monthly meeting was held this evening, Dr. Wesley Mills, President, in the chair.

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

The minutes of special meeting of Council of December 22nd and of the regular meeting of January 21st were read.

The Librarian reported that a large number of exchanges had been received and that nearly all the volumes of Proceedings of Scientific Societies had been completed ready for binding.

J. Gentles, L.D.S., was proposed as an ordinary member by F. W. Richards, seconded by E. T. Chambers. On motion of George Sumner, seconded by the Rev. Dr. Campbell, the rules were suspended, and Mr. Gentles was elected by acclamation.

Moved by the Rev. Dr. Campbell, seconded by George Sumner, and resolved: That the Natural History Society has heard with great regret of the death of the son of Dr. B. J. Harrington, one of its most valued members, and a Past President of the Society, and does hereby extend to Dr. Harrington and his family its sympathy in their sad bereavement.

A paper by Mr. E. D. Wintle, on an unusual occurrence of the Razor-Billed Auk at Montreal, and a second on a remarkable flight of certain birds from the Atlantic Coast up the St. Lawrence to the Great Lakes, was read by Mr. Williams.

Mr. Williams communicated some remarks on Special Migrations of animals.

The Rev. Dr. Campbell moved, seconded by Mr. E. T. Chambers, a vote of thanks to Mr. E. D. Wintle for his interesting paper and to Mr. Williams for his communication.

Dr. Mills then read a communication on The Scientific Societies of America and the work they are doing.

MONTREAL, Feb. 25th, 1895.

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 meeting of Council of February 18th were read.

Prof. John Craig was proposed by the Rev. Dr. Campbell, seconded by Dr. Wesley Mills, as an ordinary member. On motion of Rev. Dr. Campbell, seconded by George Sumner, the Secretary was instructed to cast one ballot for the election of this member.

A fine eagle from Agassiz, B.C., was presented by Herbert W. Sheam, of the same place. On motion of the Rev. Dr. Campbell, seconded by Mr. Williams, the thanks of the Society were tendered to the donor.

Mr. E. T. Chambers, the Librarian, reported the usual number of exchanges, among which were a number from La Plata.

A paper on Dimorphism and Polymorphism in Butterflies was then read by Mr. H. H. Lyman. It was moved by Mr. Kearley, seconded by J. S. Shearer, that the thanks of the Society be accorded to Mr. Lyman for his valuable paper.

A paper entitled "Additional Remarks on the Flora of the Island of Montreal," was then read by the Rev. Dr. Campbell. Moved by Edgar Judge, seconded by J. M. M. Duff, that the hearty thanks of the Society be given to the Rev. Dr. Campbell for the communication. Carried.

Book Notices.

From the Greeks to Darwin, an Outline of the Development of the Evolution Idea.—By Henry Fairfield Osborn, Sc.D., Da Costa Professor of Biology in Columbia College, Curator of the American Museum of Natural History. MacMillan & Co., New York and London, 1894. Price $2.00.

The present work is the outcome of studies which Professor Osborn has been carrying on for a few years past, and should be welcomed as an attempt to select the men who have been potent factors in the development of the evolution idea and to define the part played by them. The work is divided into six chapters : The Anticipation and Interpretation of Nature ; Among the Greeks ; The Theologians and Natural Philosophers ; the Evolution of the Eighteenth Century ; from Lamarck to St. Hilaire ; and Darwin.

To choose rightly was no easy task, and a few names have been omitted that might well have been added to the illustrious list.

Throughout, the author has treated his subject with that conspicuous impartiality which has characterized all his writing on Evolution, and has attempted to correct many prevalent misconceptions.

Dr. Osborn seems to think that the idea of evolution has not only run through the ages, but that the idea of each age has some genetic connection with that which preceded and succeeded it. While this may be in a measure true, and in certain instances undoubtedly is, yet we doubt if it be so to the extent the author of this work seems to believe. There are many passages, however, in which a view somewhat at variance with this is set forth; but he speaks of a "chain," and of such ideas constituting a chain. That certain ideas of evolution did constitute a short chain there seems no doubt; but what influence, we would like to ask, had Greek notions of evolution on Darwin? It is well known that Darwin never did drink deep of Greek literature. We should say that the evolution idea was a purely independent and spontaneous growth in Darwin's own mind, and to connect his ideas in a relation of effect and cause with those of the Greeks or any others except in the most indirect way, seems to us an error.

It is undoubtedly most interesting to follow the varying phases and fortunes of the evolution idea, but to attempt to bind these ideas together into a chain and say that each link is genetically related to the other is more than is warrantable. But, as before noted, there are passages which would seem to indicate that this is not Dr. Osborn's intention, but we think that this might have been more clearly stated, as certainly the general impression left by the book is as we have indicated.

The work is scholarly, yet readable, and is rendered attractive by the manner in which the printer and publishers have done their work. It deserves and will not fail to be widely known.

WESLEY MILLS.

AMPHIOXUS AND THE ANCESTRY OF THE VERTEBRATES. — By Arthur Willey, B.Sc.

This volume makes one of a beautiful and valuable series of works known as the Columbia University Biological Series, and is an indication of the activity, tendencies and scope of the new biology. Amphioxus, on account of its peculiar position in the animal scale has long been of extraordinary interest.

The author's work is divided into five main parts as follows:

I. Anatomy of Amphioxus, which is preceded by an introduction from the pen of Professor Osborn.

II. Anatomy of Amphioxus (continued).

III. Development of Amphioxus, which is further sub-divided into embryonic development, larval development, general considerations, Amphioxus and Ammocœtes.

IV. The Ascidians, including structure of a simple Ascidian, development of Ascidians, metamorphosis of Ciona intestinalis.

V. The protochordata in their relation to the problem of vertebrate descent.

This outline of the ground covered will show how complete the work has been made.

The book is well printed and admirably illustrated by a large number of cuts. The outcome of the entire series of studies on this subject, of absorbing interest to the biologist who believes in evolution, is stated in the final paragraph of the book, which we quote entire: "For the present we may conclude that the proximate ancestor of the vertebrates was a free-swimming animal intermediate in organization between an Ascidian tadpole and Amphioxus, possessing the dorsal mouth, hypophysis and restricted notochord of the former, and the myotomes, cœlomic epethelium, and straight alimentary canal of the latter. The ultimate or primordial ancestor of the vertebrates would, on the contrary, be a worm-like animal whose organization was approximately on a level with that of the bilateral ancestors of the Echinoderms."

WESLEY MILLS.

ABSTRACT FOR THE MONTH OF JANUARY, 1895.

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 vapor.	‡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	12.57	17.2	7.0	10.2	30.0735	30.124	30.032	.092	0662	85.3	9.2	W.	4.9	7.7	10	2	15	....	Inap.	Inap.	1
2	9.92	17.9	5 0	12.9	30.1765	30.207	30 115	.092	.0540	78.3	4.7	S.W.	13.7	3.8	10	0	87	....	0.1	0.01	2
3	19.22	23.2	9.0	14.2	30.1453	30.213	29.977	.236	.0890	83.7	15.7	S.	12.2	10.0	10	10	00	....	Inap.	Inap.	3
4	12.03	26.8	− 5.0	31.8	30.0677	30.370	29.826	.544	.0708	80.8	7.3	S.W.	24.9	2.8	10	0	85	....	0.6	0.06	4
5	− 7.18	0.3	−12.7	13.0	30.4748	30.527	30.400	.127	.0252	81.7	−11.7	W.	3.7	2.3	10	0	81	....	....	....	5
SUNDAY. 6	.....	12.7	− 8.9	21.6	....	......	......	...	.....	....	...	N.	12 9	....	..	.	00	....	4.0	0.40	6 .. ..SUNDAY
7	20.77	27.2	10.6	16.6	29.9938	30.085	29 940	.145	1100	96.0	19.8	N.	1.4	10.0	10	10	00	0.12	....	0.12	7
8	25.27	29.2	17.5	11.7	30.2918	30.423	30 183	.240	.1230	89.2	22.5	W.	3 3	9 2	10	5	00	....	0.1	1.01	8
9	9.13	27.5	3.5	24.0	30.5407	30.615	30.498	.117	.0553	83 2	6.7	W.	11.2	4.3	10	0	71	....	....	....	9
10	9.55	20.5	2.0	18.5	30.4305	30.637	30.039	.598	.0598	83.2	5.2	N.	16.0	8.3	10	0	00	....	3.2	0 32	10
11	28.77	33.2	16.4	16.8	29.7382	29.806	29.616	.190	.1488	93.8	27.0	S.W.	14.8	8.8	10	3	00	0.16	0.1	0.17	11
12	30.65	34.8	25.9	8.9	29.9263	29.964	29.881	.083	.1458	85.3	26.5	S.W.	14.9	4 0	10	0	82	....	....	....	12
SUNDAY.... .. 13	.....	37.2	26.2	11.0	... ...	......	......	....	....	....	....	N.E.	24.5	....	....	.	17	....	1.3	0.13	13... ... ...SUNDAY
14	16.13	28.0	5.8	22.2	29.7632	29.910	29.608	.302	.0727	78.2	10.7	S.	17.2	8.5	10	1	03	....	0.2	0.02	14
15	20.70	24.9	12.0	12.9	29.9595	29.993	29.911	.082	.0883	78 3	15.5	S.	14 7	6.8	10	0	21	....	Inap.	Inap.	14
16	28.37	32.6	22.2	10.4	29.8588	29.954	29.790	.164	.1242	79.7	23.0	S.W.	17 0	9 8	10	9	00	....	0.1	0.01	15
17	18.38	31.5	8.5	23.0	29.9495	30 110	29.826	.284	.0768	74.5	11.8	W.	18.0	5.7	10	0	48	....	....	....	16
18	6.05	11.8	2.5	9 3	30.0855	30.172	29 978	.194	.0410	71.5	− 1 5	W.	10.0	1.7	10	0	97	....	....	....	17
19	7.50	14.6	− 0.7	15.3	30.1113	30.223	30.003	.220	.0507	82.2	3.2	W.	13.6	0.2	1	0	79	....	....	....	18
SUNDAY.. 20	.....	20.8	7.2	13.6	......	......	......	...	.....		....	W.	13.2	....	..	..	94	....	....	....	20 ....SUNDAY
21	19.68	32.5	6.0	26.5	29.7067	30.030	29.309	.721	.0963	83.3	15.7	N.E.	14.3	8 0	10	0	00	0 52	....	0.52	21
22	30.72	35.8	26.5	9.3	29.3392	29.367	29.316	.051	.1527	87 8	27.7	W.	11.6	10.0	10	10	00	0.56	2.6	0.76	22
23	19.60	29.2	12.8	16.4	29.4427	29.530	30.359	.171	.0862	80.5	14 5	W.	15.4	6.2	10	0	76	...	0.1	0.01	11
24	3.28	16.5	0.0	16.5	29 7908	29.985	29.608	.377	.0370	73.7	− 3.7	S.W.	19.8	3.3	10	0	89	....	Inap.	Inap.	24
25	2.38	7.7	− 3 5	11.2	30.2172	30.282	30 122	.160	.0378	79.2	− 3.0	S.W.	15.4	1.3	8	0	96	....	...	....	25
26	11.00	19.5	2 5	17.0	29.4618	29.927	29.200	.727	.0667	91.0	8.7	E.	19.0	10.0	10	10	00	....	9.4	0.94	26
SUNDAY........27	.....	26 8	13.2	13.6	....	......	......	....	.....	...	....	S.W.	32.2	....	....		26	....	2.3	0.20	27 ....SUNDAY
28	11.07	15.3	6.3	9.0	30.0007	30.060	29.915	.145	.0602	83.3	7.0	S.W.	28.0	2.5	10	0	75	....	....	...	28
29	10.22	15.9	4.8	11.1	29.8727	29.968	29 811	.157	.0573	83.3	6.0	S.W.	10.4	4.0	10	0	51	....	....	...	29
30	16.72	25.7	9.6	16.1	29.9220	30.028	29.876	.152	.0797	85.0	13.2	S.W.	13.6	8.3	10	0	00	. . .	0 8	0.08	30
31	9.45	16.1	6.2	9.9	30.2448	30.301	30.172	.129	.0548	82.3	5.2	S.W.	10.5	1.5	9	0	51	....	....	....	31
....Means	14.89	23.00	7 69	15 31	29.9846	30.105	29.863	.241	.0789	82.8	10.6	S. 70¼° W.	14.59	5.9	9.6	2 2	40.0	1.36	24.9	3.76	Sums ....
21 Years means for and including this month	11.93	20 46	3.99	16.46	30.0533	.....	......	.329	.0725	81 2	....	......	....	6.3	..	.	¶30.2	0.85	29 2	3.61	21 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............	812	947	460	337	815	4110	3156	216	29
Duration in hrs	66	56	30	22	68	226	229	18	
Mean velocity...	12.30	16.89	15.33	15.31	11.99	18.19	13 78	12.00	

Greatest mileage in one hour was 39 on the 27th.
Greatest velocity in gusts 48 miles per hour on the 4th, 13th and 27th.

Resultant mileage, 5398.
Resultant direction, S. 70¼° W.
Total mileage, 10853. Lightning on 22nd.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 14 years only.

The greatest heat was 37.2° on the 13th; the greatest cold was −12.7° on the 5th, giving a range of temperature of 49.9 degrees.

Warmest day was the 22nd. Coldest day was the 5th. Highest barometer reading was 30.637 on the 10th. Lowest barometer was 29.200 on the 26th, giving a range of 1.437 inches. Maximum relative humidity was 99 on the 11th and 26th. Minimum relative humidity was 62 on the 24th.

Rain fell on 4 days.
Snow fell on 18 days.
Rain or snow fell on 20 days.
Lunar halos 2, on 8th and 9th.
Solar halos, 4, on 15th, 21st, 24th and 29th.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1895.

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 vapor.	‡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	16.48	27.2	1.2	26.0	30.1768	30.227	30.142	.085	.0797	82.3	12.0	S.W.	16.4	5.5	10	0	52	....	0.3	0.03	1
2	16.92	23.3	8.0	15.3	30.1812	30.305	30.128	.177	.0778	80.0	12.0	W.	14.2	6.8	10	0	30	....	0.8	0.05	2
SUNDAY.........3	.....	9.2	—1.9	11.1	....	.....	....	...	.....	...	...	S.E.	8.4	....	....	.	59	....	....	....	3..........SUNDAY
4	5.05	14.2	—1.7	15.9	29.9130	30.087	29.803	.284	.0437	78.3	—0.8	S.E.	12.0	6.7	10	0	00	....	0.2	0.02	4
5	—12.38	1.5	—16.3	17.8	29.9733	30.002	29.934	.068	.0197	81.3	—16.8	S.W.	37.9	0.0	00	0	100	....	....	....	5
6	—13.33	—6.8	—19.8	13.0	29.9187	30.003	30.853	.150	.0200	85.0	—16.5	W.	29.0	4.8	10	0	70	...	0.3	0.03	6
7	—8.95	—5.8	—13.1	7.3	29.8163	29.914	29.557	.357	.0255	89.8	—11.2	W.	11.9	5.3	10	0	87	....	..	..	7
8	—0.23	6.5	—7.6	14.1	29.0143	29.375	28.832	.543	.0422	96.2	—1.0	N.	43.0	10.0	10	10	00	....	16.0	1.58	8
9	6.90	12.8	—3.0	15.8	29.2785	29.424	29.165	.259	.0585	96.2	6.3	S.W.	38.8	10.0	10	10	00	....	2.0	0.20	9
SUNDAY.......10	.....	19.0	1.3	17.7	....	.....	......	....	...	....	....	W.	24.8	...	....	.	94	....	....	....	10..........SUNDAY
11	18.60	25.8	8.8	17.0	29.9767	30.040	29.891	.149	.0947	92.5	16.7	W.	22.0	5.7	10	0	36	....	0.2	0.02	11
12	22.77	26.1	19.3	6.8	29.7752	29.808	29.690	.178	1018	83.5	18.8	W.	15.3	7.3	10	2	70	....	....	..	12
13	23.47	27.2	20.8	6.4	29.6272	29.725	29.572	.153	.1110	88.0	20.7	W.	12.4	9.7	10	8	00	....	0.4	0.04	13
14	19.28	25.2	15.8	9.4	29.8695	30.050	29.685	.365	.0927	88.2	16.7	W.	32.5	3.2	10	0	100	....	0.3	0.03	14
15	19.35	22.5	15.0	7.5	30.1653	30.258	30.045	.213	.0922	87.7	16.7	S.W.	17.3	6.3	10	0	58	....	Inap.	Inap.	15
16	24.02	29.5	16.9	12.6	29.8008	30.047	29.637	.410	.1178	90.7	21.5	S.W.	26.4	6.2	10	0	57	....	Inap.	Inap.	16
SUNDAY.......17	.....	30.6	20.2	10.4	....	......	......	....	.....		....	S.W.	15.3	....	...	..	74	....	....	....	17..........SUNDAY
18	28.32	34.3	21.5	12.8	29.7363	29.840	29.658	.182	.1450	91.7	26.3	S.	14.1	9.5	10	0	21	....	....	....	18
19	28.93	32.8	24.5	8.3	29.7022	29.730	29.671	.059	.1413	88.7	26.0	S.W.	17.6	6.7	10	0	00	...	0.2	0.02	19
20	19.50	23.4	15.2	8.2	29.6477	29.710	29.528	.182	.0893	84.7	15.8	S.W.	20.7	0.8	3	0	84	....	Inap.	Inap.	20
21	27.70	34.9	17.2	17.7	29.2908	29.456	29.158	.298	.1390	90.5	25.3	S.	21.4	8.8	10	3	00	....	0.5	0.05	21
22	8.72	26.5	3.1	23.4	29.8073	29.992	29.556	.436	.0547	84.2	4.7	W.	25.1	4.0	10	0	68	....	...	....	22
23	3.22	9.4	—2.7	12.1	30.1757	30.347	30.056	.291	.0415	83.5	—1.3	S.W.	17.8	0.0	0	0	99	....	....	....	23
SUNDAY........24	.....	24.8	3.0	21.8	.....	......	......	....	.....	...	....	S.W.	20.1	...	...		53	....	....	...	24..........SUNDAY
25	26.27	37.2	18.2	19.0	29.7716	29.920	29.617	.303	.1340	93.2	24.5	S.W.	23.5	9.8	10	9	00	Inap.	3.5	0.35	25
26	10.33	20.1	4.0	16.1	30.2078	30.295	30.050	.245	.0557	79.7	5.3	S.W.	22.0	0.2	1	0	100	....	....	....	26
27	20.13	28.8	7.3	21.5	29.9062	30.150	29.707	.443	.0998	87.2	17.2	S.W.	9.9	6.3	10	0	00	.	....	....	27
28	29.68	37.2	23.0	14.2	29.4747	29.671	29.372	.299	.1607	96.8	28.8	S.	7.8	10.0	10	10	00	Inap.	...	Inap.	28
...........Means	14.20	21.34	7.08	14.26	29.8003	29.935	29.680	.255	.0853	87.50	1.15	S. 63¾° W.	20.62	6.0	8.50	2.17	40.9	0.00	24.7	2.45	Sums ....
21 Years means for and including this month	15.84	23.69	6.79	16.90	30.0365	.....	......	.303	.0880	79.33	....	......	....	5.9	..	.	¶41.7	0.78	22.5	2.94	21 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	906	....	12	273	907	6722	4764	276	
Duration in hrs	45	....	2	29	62	275	225	19	15
Mean velocity...	20.1	....	6.0	9.4	14.6	24.4	21.3	14.5	

Greatest mileage in one hour was 56 on the 8th.

Greatest velocity in gusts 60 miles per hour on the 8th.

Resultant mileage, 9970.
Resultant direction, S. 63¾° W.
Total mileage, 1 860.
Average mileage per hour 2062.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 14 years only.

The greatest heat was 37.2° on the 25th and 28th; the greatest cold was —19.8° on the 6th, giving a range of temperature of 57.0 degrees.

Warmest day was the 19th. Coldest day was the 6th. Highest barometer reading was 30.347 on the 23rd. Lowest barometer was 28,832 on the 8th, giving a range of 1.515 inches. Maximum relative humidity was 100 on the 8th.

Minimum relative humidity was 51 on the 5th.

Rain fell on 2 days.

Snow fell on 15 days.

Rain or snow fell on 16 days.

Auroras were observed on 1 night on 14th.

Lunar halos 4, on 3rd, 4th 7th and 8th.

Lunar corona 1, on the 6th.

Fog on 1 day, 28th.

Solar halos, 6 days 3rd, 4th, 5th, 17th, 18th and 22nd

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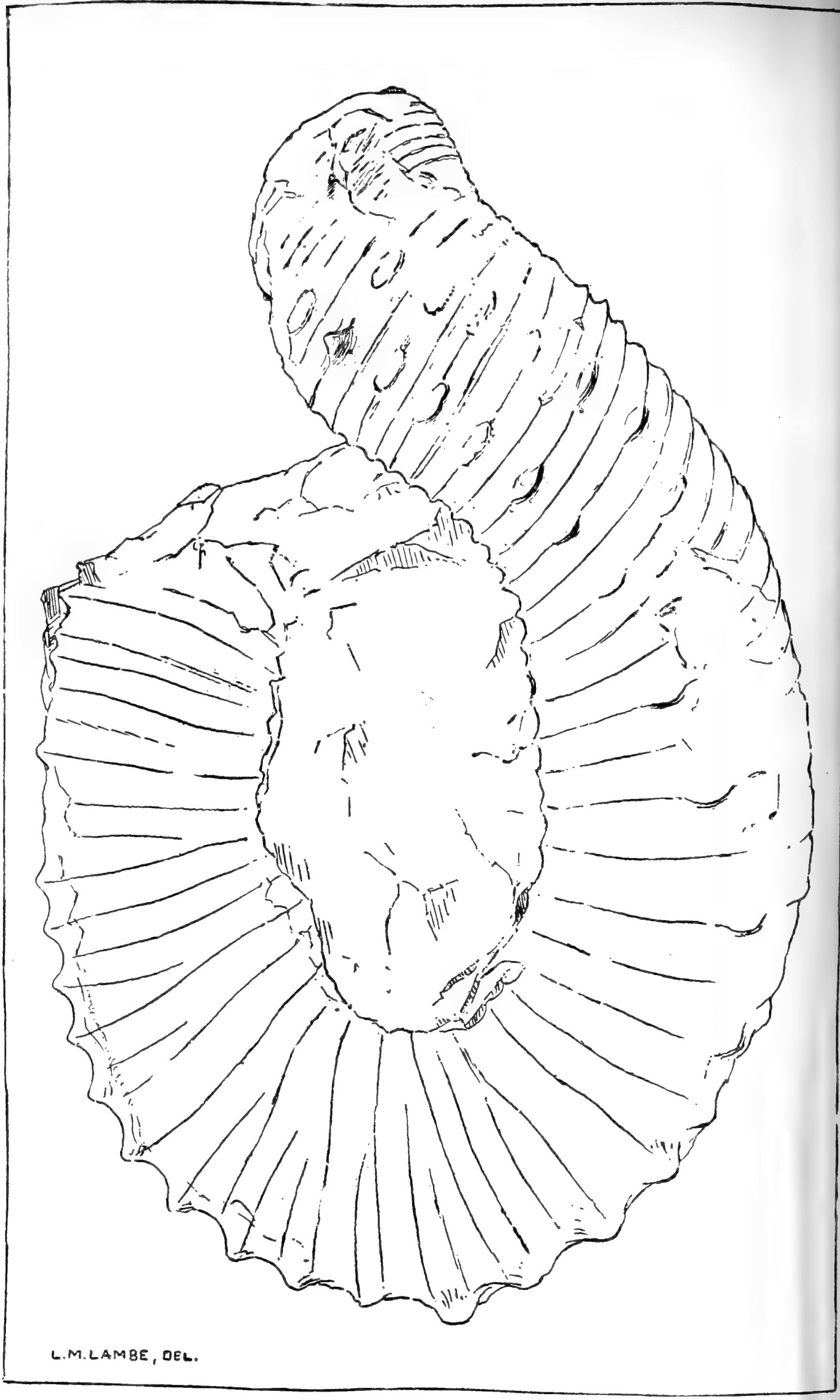

ANISOCERAS VANCOUVERENSE (Gabb).

THE

CANADIAN RECORD

OF SCIENCE.

VOL. VI. APRIL, 1895. No. 6.

Notes on some fossils from the Cretaceous rocks of British Columbia, with descriptions of two species that appear to be new.[1]

By J. F. Whiteaves.

Anisoceras Vancouverense.

Hamites Vancouverensis, Gabb. 1864. Geol. Surv. California, Palæont., vol. I., p. 70, pl. 13, fig. 18.

Heteroceras Cooperi, Meek. 1876. U. S. Geol. and Geog. Surv. Terr., vol. II, No. 4, p. 367, pl. 3, figs. 7 and 7a. Perhaps also "?=*Ammonites Cooperi,*" Gabb. 1864, Geol. Surv. California, Palæont., vol. I., p. 69, pl. 14, figs. 23 and 23a.

The original description of *Hamites Vancouverensis* is as follows: "Shell large, section elliptical, longest diameter from dorsal to ventral side. Inner width of the curve less than the diameter of the smaller arm. Surface marked by numerous sharp ribs crossing the shell, inclined obliquely forwards; well marked but diminished in size on the ventral side; largest laterally; each rib carrying a small flattened tubercle on the latero-dorsal angle; some

1. Communicated by permission of the Director of the Geological Survey of Canada.

ribs in the curve, on the ventral side, exhibit a tendency to tuberculation, but the shell being broken off at that point, their presence cannot be satisfactorily determined. Interspaces between the ribs broadly concave. Septum unknown. Figure, one-half natural size. Locality, Vancouver Island, associated with *Ammonites Newberryanus* and another Ammonite, species undetermined, and a Baculite, figured on pl. 17, figs. 28 and 28a, and pl. 14, fig 29. Closely allied, in form and ornamentation, to *H. Fremontii,* Marcou, Geol. N. America, p. 36, pl. 1, fig. 3. It differs in the ribs continuing completely across the ventral face, and in each rib carrying a node, instead of every third rib, as in Marcou's species." The specimen figured by Mr. Gabb, it may be added, has a little more than four inches of the prolonged portion of the shell preserved, and a very small piece of the reflected anterior portion.

Until quite recently, the writer had never seen a specimen of this species. In the fall of 1883, Mr. Walter Harvey, of Comox, V.I., made a remarkable collection of fossils (which has since been acquired for the provincial museum at Victoria) from the Cretaceous rocks at Denman and Hornby islands, in the Strait of Georgia. This collection was kindly loaned to the writer for examination and study, by Mr. John Fannin, the Curator of the museum at Victoria, in the spring of 1894. Besides other specimens of much scientific interest, which have been or which will be reported upon elsewhere, it contains a fine example of *Hamites Vancouverensis* or, as it should now be called, *Anisoceras Vancouverense,* from Hornby Island. The still more perfect specimen of that species represented in outline, of one-fifth less than the natural size, on the plate which accompanies this paper, was collected by Mr. Harvey at Hornby Island this year (1895) and kindly forwarded to the writer for examination.

The specimen belonging to the Museum at Victoria is a well preserved cast of the interior of nearly the whole of the prolonged and reflected portions of the shell, with small pieces of the test remaining. Its maximum length is a little more than five inches and its marginal outline is regularly but rather broadly elliptical, as the shell is curved obliquely outward before becoming straight and prolonged. The distance between the prolonged and reflected portions is much less than the dorso-ventral diameter of the reflected portion. The surface is strongly ribbed, and many of the ribs bear a large conical tubercle on each side of the periphery, but there is much irregularity in the disposition of the ribs and tubercles. On the sides of the shell the ribs are usually simple and disposed with comparative regularity, but they occasionally bifurcate, or a short rib is intercalated between two longer ones, and two ribs frequently coalesce on both sides, at one of the tubercles on the outer margin of the periphery. In some places a single continuous rib devoid of tubercles alternates with a single tuberculated rib or with two ribs that bear a tubercle between them on each side of the periphery, but the pairs of tubercles are placed at varying distances apart longitudinally, aud not rarely a little to one side of a rib rather than immediately upon it. The sutural line is nowhere visible.

The specimen figured, which is slightly distorted, is nearly eight inches in its maximum length. Although imperfect posteriorly, enough of the earlier portion of the shell is preserved to show that it is narrowly elongated, sinuous, spirally twisted and curved obliquely outward before becoming straight and prolonged, and that it does not consist of a straight shelly tube bent twice or more upon itself, as in *Hamites* proper. The spiral twist posteriorly is especially marked by the lateral position of the two rows of tubercles which ultimately border the periphery. The ribs, which sometimes trifurcate, are much narrower than the broad concave grooves between them, and at least one of the tubercles, in the earlier portion of the shell, is prominent and acutely conical, thus giving the impression that the whole of the tubercles upon the ribs of both specimens may be the bases of spines. This specimen has convinced the writer that *Hamites Vancouverensis* is a true *Anisoceras,* allied to *A. armatum,* Sowerby, but devoid of lateral tubercles, also that the fragment from Comox described and figured by Meek as *Heteroceras Cooperi,* is probably a small piece of the abruptly bent part of *Anisoceras Vancouverense.* A similar fragment, now in the writer's possession, was collected quite recently by Mr. Harvey at Hornby Island. It is most likely also that the fragments of the shell of a cephalopod from the Chico Group of California, for which Gabb proposed the name "? *Ammonites Cooperi,*" are distorted pieces of *A. Vancouverense,* and if that be the case the laws of priority may require that the species shall be called *Anisoceras Cooperi,* Gabb. (sp.), as the description of Gabb's *Ammonites Cooperi* immediately precedes that of his *Hamites Vancouverensis.*

HETEROCERAS HORNBYENSE. (Nom. prov.)

Shell dextral, depressed turbinate, much broader than high, and composed, so far as is known, of five or six rounded, ventricose volutions, which are in close contact but without embracing; spire moderately elevated; umbilicus broad and deep, exposing the whole of the inner volutions.

Surface marked with simple and not very flexuous transverse ribs. Upon the last volution one or two continuous ribs without tubercles alternate with a rib or pair of ribs which bears or bear a small but rather prominent tubercle on each side of the periphery. Usually two ribs coalesce, both above and below, at each tubercle, but occasionally a single thickened rib bears a pair of tubercles. In places, also, where the test is preserved, the surface is seen to be marked with fine raised lines, parallel to the ribs. Sutural line unknown.

Maximum breadth of the outer volution of the largest specimen collected, nearly two inches and three-quarters.

Hornby Island, W. Harvey, 1894; two specimens, one with most of three volutions, and the other with the whole of four volutions and a part of the fifth preserved.

It is, perhaps, doubtful whether the distinctions between *Heteroceras* and *Anisoceras* can be maintained. In the one the earlier volutions are said to be always in contact, while those of the other are described as separate and as forming an irregular open spiral. The two specimens from Hornby Island for which the foregoing provisional name is suggested, are coiled in precisely the same way as the *Heteroceras Conradi* of the Mesozoic Fossils,[1] and differ therefrom only in their much finer ribs and more particularly in the circumstance that some of these ribs bear a tubercle on each side of the periphery. On the other hand, the surface ornamentation of the only known specimens of *H. Hornbyense* is so like that of *Anisoceras Vancouverense*, that it is just possible that they may prove to be specimens of the early stage of large individuals of that species.

HETEROCERAS PERVERSUM. (Nom. prov.)

Shell sinistral, but in other respects essentially similar to that of the preceding species.

Hornby Island, W. Harvey, 1894; a single specimen about an inch and three quarters in its maximum diameter, with nearly the whole of one volution remarkably well preserved.

It is not at all unlikely that the early volutions of *H. Hornbyense* may be coiled indifferently to the right or left, and if so, that this may be a mere sinistral variety of that

1. Geological Survey of Canada, Mesozoic Fossils, vol. I., part 2 (1879), p. 100, pl. 12, figs. 1-3.

shell. Or, if *H. Hornbyense* should prove to be the apical portion of *Anisoceras Vancouverense,* it may be that the apex of that species is coiled to the right in some specimens and to the left in others.

Illustrations of each of the specimens referred to in this paper will probably be published in the fourth and concluding part of the first volume of Canadian Mesozoic Fossils.

OTTAWA, March 23rd, 1895.

EXPLANATION OF PLATE II.

ANISOCERAS VANCOUVERENSE.

Side view of the most perfect specimen known to the writer. Four-fifths of the natural size.

CONTRIBUTIONS TO CANADIAN BOTANY.

By JAMES M. MACOUN.

VI.

CALTHA LEPTOSEPALA, DC.

Mount Queest, Shuswap Lake, B.C. (*Jas. M. Macoun.*) Mountains at Roger's Pass, B.C.; mountains north of Griffin Lake, B.C.; Mount Arrowsmith, Vancouver Island, alt. 5,500 feet. (*John Macoun.*) Not before recorded from Vancouver Island.

DRABA ALPINA, L., var. GLACIALIS, Dickie.

Cornwall Hills, west of Ashcroft, Thompson River, B.C., alt. 6,600 feet. (Jas. McEvoy, Herb. No. 5098.*) Not recorded west of Rocky Mountains.*2

LUPINUS LAXIFLORUS, Dougl.

Deer Park, Lower Arrow Lake, B.C.; Sproat, Columbia River, B.C., 1890. (*John Macoun.*)

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

*2 The geographical limits given in this paper refer to Canada only.

LUPINUS NOOTKATENSIS, Don.

Revelstoke and Sproat, Columbia River, B.C.; mountains north of Griffin Lake, B.C. (*John Macoun.*) Mountains south of Tulameen River, B.C. (*Dr. G. M. Dawson.*) North Thompson River B.C.; Mt. Queest, Shuswap Lake, B.C.; Toad Mountain, Kootaine Lake, B.C. (*Jas. M. Macoun.*) East of Stump Lake, B.C. (*Jas. McEvoy.*) Cariboo Mountains, B.C. (*Amos Bowman.*) Not before recorded from interior of British Columbia. The above references include forms which may be ultimately separated into varieties.

MELILOTUS OFFICINALIS, Willd.

Along the streets of Banff, Rocky Mountains, and in gardens at Spence's Bridge, B.C. (*John Macoun.*) Not before recorded west of Ontario, though probably of general distribution throughout the settled parts of Canada.

MEDICAGO DENTICULATA, Willd.

On ballast at Nanaimo, Vancouver Island. (*John Macoun*, Herb. No. 125.) The var. *apiculata*, Willd, was collected by Prof. Macoun at the same place in 1887.

MEDICAGO SATIVA, L.

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

TRIFOLIUM HYBRIDUM, L.

Medicine Hat, Assa.; Banff, Rocky Mountains; Roger's Pass, Selkirk Mountains; Nanaimo, Vancouver Island. (*John Macoun.*)

TRIFOLIUM PAUCIFLORUM, Nutt.

On gravel, Penticton, Lake Okonagan, B.C., 1889. (*John Macoun.*) Only record from interior of British Columbia.

OXYTROPIS CAMPESTRIS, DC.

Dry banks of the Upper Liard River, Lat. 60°, Yukon District, 1887. (*Dr. G. M. Dawson.*) Fort Severn, Hudson Bay, 1886. (*Jas. M. Macoun.*)

OXYTROPIS VISCIDA, Nutt.

Dry banks, Dease Lake, Lat. 58° 30′, B.C., 1887. (*Dr. G. M. Dawson.*)

VICIA AMERICANA, Muhl., var. LINEARIS, Wat.

In thickets at Nanaimo, Vancouver Island, 1887. (*John Macoun.*) Not before recorded west of Rocky Mountains.

VICIA CRACCA, L.

Meadows at Spence's Bridge, B.C., 1889. (*John Macoun.*) Not before recorded west of Ontario.

LATHYRUS OCHROLEUCUS, Hook.

Thickets at Agassiz, B.C., 75 miles from coast. (*John Macoun.*) Western limit in Canada.

LATHYRUS PALUSTER, L.

Thickets at Barclay Sound, Vancouver Island. (*John Macoun.*) Not before recorded from Vancouver Island.

PRUNUS SPINOSA, L., var. INSTITIA, Gray.

In thickets, Pelee Island, Lake Erie, 1892. (*John Macoun.*) Not before recorded from Canada. Naturalized.

PRUNUS PENNSYLVANICA, L.

Forming thickets throughout Labrador north to Lat. 54°. (*A. P. Low.*)

SPIRÆA BETULIFOLIA, Pallas.

Peel's River, Mackenzie River Delta, 1892. (*Miss E. Taylor.*) Northern limit in Canada.

SPIRÆA DISCOLOR, Pursh., var. ARIÆFOLIA, Wat.

Woods at Sicamous, B.C., and Sproat, Columbia River, B.C. (*John Macoun.*) Not before recorded from interior of British Columbia.

SPIRÆA DOUGLASII, Hook, var. NOBLEANA, Wat.

Thickets at Revelstoke, B.C., 1890. (*John Macoun.*) Not before recorded from Canada.

SPIRÆA PECTINATA, T. & G.

Peel's River, Mackenzie River, 1889. (*R. McConnell.*) Northern limit in Canada.

RUBUS STRIGOSUS, Michx.

In river valleys north to Lat. 57°, Labrador. (*A. P. Low.*) Lat. 60° 17′, Long. 103° 07′. (*Jas. W. Tyrrell.*) Peel's River, Mackenzie River Delta. (Miss E. Taylor.)

RUBUS LEUCODERMIS, Dougl.

In thickets, Deer Park, Lower Arrow Lake, B.C., 1890. (*John Macoun.*) Eastern limit.

GEUM CALTHIFOLIUM, Menzies.

Lincoln Mt., Observatory Inlet, B.C., 1893. (*Jas. McEvoy.*) Not found in Canada since Menzies' time.

GEUM MACROPHYLLUM, Willd.

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

GEUM STRICTUM, Ait.

Fort Simpson, Lat. 62°, Mackenzie River. (*Miss E. Taylor.*) Common in the vicinity of Victoria, Vancouver Island. (*John Macoun.*)

POTENTILLA GLANDULOSA, Lindl.

Eagle Pass, B.C.; Nanaimo and Mount Benson, Vancouver Island. (*John Macoun.*) Not before recorded from Vancouver Island.

POTENTILLA RIVALIS, Nutt., var. MILLEGRANA, Wat.

Borders of irrigation ditches, Spence's Bridge, B.C., 1889. (*John Macoun.*) Perhaps introduced. Not before recorded west of Rocky Mountains.

SIBBALDIA PROCUMBENS, Linn.

Mount Queest, Shuswap Lake, B.C. (*Jas. M. Macoun.*) Mountains at Griffin Lake, B.C., alt. 6,000 feet; Mount Arrowsmith, Vancouver Island, alt. 5,600 feet. (*John Macoun.*) Not before recorded from Vancouver Island.

AGRIMONIA EUPATORIA, Linn.

Moist thickets, mouth of Kootaine River, B.C. (*Dr. Geo. M. Dawson.*) Revelstoke and Agassiz, B.C. (*John Macoun.*) Not before recorded west of the Rocky Mountains.

POTERIUM CANADENSE, Benth & Hook.

Common in river valleys in Labrador, north to Lat. 58°. (*A. P. Low.*)

POTERIUM SANGUISORBA, Linn.

In fields at Spence's Bridge, B.C. (*John Macoun.*) Not recorded west of Ontario. This reference was placed by mistake under *P. annuum* by Prof. Macoun. (Cat. Can. Plants, vol. II, p. 319.)

PIRUS AMERICANA, DC.

Not rare in interior of Labrador north to Lat. 54°. (*A. P. Low.*)

SAXIFRAGA NIVALIS, Linn.

Borders of coulees, Cypress Hills, Assa., 1894. (*John Macoun,* Herb. No. 4921.) Not before recorded between Hudson Bay and the Rocky Mountains.

HEUCHERA CYLINDRICA, Dougl., var. GLABELLA, Wheelock.

H. Hallii, Macoun, Cat. Can. Plants, Vol. I., p. 158, in part.

Summit of South Kootanie Pass, Rocky Mountains. (*Dr. G. M. Dawson.*)

HEUCHERA CYLINDRICA, Dougl., var. OVALIFOLIA, Wheelock.

H. Hallii, Macoun, Cat. Can. Plants, Vol. I., p. 158, in part.

H. cylindrica, Dougl., var. *alpina,* Macoun, Cat. Can. Plants, Vol. I., p. 526.

Crow Nest Pass, Rocky Mountains; South of Kamloops, B.C. (*Dr. G. M. Dawson.*) Morley and Kananaskis, foot-hills of Rocky Mountains; Eagle Pass, B.C.; Spence's Bridge, B.C. (*John Macoun.*)

DROSERA INTERMEDIA, Drev. & Hayne, var. AMERICANA, DC.

Upper West Branch, Hamilton River, Labrador, 1894. (*A. P. Low,* Herb. No. 4998.) Not before recorded from Labrador.

LYTHRUM ALATUM, Pursh.

Damp ground, Griffin Lake, B.C., 1889. (*John Macoun.*) Not before recorded in Canada west of Ontario, though found in Colorado. It is possible that the seeds of the Griffin Lake plants were in some way introduced, though this is not probable.

ASTER PUNICEUS, L.

Lake Michikamow, Labrador, 1894. (*A. P. Low.*) Not before recorded from Labrador.

ANTENNARIA DIMORPHA, Torr & Gray.

Clay banks near the Police Barracks, Medicine Hat, Assiniboia, 1894. (*John Macoun,* Herb. No. 5052.) Not before recorded east of British Columbia.

HELIANTHUS TUBEROSUS, L.

H. doronicoides, Lam; Macoun, Cat. Can. Plants, vol. I., p. 246.

Along the Thames River at Chatham, Ont., 1894. (*John Macoun,* Herb. No. 5064.) Indigenous.

TUSSILAGO FARFARA, L.

Roadsides near Sutton Junction, Que. (*Jas. Fletcher.*) Near Toronto, Ont. (*Mrs. White.*) Along the shore of Cedar Island, Niagara River, Ont., 1894. (*R. Cameron,* Herb. No. 4941.) Not before recorded west of New Brunswick.

THELOSPERMA AMBIGUUM, Gray.

On the banks of the Saskatchewan River at Police Point, Medicine Hat, Assiniboia, May 31st, 1894. (*John Macoun,* Herb. No. 5073.) New to Canada.

GILIA MINIMA, Gr.

All references under *G. intertexta,* Steud.; Macoun, Cat. Can. Plants, Vol. I., p. 330, go here.

GILIA INTERTEXTA, Steud.

Along an old road near Victoria, Vancouver Island, 1893. (*John Macoun,* Herb. No. 658.) First Canadian record.

ECHINOSPERMUM REDOWSKII, Lehm., var. CUPULATUM, Gr.

Abundant in the vicinity of Medicine Hat, Assiniboia, 1894. (*John Macoun,* Herb. No. 5806.) Not before recorded east of British Columbia.

KRYNITKIA CRASSISEPALA, Gray.

Dry prairies near Medicine Hat, Assa., 1894. (*John Macoun*, Herb. No. 5803.) Our only Canadian specimens, though recorded from the Saskatchewan in Gray's Flora of North America.

MYOSOTIS ARVENSIS, Hoffm.

In a brook (No. 693) and on ballast (No. 694), at Nanaimo, Vancouver Island, 1893. (*John Macoun.*) Not before recorded west of Ontario.

ASPERGO PROCUMBENS, L.

Along garden fences, Whitby, Ont., 1894. (*Chas. McIllivray*, Herb. No. 4954.) New to Canada.

CONVOLVULUS ARVENSIS, Linn.

Ashcroft, B.C. (*Jas. McEvoy.*) Cedar Hill, near Victoria, and on ballast heaps at Nanaimo, Vancouver Island. (*John Macoun.*) Not before recorded west of Ontario.

SALSOLA KALI, L.; var. TRAGUS, DC.

Reported from several localities in Ontario. Abundant and spreading in Manitoba.

EUPHORBIA PRESLII, Guss.

In cultivated fields near Chatham, Ont., 1894. (*John Macoun*, Herb. No. 5898.) The only specimens in our herbarium, though reported from Hamilton, Ont., by Buchan.

SAGITTARIA, Linn.

The publication of Mr. Smith's revision of the North American species of *Sagittaria* and *Lophotocarpus* in the Sixth Report of the Missouri Botanic Garden has so altered the nomenclature and has in a few instances so materially affected our knowledge of the distribution of the species known to occur in Canada, that a complete revision of the references given by Prof. Macoun in Parts IV. and V. of his catalogue is necessary. Many additional references are also given, and the descriptions of two easily confounded species are copied from Mr. Smith's revision, as it is in the hands of very few Canadian botanists. All our herbarium specimens have been examined by Mr. Smith.

S. ARIFOLIA, Nutt. in herb.

S. variablis, var. *hastata*, Macoun, Cat. Can. Plants, Vol. II., p. 77, forms *b* and *c* in part.

Terrestrial, or emergent aquatic, weak, ascending, 2 to 4 dm. high ; petioles rather stout, usually curving outward ; blade of leaf 6 to 12 or 18 cm. long, arrow-shaped, acute, the margin mostly straight or arcuate, basal lobes divergent, acute or acuminate ; scape weak, ascending, simple or rarely branched ; bracts lanceolate, acute, 8 to 20 mm. long, scarious margined and obscurely veined, often reflexed ; 1 to 3 lower verticils pistillate ; fertile pedicels ascending, 15 to mostly 25 mm. long, or sometimes almost wanting ; fruiting head round, 8 to 15 mm. in diameter ; achenium 2 mm. long, tumid winged on both margins, the sides smooth, or often with a vertical subepidermal resin passage. Phyllodia of two forms, either long, slender, petiole-like, or flattened, linear-lanceolate, 2 to 5 dm. long and 10 to 15 mm. wide.

Grande Vallée, Gaspé, Que. ; Nipigon River, Ont. ; Hand Hills and Eagle Hills, Alberta ; Sicamous, B.C. ; Kamloops, B.C. (*John Macoun.*) Manitoba. (*Bourgeau.*) Moose Mountain Creek, Assa. (*Jas. M. Macoun.*)*

S. CUNEATA, Sheldon.

S. variabilis, var. *diversifolia*, Macoun, Cat. Can. Plants, Vol. II., p. 78, in part.

* No localities are given in this paper except those from which there are specimens in the herbarium of the Geol. Survey, or which are included in Mr. Smith's revision.

S. variabilis, var. *gracilis,* Macoun, Cat. Can. Plants, Vol. II., p. 78, in part.

Eagle Hills, Alberta; Sicamous, B.C. (*John Macoun.*) South Thompson River, B.C. (*Dr. G. M. Dawson.*)

S. LATIFOLIA, Willd.

Monœcious, with the lower verticils fertile, or diœcious; scape 1 to 12 dm. high, angled, simple or branched; flowers large, 2 to 4 cm. wide, the petals white; stamens numerous, 25 to 35; fertile pedicels shorter than the sterile; bracts sometimes connate in the upper verticils, acute, acuminate, or obtuse, not scarious; achenium broadly winged on both margins, 2.5 to 3.5. or rarely 4 mm. long, with a lateral horizontal or curving beak $\frac{1}{4}$ to $\frac{1}{3}$ its length, sides usually smooth or with a costate angle curving downward from the base of the beak, rarely with a sub-epidermal resin passage on each face.

Mr. Smith recognizes five forms of this species, two of which with the species proper are found in Canada.

S. latifolia, proper.

S. variabilis, var. hastata, form *a,* Macoun, Cat. Can. Plants, Vol. II., p. 77, in part.

North Pond, and Mt. Stewart, Prince Edward Island; Nation River, near Casselman, Ont. (*John Macoun.*) Ottawa, Ont. (*Wm. Macoun.*) Little Buffalo Lake, Sask. (*Jas. M. Macoun.*)

Form a.

S. variabilis, var. obtusa, Macoun, Cat. Can. Plants, Vol. II., p. 77, in part.

S. variabilis, var. angustifolia, Macoun, Cat. Can. Plants, Vol. II., p. 78, in part.

Campbellton, N.B. (*R. Chalmers.*) Nation River at Casselman, Ont.; Belleville, Ont. (*John Macoun.*)

Form c.

S. variabilis, var. hastata, forms *b* and *c,* Macoun, Cat. Can. Plants, Vol. II., pp. 77 and 78, in part.

Prince Edward Island; Bay of Quinté, Ont.; Lulu Island, mouth of Fraser River. (*John Macoun.*) New Brunswick. (*Chadborne.*) Lake Temiscouata, Que. (*Northrup.*) Missinaiba River, Ont. (*Dr. R. Bell.*) Manitoba. (*Bourgeau.*) Muskeg Island, Lake Winnipeg, Man. (*Jas. M. Macoun.*)

S. LATIFOLIA, Willd., var. PUBESCENS, (Muhl.) J. G. Smith.

S. variabilis, var. *pubescens,* Macoun, Cat. Can. Plants, Vol. II., p. 78.

Specimens collected in the Bay of Quinté, Ont., by Prof. Macoun, with pubescent bracts that are transition forms between this variety and the diœcious form *a* of the species have been referred here by Mr. Smith.

S. RIGIDA, Pursh.

S. heterophylla, and var. *rigida,* Macoun, Cat. Can. Plants, Vol. II., pages 78 and 79.

Abundant in many places about Ottawa, Ont. (*Fletcher, Fl. Ott.*) In several places in the vicinity of Belleville, Ont., and Weller's Bay, Lake Ontario. (*John Macoun.*)

S. GRAMINEA, Michx, Macoun, Cat. Can. Plants, Vol. II., p. 79.

Newfoundland. (*Miss Brenton*). North Sydney, Cape Breton, N.S.; Gull River, Victoria Co., Ont. (*John Macoun.*) Several stations in New Brunswick. (*Fowler's Cat.*) Little Tobique River, N.B. (*G. U. Hay.*) Lake Muskoka, Ont. (*Dr. Burgess, Dr. Britton* and *Miss Timmerman.*)

LOPHOTOCARPUS CALYCINUS, (Engelm.) J. G. Smith.

Sagittaria calycina, var. *spongiosa*, Macoun, Cat. Can. Plants, Vol. II., p. 78.

Several stations in New Brunswick. (*Fowler, Cat.*)

LISTERA AUSTRALIS, Lindl.

Poplar Ridge, Mer Bleue, near Ottawa, Ont., June 21st, 1893. (*Jas. Fletcher.*) New to Canada. Recorded in *Ottawa Naturalist.*

SCIRPUS SUBTERMINALIS, Torr.

In the Columbia River at Revelstoke, B.C., 1890. (*John Macoun*, Herb. No. 7372.)

ELEOCHARIS ROSTELLATA, Torr., var. OCCIDENTALIS, Wats.

Near Ainsworth, Kootaine Lake, B.C., 1890. (*John Macoun*, Herb. No. 7386.) Not before recorded from B.C. mainland.

AGROPYRUM VIOLACEUM, Hornm.

East Main River, near James Bay. (*A. H. D. Ross.*) Attikanak Branch, Hamilton River, Labrador. (*A.P.Low.*) Not before recorded from Labrador.

THE GOLD DEPOSITS OF MOUNT MORGAN, QUEENSLAND.*

By FRANK D. ADAMS, Ph.D., McGill University.

Mount Morgan is situated just within the tropics, about twenty-six miles south-west of Rockhampton, in central Queensland, and its gold deposits are among the most remarkable ever discovered, not only on account of their extraordinary richness, but also on account of the purity of the gold. Numerous and varied tales are told of the

* Jack, Robert L.—Report on the Mount Morgan Gold Deposits, reprinted from an official report of 21st November, 1884.

Rickard, T. A.—"The Mount Morgan Mine, Queensland."—Trans. Am. Inst. Mining, Eng., Vol. XX., p. 133, 1892.

first recognition of their value, but the best authenticated facts are as follows: The property forms part of a block of 640 acres originally taken up in 1873 for grazing purposes by one Donald Gordon. The Brothers Morgan held land in the same district, and were one day shown by Gordon a fragment of gold-bearing quartz which he had picked up in Mundic Creek. For a consideration, said to have been £20 and as much whiskey as he could drink, Gordon agreed to show them the locality where the specimens had been found. On the hill overlooking the creek he showed them the silicious ironstone that carried visible gold, and they found by sending samples to Sydney that it was even richer than they had imagined, so they purchased Gordon's holding at £1 per acre.

The three Morgans subsequently sold, first a part, and eventually the whole of their interest in the mine. In 1886 a company was formed with a capital of one million shares of £1 each. These shares rose, toward the end of 1888 to £17 5s. (about $86.25) giving the mine a market value of seventeen and a quarter millions sterling, or over eighty-six million dollars.

In one year, ending November 30th, 1889, the Mount Morgan mine produced 75,415 tons of ore, yielding a little over 323,542 ounces of gold, worth $6,657,424, and permitting the payment of $5,500,000 in dividends. The yield per ton was 4 oz., 6 dwts., 4 grs., while the working cost was, as is seen, only 17 per cent. of the value of the product. The yield has now fallen off somewhat, though the mine is still very productive, affording last year 119,900 ounces of gold, and paying dividends to the value of nearly $1,500,000.

The mine does not, as the name would imply, crown the summit of a mountain properly so called, but forms a quarry at the top of a hill only 500 feet above the village at its base, and 1,225 feet above sea level, surrounded by very broken, hilly country and almost encircled by a small stream (Mundic Creek) and is in many respects distinct in position and geological structure from the hillocks about it. The crest of the hill is being rapidly broken away in the quarrying operations, from 1200 to 1700 tons per week being removed.

In a report published in 1884, Mr. Robert L. Jack, the Government Geologist of Queensland, described this remarkable deposit and put forward an explanation of its origin. This report has, after a lapse of some ten years, been reprinted with a few notes and corrections, and the following extract from it presents Mr. Jack's views as to the mode of occurrence and genesis of the deposit :—" In the immediate neighbourhood of Mount Morgan the country rock consists mainly of bluish-grey quartzite—a fine-grained siliceous sandstone, now more or less vitrified—full of minute crystals of iron pyrites and specks of magnetic iron-ore, greywackes of the ordinary type ; hard, fine-grained sandstones or mingled siliceous and feldspathic materials, now somewhat indurated ; and lastly, occasional masses of shale hardened to a flinty consistency,—and a few belts of serpentine. The strata are of cretaceous age, and the sandstones above mentioned are sometimes charged with auriferous pyrites to a remarkable extent, and although large tracts of these pyritiferous quartzites are too poor to be worked, recent explorations have disclosed a large body assaying from half an ounce up to 174 ounces of gold to the ton. "As the stratified rocks in this locality appear to have been in thick beds, and as their metamorphism has gone to a considerable length, it is not easy to be certain of either dip or strike. The stratified rocks are, moreover, interrupted and intersected in every direction by dykes and other intrusive masses of dolerite (itself altered by the substitution of viridite for augite or olivine), trachyte and other igneous rocks, the intrusive masses apparently occupying as much space as the remnant of the original stratified formation itself.

The work is carried on in two quarries or faces. No. 1 cuts into the hill from a level of about 25 feet below the summit, and is designed simply to remove the top of the mountain for the purpose of passing it through the stampers. No. 2, or Magazine Quarry, presents the aspect of a "sidling" road cut out of a steep hill, and attacks the auriferous deposit at a level of about 100 feet below No. 1. "The central portion of the upper cutting is a large mass of brown haematite ironstone, generally in great blocks (up to some tons in weight), with a stalactitic structure, as if the iron oxide had gradually filled up cavities left in the original deposit. The ironstone contains gold of extraordinary fineness, which, however, after a little practice, can be detected in almost every fresh fracture. The ironstone is more or less mixed with fine siliceous granules. Gradually to the right and left of the central mass the silica more and more replaces the ironstone. It is a frothy, spongy, or cellular sinter, sometimes so light, from the entanglement of air in its pores, that it floats in water like pumice. Fine gold is disseminated throughout this siliceous deposit as well as in the ironstone. Near the west of the cutting is a vertical dyke of kaolin mixed with fine siliceous granules, passing into pure kaolin with some silicates of magnesia, including a fine variety of French chalk.

I selected a number of specimens as characteristic of the various deposits of the upper cutting. These, when assayed by Mr. Karl Staiger, City Analyist, Brisbane, gave the following results :—

No. 5.—Stalactitic brown haematite from middle of cutting, 6 oz., 11 dwt., gold per ton.

No. 6.—Siliceous sinter, veined with quartz, 4 oz., 5 dwt., gold per ton.

No. 7.—A mixed mass of ironstone and silica from level of the road, east of the dyke, 5 oz., 3 dwt., gold per ton.

No. 8.—Iron stained siliceous sinter from west side of dyke, 10 oz., 14 dwt. of gold per ton.

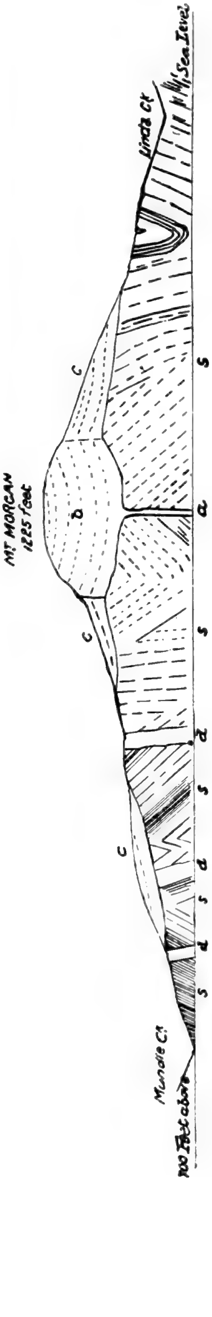

Figure I.—Section across Mount Morgan.

A, pipe of geyser (theoretical); b, deposit cup of geyser; c, overflow deposit of geyser; s, metamorphic rocks; d, dolerite dykes.

Down the hillsides to the north, west and south, similar deposit is everywhere met with, a frothy, spongy matrix, sometimes aluminous and sometimes siliceous, generally ironstained, and occasionally associated with large masses of red and brown haematite, but gold has as yet only been obtained from a few places away from the hill-top, although naturally there has been vigorous prospecting wherever the "formation" resembles that of Mount Morgan.

After a careful study of the whole formation I have come to the conclusion that nothing but a thermal spring in the open air could have deposited the material under consideration. The frothy siliceous sinter agrees in every respect with the deposits of the New Zealand and Iceland geysers and of the still more wonderful hot springs of the Yellowstone National Park, so graphically and scientifically described by Dr. A. C. Peale (12th Annual Report of the United States Geological and Geographical Survey of the Territories, Part II., Section 2, "On the Thermal Springs of the Yellowstone National Park," Washington, 1883.) The frothy and cavernous condition of the siliceous sinter of Mount Morgan may be accounted for by the escape of steam while the silica was yet (after deposition on the evaporation of the water) in the gelatinous condition so frequently observed in the deposits of hot springs. The aluminous silicates represent the familiar outbursts and flows of mud. The iron oxide appears to have been deposited in some cases along with the silica and alumina, and in others to have been developed later —its solvent fluid having been, as it were, injected into the interstices and caverns of the silica and alumina. In some cases it may have been originally pyrites, as it now and then occurs in cubical hollows. Calcareous sinter is very common in siliceous springs, and its absence from Mount Morgan must needs imply the local absence of limestones among the rocks from which the spring is fed. The silica would be found abundantly in the quartzites and the alumina in the shale and greywackes of the country rock in the neighbourhood, and possibly both silica and alumina may have come in part from a deep seated underlying granite. The gold, and to some extent the iron, may have been dissolved out of iron pyrites of such reefs as the "Mundic Reef" seen in Mundic Creek.

In such active geysers as are accessible to observation, we find a narrow pipe or fissure, terminating upwards in a crater-like cup or basin. The Great Iceland Geyser, for example, has a pipe 12 feet in diameter, which has been sounded to a depth of 70 feet. I have seen no satisfactory explanation of the necessity for a cup, nor can suggest one, but all the same the repeated ocurrence of the cup evidently takes place in obedience to some natural law. It may be taken for granted that the Mount Morgan geyser was no exception to the rule, and I believe that that upper portion of the Mount where ironstone predominates, and to which gold is almost confined, represents a basin occasionally filled with a fluid in which iron, alumina, manganese and gold were held in solution, to be deposited when the bulk of the water from time to time withdrew into the pipe or the subterranean reservoirs with which the pipe communicated. The overflow of the ejected fluid left a siliceous, aluminous and ferruginous deposit on the slope of the hillside, but the gold does not appear to have been deposited to any extent beyond the limit of the basin. It may be remarked that "prospects" of gold have been obtained in a few localities in the overflow deposit. In such cases it may be a question whether the gold was carried down the overflow or whether it emanated from some subsidiary springs, which, in such cases as our experience of active geysers has shown, are pretty sure to break out in the vicinity of the main overflow. "Callan's Knob," for instance, is suggestive of one of these smaller springs.

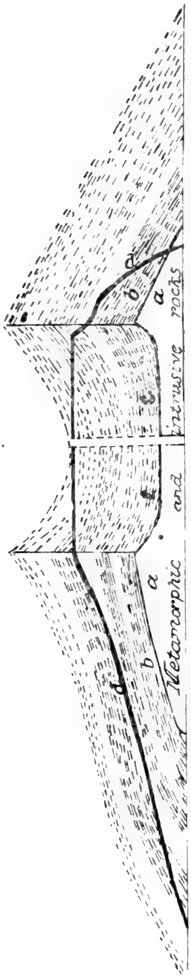

Figure II.—Diagrammatical section showing the building up of geyser deposits and subsequent denudation.

The accompanying diagramatic section (Figure II.) represents my idea of what would take place in the case of a geyser remaining in activity for a, geologically speaking, lengthened period. The original form of the ground may be taken to have been the line (a a). At the end of an outburst the sides of the hill would be covered with a deposit of precipitated material (b b), while on the recession of the water from the cup, a film or layer of solid material (c c) would be deposited on its sides and bottom. If we suppose the cup to be a necessity arising from the operation of a natural law, as it seems to be, the continued action of the geyser must result in the building up of a cylindrical cup-deposit, surrounded by an overflow-deposit resembling a series of cased saucers placed upside down with the bottom knocked out. Whether the different physical and chemical conditions under which the solvent in the cup and that which overflowed precipitated their solid materials, is sufficient to account for the presence of gold in one deposit and its absence (or scarcity) in the other, is a question which I leave to chemists. As a matter of fact, this appears to have been the case in Mount Morgan."

"After the cessation of thermal activity, the powers of sub-aerial denudation would come into play and might carve down the hill till the line d. d. should represent the surface contour of to-day. Such, I believe, is the history of Mount Morgan as we now see it. Denudation would obliterate the lateral terraces which are so familiar a feature of the scenery of every important geyser district in New Zealand and the Yellowstone, and which were probably not absent from the slopes of Mount Morgan. Mud pipes and other evidences of the outbreak of hot water and gases from minor vents would be removed by the same process."

Since the report from which the above quotations were taken, was written, some ten years have elapsed, and continuous work on a large scale has opened up and revealed many additional details concerning this most interesting ore body.

The supposed "over-flow deposit" is now recognised by Mr. Jacks as consisting merely of altered and weathered portions of the country rock.

So that Figure II. and also Figure I., so far as the overflow deposit is concerned, although they have found their way into scientific publications the world over, are quite erroneous. The pipe also which Mr. Jack states to be "theoretical," has not been discovered, although the mountain has been traversed by a number of adits and cross-cuts, in addition to extensive surface excavations.

In a second report, however, dated December 12, 1888, Mr. Jack says, "The evidence now on hand goes far to confirm my original view that the auriferous material was deposited by a thermal spring." But it seems clear that if the supposed evidences of deposition in the open air are found to be fallacious, and we have merely an instance of the deposition of auriferous material in a mass of shattered rock by the agency of heated waters, these deposits, which have been considered a remarkable instance of a most unusual mode of occurrence of the precious metals, must be relegated to the large class of ore deposits known to have originated in the way just referred to, and of which the Comstock Lode and other similar deposits are examples. Recent developments, although showing the supposed overflow deposit to be non-existent, and failing to reveal any geyser pipe, have shown the ore body to be confined to the upper portion of the mountain.

Mr. Rickard believes the history of the deposit to be as follows:—

"A period of dynamic disturbance is indicated by the intrusion of dolerite, which, by extreme metamorphism might have changed a dolomite into the serpentine we now see; would have indurated the shales so that they are scarcely to be distinguished from the crystalline rocks, and would also, accompanied by chemical alteration, change a ferruginous red sandstone into bluish-grey, highly pyritiferous quartzite. Approaching the surface the same energy would be expended in fracturing the quartzite and greywacke, the intrusive dolerite would rise through the fissures in the shattered rock, forming dykes, which, meeting a silico feldspathic granular rock (the greywacke) would give it a semi-crystalline character. The sandstone would similarly be vitrified. Later movements would result in the further intersection of this part of the district by the numerous dykes, the decomposed remains of which are now to be seen ramifying through the deposit. Those gradual chemical interchanges would take place which resulted in the alteration of the shattered country rock, and its becoming a portion of the gangue enclosing the auriferous material, which was then or at a later time, deposited. In process of time, sub-aerial denudation removed the sandstone which now is only to be seen on the further summits of the neighboring hills. Atmospheric agency continued to carve away the less siliceous and less porous portions of the country surrounding the deposit, until Mount Morgan, owing to the pervious quartzose nature of its crest, remained as a low hill in an undulating country."

Which of these views is correct, further developments of the property will probably decide.

The character of the Mount Morgan gold itself is also highly interesting. Loch, in his work on gold, published in 1882, says, "no gold has yet been found in nature unalloyed with silver," but the gold which occurs so abundantly in this great deposit is almost free from silver, assaying about 99.7 per cent. of gold, the rest consisting of copper with a trace of iron; the gold being, it is believed, the purest native gold hitherto found.

Argon.

The announcement of the probable existence of a new element in the atmosphere, made by Lord Rayleigh and Professor Ramsay at the meeting of the British Association last summer, aroused the profound attention of the scientific world. A large number of elements have been discovered in the last quarter of a century, but all of them are metallic substances which occur in minute quantities in rare minerals. The latest addition to the list of non-metallic elements was bromin, discovered nearly seventy years ago, and the existence of an undiscovered element belonging to this group did not appear probable. Still less likely did it seem that such an element could be present in the atmosphere. Our knowledge of the air was satisfactory and complete. Innumerable analyses had established the facts in regard to its composition. Hence the announcement above referred to was met with much scepticism, in spite of the eminent character and skill of the men who made it; and the whole chemical world has waited anxiously and impatiently for a full account of the work. This has now been given in a paper by Lord Rayleigh and Professor Ramsay, which was read before the Royal Society at a special meeting on January 31. The long delay between the preliminary announcement and the presentation of the paper is fully accounted for by this statement of Lord Rayleigh's:

"The research has been in many respects a very difficult one. I am not without experience in experimental difficulties, but certainly I have never encountered them in anything like so severe and aggravating a form as in this investigation. Every experiment that one attempts takes about ten days or a fortnight to carry out to any definite conclusion, and the result has been of necessity much less progress than we could have hoped for, and many of the questions have been left open that we could have wished to settle."

The history of the discovery is in brief as follows: In the course of a series of determinations of the densities of some of the more permanent gases, Lord Rayleigh found in the case of nitrogen that if obtained from chemical compounds it was about one-half per cent. lighter than if extracted from the atmosphere. This discrepancy was naturally thought at first to be due to contamination with impurities consisting of known substances. When experiment had demonstrated that this was not the case, the dissociation of the molecules of the nitrogen derived from chemical sources into detached atoms suggested itself as a possible explanation of its greater lightness. But both gases subjected to the action of the silent electric discharge retained their densities unchanged. This was discouraging, and a further experiment of a different kind disposed of this explanation in a still more decisive manner. It was exceedingly improbable that the nitrogen of chemical origin could be a mixture, as that would necessitate the existence of two kinds of nitric acid. The simplest remaining explanation was to admit the existence of a second ingredient in the nitrogen obtained from the atmosphere. If the supposed gas had a density half as much again as that of nitrogen, the presence of one per cent would suffice to explain the observed differences in density. This explanation brought the investigators face to face with the great improbability that a gas all about us and present in such enormous quantity could have remained so long unsuspected. Its demonstration demanded the isolation and identification of the new gas, and to the solution of this problem the research was now directed.

It is interesting to note here that Cavendish, more than a hundred years ago, in his careful and exact study of atmospheric nitrogen, had really raised this same question of possible admixture with another gas.

Describing his attempts to cause a complete union of atmospheric nitrogen with oxygen by means of the electric spark, he says: "If there is any part of the phlogisticated air (nitrogen) of our atmosphere which differs from the rest and cannot be reduced to nitrous acid, we may safely conclude that it is not more than 1-120th part of the whole." Cavendish, however, laid no emphasis on this residual 1-120th, except as indicating by its minuteness the great purity of the nitrogen from air. But in these days science no longer neglects "residual phenomena," and has found, in many cases before this, abundant evidence of the valuable results to be obtained by a study of them.

In the first attempts to isolate the suspected gas, Cavendish's method was employed. Electric sparks were passed through air confined over weak alkali, and oxygen gradually added till in excess. The products of the union of nitrogen and oxygen caused by the spark were absorbed by the alkali, and finally, when no further absorption took place, the excess of oxygen was removed by alkaline pyrogallate. A residue was obtained which was in all instances proportional to the amount of air operated upon.

Another method of isolating argon, and which also serves for preparing it in considerable quantities, is as follows: Air from which moisture and carbon dioxide have been removed is freed from oxygen by passing it over red-hot copper, and from nitrogen by magnesium turnings heated to a bright redness. The removal of the last portions of nitrogen is a tedious operation, requiring some two days, when the residual gas is found to be pure argon.

The gas obtained by either of these methods has a density one-fourth greater than oxygen (16.20), and dissolves in water about two and a-half times as freely as nitrogen. On account of its solubility, it is present in larger proportion in the gases dissolved in rain-water than in the air, as is indicated by the fact that "nitrogen" prepared from the gases expelled from water has a higher density than that from air,

The spectrum of argon has been examined by Professor Crookes. who finds that "No other spectrum-giving gas or vapor yields spectra at all like those of argon," and says further, "As far, therefore, as spectrum work can decide, the verdict must be that Lord Rayleigh and Professor Ramsay have added one if not two members to the family of elementary bodies."

Professor Olszewski of the University of Cracow, well known for his researches on the liquefaction of air and other gases, was furnished with 300 cc. of argon for the determination of its behaviour at low temperatures and high pressures. He reports that it can be liquefied only when its temperature is reduced (by liquid ethylene) to —121° C., and that the necessary pressure at that temperature is 50.6 atmospheres; or, in other words, that its "critical temperature and pressure" are —121° and 50.6 at. respectively. Its boiling-point is

—186.9° C. ; it freezes to an ice-like mass at —191°, and melts at --189.6°. In its behaviour at low temperatures it stands between oxygen and nitrogen, whose critical temperatures are —118° and —146° respectively, and whose boiling points are —182.7° and —194.4°.

Chemically, argon appears to be more inert than nitrogen, all attempts to induce chemical action with even the most active substances having proved abortive.

The facts so far obtainable do not warrant a final decision in regard to its simplicity. If not an element, it is a mixture. There is evidence on both sides, but the balance seems to be in favor of simplicity. Not only does argon appear to be a single elementary substance, but its molecules are apparently of simplest possible structure. A determination of the ratio of its specific heats at constant volume and constant pressure points to the conclusion that its molecules are monatomic, *i. e.*, composed of a single atom each, instead of two atoms, as is the case in almost all elementary gases and vapors.

Certain very interesting and important theoretical issues are raised by this conclusion. In connection with the density which the gas has, it indicates an atomic weight of 40. But in this case there is no place for the new element in the tables of Mendeleieff, which express the periodic law, and which have been so generally accepted. If argon should turn out to be a mixture, the difficulty may dissappear, but if its simple character is finally demonstrated, an awkward dilemma is offered between the validity of the periodic law and that of the conclusions drawn from the determinations of specific heat ratios. The periodic law of Mendeleieff is, after all, as Professor Rücker has said, "an empirical law, which rests on no dynamical foundation." The present situation will strengthen many chemists in their feeling that, although the law is a generalization which has in it many elements of truth, and has hence proved of much value to chemistry, it is by no means a complete or final expression of the relations of the elements.

The discovery of argon is a brilliant achievement. As Professor Crookes said before reading his paper on the spectra of argon, "Here we have a new chemical element, the principal properties of which seem to be the negation of all chemical properties. Chemists will understand how difficult it is to deal with anything which forms no compounds and unites with nothing. The discovery commenced by a prediction, followed after an interval by realization. . . . The prediction and discovery of argon are only equalled by the few discoveries . . . made . . . by the careful study of the periodic law, and to surpass it we must go back to the predicted existence and subsequent discovery of an unknown planet by Adams and Leverrier." —THE NATION.

Some of the Rarer Summer Flowers of Canada.

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

It may help to a knowledge of the distribution of plant life in the Dominion, to give a list of the rarer plants picked up in different parts of the country, which have been visited in the summer season, either in the way of duty or pleasure. It was the writer's privilege lately to spend a couple of weeks in South Western Ontario. During that time it was his good fortune to meet with the botanical section of the Natural History Society of London, Ontario, and to spend a few hours with them in field work on and near the banks of the Thames. This expedition was fruitful in the acquisition of not a few specimens, found in Canada only in that district. Anyone familiar with Professor Macoun's Catalogue of Canadian Plants is aware how largely he drew, in compiling it, from the collection made by Dr. Burgess, in the London district. The county of Lambton was also visited lately, —the town of Forest, and the shores of Lake Huron at Kettle and Stony Points, and several captures were made in that region of specimens not often found further east. Galt, Brantford, the County of Lanark, Sherbrooke, Cacouna, Cap-a-L'Aigle and St. John, New Brunswick, all have yielded their quota of the following, now embraced in my collection :—

Anemone nemorosa, L.—Sherbrooke and Hyde Park, Toronto.

Ranunculus multifidus, var. terrestris, Gray.—Township of Drummond, Ont.

Ranunculus repens, L.—Banks of the Thames, London.

Ranunculus Pennsylvaticus, L.—Woods near Brantford.

Delphinium ajacis, L.—Township of Dundee, Quebec.

LIRIODENDRON TULIPIFERA, L.—Kettle Point, Lake Huron.

MENISPERMUM CANADENSE, L.—London, Forest, St. Rose, Island of Jesus, Montreal Island.

PODOPHYLLUM PELTATUM, L.—London, Forest, Brantford, Galt.

SARRACENIA PURPUREA, L.—St. Martin, Island of Jesus.

ADLUMIA CIRRHOSA, Raf.—Brantford, Beauharnois.

DICENTRA CANADENSIS, DC.—Montreal Island, Smith's Falls.

DICENTRA CUCULLARIA, DC.—Montreal Island.

CARDAMINE ROTUNDIFOLIA, Michx.—Montreal Island.

ARABIS DRUMMONDII, Gray.—Rocks above wharf at Point-a-Pic, Murray Bay. (*Arabis confinis*, Watson.)

ARABIS CANADENSIS, L.—Montreal Mountain.

SISYMBRIUM SOPHIA, L.—Lachine.

NASTURTIUM PALUSTRE, var. HISPIDUM, DC.—Huntingdon.

NASTURTIUM ARMORACIA, Fries.—Philipsburgh, Cote des Neiges.

CAKILE AMERICANA, Nutt.—Cacouna, Cap-a-L'Aigle.

VIOLA RENIFOLIA, Gray.—Lachine.

SOLEA CONCOLOR, Ging.—Near London, Ont. (*Ionidium concolor*, Barth & Hook.)

SILENE ARMERIA, L.—Field above Hochelaga.

LYCHNIS VESPERTINA, Sibth.—Dundee, Q., London, Forest.

LYCHNIS, FLOS-CUCULI, L.—Banks of Grand River, Galt.

ARENARIA CAROLINIANA, Watt.—Brantford.

ARENARIA GRŒNLANDICA, Spreng.—Cap-a-L'Aigle.

ARENARIA MICHAUXII, Hook.—Stony Point, Lake Huron.

STELLARIA PUBERA, Michx.—Port-a-Persil, Q.

CERASTIUM ARVENSE, var. OBLONGIFOLIUM, Holl & Brit.—Near St. John, N.B., Cacouna.

HOLOSTEUM UMBELLATUM, L.—Kettle Point, Lake Huron.

BUDA MARINA, Dumort.—Cacouna Island.

HYPERICUM ASCYRON, L.—Fergus, Ont., St. Scholastique, Q.

HYPERICUM ELLIPTICUM, Hook.—Bathurst, Ont.

HIBISCUS SYRIACUS, Niles.—Illinois.

LINUM STRIATUM, Walter.—Township of Drummond, Ont.

GERANIUM MACULATUM, L.—Brantford, London.

ILEX VERTICILLATA, Gray.—Eastern Townships, Q., St. John, N.B.

NEMOPANTHES FASCICULARIS, Rap.—Cap-a-L'Aigle, Labelle, St. John, N.B.

EUONYMUS ATROPURPUREUS, Jacq.—London, Ont.

EUONYMUS AMERICANUS, var. OBOVATUS, Torr & Gray.—Galt.

RHAMNUS ALNIFOLIA, L'Her.—Forest, Ont.

STAPHYLEA TRIFOLIA, L.—London, Ont.

NEGUNDO ACEROIDES, Mœnch.—Galt, Calumet, Montreal.

VITIS RIPARIA, Michx.—St. Rose, Kettle Point, Lake Huron.

RHUS COPALLINA, L.—Cap-a-L'Aigle.

RHUS CANADENSIS, var. TRILOBATA, Gray.—Kettle Point, Lake Huron.

POLYGALA POLYGAMA, Watt.—London, Ont.

POLYGALA SENEGA, L.—Brantford.

TRIFOLIUM ARVENSE, L.—Rabbit-foot clover—Cap-a-L'Aigle.

ASTRAGALUS COOPERI, Gray.—Near London, Ont.

VICIA HIRSUTA, Koch.—Cap-a-L'Aigle.

VICIA TETRASPERMA, Loisel.—Mount Royal Park.

VICIA CAROLINIANA, Watt.—Murray Bay.

APIOS TUBEROSA, Boer.—Huntingdon, Island of Montreal.

SPIRÆA LOBATA, Jacq.—Queen of the Prairie—St. Lambert's.

PHYSOCARPUS OPULIFOLIUS, Maxim.—Beaconsfield, Island of Montreal.

RUBUS CHAMÆMORUS, L.—Saguenay, Port-a-Persil.

RUBUS CANADENSIS, L.—Near St. John, N.B.

GEUM MACROPHYLLUM, Willd.—St. John, N.B.

GEUM VIRGINIANUM, L.—Island of Montreal.

WALDSTEINIA FRAGARIOIDES, Tratt.—Hyde Park, Toronto.

POTENTILLA RIVALIS, Natt.—Cacouna, Cap-a-L'Aigle.

POTENTILLA FRUTICOSA, L.—Island of Montreal.

POTENTILLA TRIDENTATA, Ait.—Cap-a-L'Aigle.

POTENTILLA CANADENSIS, L.—Island of Montreal.

POTERIUM CANADENSE, Benth & Hook.—Cacouna, Island of Montreal.

PYRUS CORONARIA, L.—Galt.

PYRUS ARBUTIFOLIA, L.—Near St. John, N.B.

CRATAEGUS COCCINEA, var. MACRACANTHA, Dudley—Mount Royal Park.

CRATAEGUS TOMENTOSA, var. PYRIFOLIA, Gray.—Mount Royal Park.

CRATAEGUS PUNCTATA, Jacq.—Mount Royal Park.

CRATAEGUS COCCINEA, var. MOLLIS, Torr & Gray.—Mount Royal Park.

SAXIFRAGA AIZOIDES, L.—Point-a-Pic, Murray Bay.

SAXIFRAGA STELLARIS, var. COMOSA, Willd.—Point-a-Pic.

PARNASSIA CAROLINIANA, Michx.—Galt, Island of Montreal, Cacouna.

SEDUM ACRE, L.—Galt, London, Ont.

HAMAMELIS VIRGINIANA, L.—Galt.

DECODON VERTICILLATUS, Ell.—Beauharnois, Montreal.

EPILOBIUM ANGUSTIFOLIUM, var. CANESCENS, Wood.—Kettle Point, Lake Huron, Salmon River.

LIGUSTICUM SCOTICUM, L.—Cap-a-L'Aigle.

THASPIUM AUREUM, Nutt.—Sherbrooke.

CŒLOPLEURUM GMELINI, Ledeb.—St. Helen's Island.

PIMPINELLA INTIGERRIMA, Benth & Hook.—Montreal Mountain, Kettle Point, Lake Huron.

CONIUM MACULATUM, L.—Huntingdon.

BERULA ANGUSTIFOLIA, Hook.—Huntingdon.

Cicuta bulbifera, L.—Orangeville.

Viburnum obovatum, Watt.—Kettle Point, Lake Huron.

Triosteum perfoliatum, L.—Galt.

Cephalanthus occidentalis, L.—Kettle Point, Montreal Island.

Houstonia angustifolia, Michx.—Brantford.

Houstonia Cærulea, L.—In great abundance in the fields near Sherbrooke, Que.

Galium pilosum, Ait.—Forest, Ont., and Montreal Island.

Galium lanceolatum, Torr.—Galt.

Galium asprellum, Michx.—Orangeville.

Dipsacus sylvestris, Mill.—Bathurst, Ont., Lachine.

Aster Lindleyanus, Torr & Gray.—Cap-a-L'Aigle.

Aster Tardifolius, L.—Bank of Murray River.

Inula Helenium, L.—Drummond, Ont., Bath, Montreal Island.

Galinsoga parviflora, Cav.—McGill College grounds.

Rudbeckia laciniata, L.—Galt.

Tussilago Farfara, L.—Near St. John, N.B.

Cnicus altissimus, var. discolor, Gray.—Cap-a-L'Aigle.

Onopordon acanthium, L.—Galt.

Lampsana communis, L.—Cacouna Point, Quebec.

Hieracium murorum, L.—Cap-a-L'Aigle.

Sonchus arvensis, L.—Cap-a-L'Aigle, Montreal Island.

Tragopogon porrifolius, L.—Lucan's Crossing.

Tragopogon pratensis, L.—Montreal Island.

Lobelia syphilitica, L.—Galt.

Lobelia puberula, Michx.—Montreal Island.

Lobelia spicata, Lam.—Galt.

Gaylussacia dumosa, Torr & Gray.—St. John, N.B.

Gaylussacia resinosa, Torr & Gray.—St. John, N.B.

Vaccinium Vitis-Idæa, L.—St. John, N.B.

Vaccinium oxycoccus, L.—Cap-a-L'Aigle, St. John, N.B.

Chiogenes hispidula, Torr & Gray.—Cacouna Island, Port-a-Persil.

Arctostaphylos uva-ursi, Spreng.—Cacouna Island, Port-a-Persil.

Epigæa repens, L.—Lachute, The Trou, Murray Bay.

Gaultheria procumbens, L.—The Trou, Montreal Island.

Andromeda polifolia, L.—Near St. John, N.B.

Cassandra calyculata.—Port-a-Persil, St. John, N.B.

Loiseleuria procumbens, Desv.—Cap-a-L'Aigle.

Kalmia angustifolia, L.—Near St. John, N.B.

Kalmia glauca, Ait.—Cap-a-L'Aigle.

Rhododendron Rhodora, Don.—Near St. John, N.B.

Ledum latifolium, Ait.—Port-a-Persil, Island of Montreal.

Chimaphila mubellata, Nutt.—Cap-a-L'Aigle, Montreal Island.

Moneses uniflora, Gray.—Cap-a-L'Aigle.

Plantago lanceolata, L.—Galt, London, Ont.

Plantago decipiens, Barneoud.—Cap-a-L'Aigle, Port-a-Persil.

Plantago cordata, Lam.—Beauharnois.

Steironema ciliatum, Raf.—Isle Heron.

Lysimachia nummularia, L.—Beauharnois.

Glaux maritima, L.—Murray Bay.

Ligustrum vulgare, L.—Forest.

Apocynum cannabinum, L.—London, Ont., Beaconsfield.

Asclepias tuberosa, L.—Galt, Stony Point, Lake Huron.

Asclepias phytolaccoides, Pursh.—Galt, London.

Asclepias Meadii, Torr.—Brantford.

Asclepias tuberosa, var. decumbens, Pursh.—Sandhill, Stony Point.

Gentiana crinita, Frœl.—Galt.

Gentiana serrata, Gunner.—Galt.

Gentiana quinqueflora, Lam.—Cacouna Point.

GENTIANA ANDREWSII, Griseb.—Montreal Island.

PHLOX DIVARICATA, L.—Galt.

MENYANTHES TRIFOLIATA, L.—Murray Bay.

HYDROPHYLLUM APPENDICULATUM, Michx.—Near London.

CYNOGLOSSUM VIRGINICUM, L.—Island of Montreal.

MERTENSIA MARITIMA, Don.—Cacouna, Murray Bay.

LITHOSPERMUM LATIFOLIUM, Michx.—Montreal Island.

ONOSMODIUM CAROLINIANUM, DC.—Sandhill, Stony Point.

ECHIUM VULGARE, L.—Bathurst, Ont., Galt.

CUSCUTA GRONOVII, Willd.—Oliver's Ferry, Ont.

HYOSCYAMUS NIGER, L.—Fletcher's field, Montreal.

PHYSALIS GRANDIFLORA, Hook.—Cap-a-L'Aigle.

VERBASCUM BLATTARIA, L.—Galt.

LINARIA CYMBALARIA, Mill.—Near Toronto.

PENTSTEMON PUBESCENS, Solander.—Galt.

LIMOSELLA AQUATICA, var. TENUIFOLIA, Hoffm.—Murray Bay.

GERARDIA PURPUREA, var. PAUPERCULA, Gray.—Montreal Island.

EUPHRASIA OFFICINALIS, L.—Cap-a-L'Aigle, Quebec.

PEDICULARIS PALUSTRIS, var. WLASSOVIANA, Bunge.—Murray Bay.

COLLINSONIA CANADENSIS, L.—Galt.

LYCOPUS SINUATUS, Ell.—Huntingdon, Montreal Mountain.

CATALPA BIGNONIOIDES, Watt.—McGill College grounds, flowered in 1893.

TEUCRIUM CANADENSE, L.—Beauharnois, Huntingdon.

CALAMINTHA NEPETA, Link.—Mount Royal Park.

CALAMINTHA CLINOPODIUM, Benth.—Huntingdon.

HEDEOMA PULEGIOIDES, Pers.—St. Lambert's.

MONARDA DIDYMA, L.—Montreal Island.

LOPHANTHUS NEPETOIDES, Benth.—Mount Royal Park, London.

NEPETA GLECHOMA, Benth.—Montreal Mountain, Brantford, Stony Point, Lake Huron.

CYCLOLOMA PLATYPHYLLUM, Moquin.—London, Ont.

CHENOPODIUM URBICUM, L.—Montreal suburbs.

ATRIPLEX PATULA, var. HASTATA, Gray.—Cap-a-L'Aigle, Cacouna.

SALSOLA KALI, L.—Cap-a-L'Aigle, Cacouna.

PHYTOLACCA DECANDRA, L.—London, Ont.

RUMEX BRITANNICA, L.—London, Ont., Forest.

RUMEX SALICIFOLIUS, Weinmann.—Cap-a-L'Aigle.

RUMEX VERTICILLATUS, L.—Mount Royal Park.

RUMEX SANGUINEUS, L.—Near St. John, N.B.

RUMEX ACETOSA, L.—Cap-a-L'Aigle.

POLYGONUM CILINODE, Michx.—Cap-a-L'Aigle.

ARISTOLOCHIA SIPHO, L'Her.—Brantford.

SASSAFRAS OFFICINALE, Nees.—Glenmorris, near Galt.

DAPHNE MEZEREUM, L.—Montreal Mountain.

DIRCA PALUSTRIS, L.—Sharbot Lake, Drummond, Montreal Island.

SHEPHERDIA CANADENSIS, Nutt.—Murray Bay, London, Ont.

EUPHORBIA PEPLUS, L.—Streets of Montreal.

EUPHORBIA HUMISTRATA, Engelm.—Mount Royal Park.

EUPHORBIA OBTUSATA, Pursh.—Montreal Island.

CELTIS OCCIDENTALIS, L.—St. Helen's Island, London, Montreal Island.

BŒHMERIA CYLINDRICA, Willd.—Suburbs of Montreal.

PLATANUS OCCIDENTALIS, L.—London, Forest.

MYRICA GALE, L.—Cacouna Island.

CARPINUS CAROLINIANA, Walter.—Drummond, Galt.

POPULUS HETEROPHYLLA, L.—Labelle.

EMPETRUM NIGRUM, L.—Cacouna Island, Cap-a-L'Aigle.

PINUS BANKSIANA, Lambert.—Cap-a-L'Aigle.

PICEA NIGRA, Link.—Cap-a-L'Aigle.

TAXUS CANADENSIS, Willd.—Cap-a-L'Aigle.

MICROSTYLIS OPHIOGLOSSOIDES, Nutt.—Cap-a-L'Aigle.

Lobelia Amœna, Michx.—Stony Point, Lake Huron.

Corallorhiza odontorhiza, Nutt.—Galt.

Corallorhiza multiflora, Nutt.—Galt.

Spiranthes Romanzoffiana, Cham.—Cap-a-L'Aigle.

Spiranthes cernua, Richard.—Montreal Island.

Spiranthes gracilis, Bigelow.—Near London, Ont.

Goodyera repens, R. Br.—Cap-a-L'Aigle.

Epipactis Helleborine, Crantz.—Montreal Mountain.

Calopogon pulchellus, R. Br.—Stony Point, Lake Huron.

Orchis spectabilis, L.—Drummond, Bathurst, Ont., Mount Royal Park.

Habenaria hyperborea, R. Br.—Cap-a-L'Aigle, Mille Isles.

Habenaria Hookeri, Torr.—Calumet.

Habenaria orbiculata, Torr.—Mount Royal, London.

Habenaria psycodes, Grey.—Stony Point, Lake Huron.

Habenaria fimbriata, R. Br.—Stony Point, Lake Huron.

Cypripedium spectabile, Swartz.—Lanark, Stony Point.

Cypripedium acaule, Ait.—Hochelaga Banks.

Dioscorea villosa, L.—Near London, Ont.

Allium Canadense, Kalm.—Kettle Point, Lake Huron.

Disporum lanuginosum, Barth & Hook.—Banks of Thames, near London, Ont.

Lilium Philadelphicum, L.—Sandhill, Stony Point, Lake Huron.

Lilium Canadense, L.—Dundee, Que., Montreal Island.

Veratrum viride, Ait.—Sherbrooke.

Arisæma Dracontium, Schott.—Near London, Ont.

Symplocarpus fœtidus, Salisb.—Sherbrooke, Nuns' Island, near London, Ont.

Triglochin palustris, L.—Stony Point, Lake Huron.

Chara fragilis, L.—Galt.

PELLÆA GRACILIS, Hook.—Banks of Grand River, Fergus.

ASPLENUIM TRICHOMANES, L.—Poïnt-a-Pic, Murray Bay.

CYSTOPTERIS BULBIFERA, Bernh.—Orangeville, Cap-a-L'Aigle.

OSMUNDA CINNAMOMEA, var. FRONDOSA, L.—Cap-a-L'Aigle.

CAMPTOSORUS RHIZOPHYLLUS, Link.—Philipsburgh, Que.

LYCOPODIUM SELAGO, L.—Cap-a-L'Aigle.

LYCOPODIUM LUCIDULUM, Michx.—Cap-a-L'Aigle.

LYCOPODIUM ANNOTINUM, L.—Cap-a-L'Aigle.

LYCOPODIUM CLAVATUM, L.—Cap-a-L'Aigle.

LYCOPODIUM CAROLINIANUM, L.—Cap-a-L'Aigle.

LYCOPODIUM COMPLANATUM, var. CHAMÆCYPARISSUS.—Cap-a-L'Aigle.

NOTE ON A SPECIMEN OF BELUGA CATODON, FROM THE LEDA CLAY, MONTREAL.

By SIR WILLIAM DAWSON, F.R.S., ETC.

This animal, the White Whale or Beluga, once very abundant and still not uncommon in the Lower St. Lawrence, is widely distributed throughout the northern seas. It occurs in Greenland, and the same or a similar species is found on the coasts and in the rivers of Aláska and Siberia. It is only a rare and occasional visitor on the coasts of northern Europe. It is one of the smaller of the toothed whales, and subsists on fish, especially cod, haddock, loche and flounders. Its creamy white colour distinguishes it very markedly from all our other cetaceans. Its favourite abode seems to be the tideways and estuaries of large rivers, which it sometimes ascends for great distances in search of food. A stuffed specimen now in the collection of this Society is said to have been taken in the St. Lawrence, near Montreal.

In the Pleistocene Period, and especially in that part of it marked by the deposit of the marine Leda clay, when all the lower lands of the St. Lawrence valley were submerged, the Beluga must have had a much wider range than at present, and was probably very abundant. Hence its remains have been more than once found in the Leda clay, sometimes as entire skeletons, in other cases as detached bones. Its first recorded occurrence was the discovery of the greater part of a skeleton by Thompson, the geologist of Vermont, in 1849, in a railway cutting near Lake Champlain, at an elevation of 60 feet above the lake, or about 150 feet above the sea. It occurred in clay, the equivalent of our Leda clay, the Champlain clay of Dana, associated with marine shells of northern types. It was regarded by Thompson as a new species, and named *Beluga Vermontana;* but a comparison with the Canadian specimens found later, and with recent bones in the Museum of McGill College, enabled the late Mr. Billings to refer it to the modern species usually known as *Beluga Catodon,* Lin., though the specific name, *albicans,* Müller, perhaps has priority. It is the *Delphinus albicans* of Fabricuus in his Fauna Grœnlandica (1780). The best specimens heretofore found in Canada are one discovered in Peel's Brickyard, Montreal, one found near Cornwall, and another discovered at Bathurst, N.B., and described by Gilpin and Honeyman. The two former specimens, of which the first is nearly perfect, are now in the museum of the Geological Survey in Ottawa, and were noticed by the late Mr. Billings in the Proceedings of this Society.

The present specimen was found in the brick-clay near Papineau Road, by the workmen of Messrs. Smith, brickmakers, when excavating the clay in the present winter. By the care of these gentlemen the bones were collected

[1] Thompson's Vermont, Appendix.

and were handed to Dr. McEachran, Dean of the Faculty of Veterinary Science, and by him presented to the Peter Redpath Museum, where they are now being mounted by Bailly for the collection of Pleistocene fossils, and may be compared with a fine recent specimen from Little Metis. The skeleton is nearly complete, and possibly some of the missing bones may be secured when the snow has disappeared. The locality is approximately about 100 feet above the River St. Lawrence, and the specimen occurred at the depth of 22 feet in the clay, associated with shells of *Leda (Yaldia) glacialis, Tellina (Macoma) Grœnlandica* and minute tests of Foraminifera. With the bones was also found a fragment of Coniferous wood, which is determined by Prof. Penhallow as that of the Black Spruce—*Picea Nigra.*

The Leda Clay was probably deposited at a depth of 50 to 80 fathoms, which corresponds approximately with one of the most marked shore lines on the Montreal Mountain at a height of about 470 feet above the sea, and with the old sea beach at Smith's Falls, Ont., which afforded some years ago the bones of a whale, described in the Proceedings of this Society in the Record of Science, Montreal, 1883. At the time, therefore. when this animal perished, and was imbedded in the Leda clay, the Montreal Mountain was a small rocky island in a wide inland sea, extending from the Laurentian Hills on the north to the high ground of the Eastern Townships on the south, communicating with the Atlantic, not only by the Gulf of St. Lawrence, but also by a strait between the hills of New England and the Adirondacks, and extending westward at least as far as the Thousand Islands. This arm of the sea was inhabited by a rich boreal fauna, consisting of species now found in the colder waters of the Gulf and River St. Lawrence, and in the Greenland Seas. Complete collections of these animals may be seen in our Museums, and have been catalogued in publications on the Pleistocene of Canada. There would thus be wide scope and probably abundant food on what is now the fertile plain of the Province of Quebec, for the Beluga and the Greenland seal, whose bones are found associated with it in the Leda clay.

Note by Prof. Penhallow on the Specimen of Wood referred to in paper on Beluga.

The specimen of wood found in association with the whale skeleton obtained from the Leda clay, Montreal, consisted of a small branch about three-fourths of an inch in diameter and five inches in length. It proved not to be impregnated by mineral matter, and readily yielded to the softening influence of water, increasing considerably in volume. Upon microscopical examination it was found that the structure was in an advanced stage of decay, and was penetrated in all directions by the mycelium of a fungus. The structure was so far broken down that nearly all the secondary growth of the cell walls had disappeared, and together with this, the markings upon which a distinction of the species must rest. The generic characters, however, were sufficiently preserved to satisfactorily ascertain that the wood is a Picea, and among existing species it approaches most nearly to P. Nigra, which it, in all probability, is.

Timber of Canada.

Paper Read Before the Society by Hon. J. K. Ward.

There are about 6,000 sawmills in the Dominion, employing during the season of, say, 150 days, not less than 15,000 men in and around the mills, sawing, piling, shipping, etc. In the woods during winter, getting out the logs and timber, and river driving, there are about the same number. Six thousand mills, averaging each 400,000 ft. per season, makes up the apparent output of all the mills. This quantity is sawed in a single day by some of the larger mills, while many of the smaller mills do not turn out 200,000 in the season. The difference in the apparent output of the mills—that is, 2,500 million—and that returned as cut on public lands is made up as taken off private lands and the Crown Lands of Nova Scotia, of which we have no returns.

The area under license in the different provinces is about 100,000 square miles, yielding annually (1893) about 2,500 million feet b. m. of sawed lumber, pine and spruce principally, and hewn timber divided as follows among the different provinces:

Ontario—7,140,000 logs, producing 728,000,000 feet b. m., principally pine; 40,000 pieces white and red pine, 42,000,000 feet b. m.; 133,000 pcs. boom timber, 2,000,000 feet b. m.; average size of pine and spruce logs, 90 feet; ordinary revenue, $939,000; ex bonus, $958,000; area under license, 21,500 miles; area unoccupied, 17,000 miles.

Quebec—Area under license, 48,000 miles, producing spruce and pine logs, 6,170,000, equalling 683,000,000 feet b. m.; producing pine, spruce and birch timber, 18,500,000 feet b. m.; railroad ties and other wood, 22,500 pieces, 12,000,000 feet b. m.; pulp cedar, etc., 10,000 cords; revenue, $892,000.

New Brunswick—Area under license, 6,000 miles, producing pine and spruce logs, 87,000,000 b. m.; hemlock logs, 7,000,000 b. m.; cedar, 14,000,000 b. m.; tamarac, 1,400,000 b. m.; 14,700 cubic feet pine and hardwood timber, 176,400 b. m.; 12,000 boom sticks, 240,000 b. m.; revenue and bonus, $102,000.

British Columbia—Area under lease, 1,200 miles, producing 80,000,000 b. m. fir and cedar; 10,000,000 cedar shingles. The timber produced in British Columbia being so much larger than is found in the east requires a very different equipment to handle it from what is used in this part of the country.

Manitoba and Territories—Area under license, 2,200 miles, producing pine and spruce logs, 24,000,000 feet b. m.; 10,000 railroad ties, 320,000 feet b. m.; 2,000,000 shingles; 5,000,000 laths; revenue, $70,000.

Large as the foregoing is, it only forms one-quarter of the sawn lumber received in Great Britain, and one-sixteenth of the timber, the great proportion being the product of the north of Europe and Southern States. While not an alarmist as to our supply of pine timber, I cannot but consider the wanton waste of it a sin, when so much good lumber has been and is being thrown away. A mistake is made by our mill men in not having more sawing capacity than the fast mills now in use possess, sawing, as they do, in 12 hours 40,000 or 50,000 feet with one circular saw. Too much haste is required to do this, when more money might be got out of the same logs, by employing two sets of saws, with the necessary trimming machinery, and doing the work with less speed. It does seem as if the lumbermen of the past, as well as many of the present day, entertained the idea that the supply of pine in Canada was inexhaustible and were anxious to get rid of it as quickly as possible.

With our vast amount of hardwood, which is fast coming into use, with the facilities of getting it to market, as well as the modern machinery for manipulating it, along with the great quantity of wood supply, said to be in British Columbia, all this, with the natural increase, if fire can be kept at bay, we can reasonably conclude that the end of our forest supply is a good way off. When that time comes, I hope a substitute will be found.

The carrying trade and commerce is largely indebted to the forest. There is more tonnage employed on the St. Lawrence and canals in conveying lumber and timber to market than on any other commodity. Quebec was once the greatest timber and ship building port in the world. Forty years ago as many as forty to fifty ships were built in a single year. Now there is not one. In years gone by as many as 600 sailing ships visited the port in the spring and fall, taking away 300,000,000 feet b. m. of timber and lumber: as much as 18,000,000 cubic feet of square timber were shipped in a season; last season about 3,000,000. Its once famous coves and wharves are deserted and falling to pieces, most of the pine deal business being done at Montreal that was formerly transacted at Quebec.

Mr. Ward emphasized the necessity of preserving the forests from fire, quoting at length from Hon. Peter White on the question. Continuing he said: "In selling lands to settlers, I would make it a condition of sale that 20 acres in every 100 should be given free and that it should be forever kept as woodland. The uninitiated, travelling through the woods after the shantymen have taken all they think worth taking, would hardly notice that the chopper had been there, except for seeing an occasional stump, a few chips, or a top of a tree, the great bulk of the timber remaining to hold back the water in its natural beds, and to prevent sudden rises and falls in the rivers, which oftentimes cause serious damage by overflowing the banks or becoming so low that they refuse to do the work they once performed with ease. To avoid these troubles and have our country remain well wooded for many years, it is but necessary to give the trees indigenous to it, leave to grow, and there will be no necessity to plant. I have no doubt but that much of the land that has been denuded of its timber would in a very few years be covered with a spontaneous growth of wood, and so prevent our country from becoming an arid waste, by utilizing only that portion of it which can be profitably worked.

To an inexperienced eye there may be hardly an evidence at first glance of the disappearance of the pine. The hardwoods with which the pine is interspersed are usually left standing to a considerable extent, and so are the smaller pine, so that even a well cut country will still look splendidly wooded. No doubt the time will come when it will be carefully re-cropped. But the commercial value is largely gone, and with it the natural desirability, for the cutting of the pine greatly lessens the value of the woods as vast reservoirs, holding the snows in spring and the rains of summer, so as to feed steadily the innumerable streams of the water sheds. Consequently, spring floods and summer droughts for the cleared lands in the valleys follow close on the lumberman's axe. A certain amount of attention has been aroused by the rapid retirement of the pine. Bad as the axe is, fire is worse. The Ontario Government has recently attempted to enforce strict precautions against fire, and it has also appropriated as a provincial park an enormous reserve near Lake Nipissing, thirteen hundred square miles, of which nine hundred are pine timber, situated on one of the chief natural watersheds of the province. But a great deal more than this is necessary if the Canadian pine forests are not soon to disappear like the tracts of Maine. We cannot urge too strongly on the government to set apart all lands not suitable for making a decent home for the settler. Much of the land that they are tempted to go on is not worth the trouble of clearing; it is only the presence of the lumberman, in many cases, that enables him to exist. The question of revenue is of importance, as well as other considerations in not destroying the forests and the country of its principal source of wealth.

The product of the forest is disposed of about as follows:

Exported sawn lumber and timber..........	$24,000,000
260 million feet b. m. sawlogs..............	208,000
Railroad ties, pulpwood, bark..............	27,000,000

The first timber shipped to Europe from Canada was sent from Quebec to Larochelle by Talon in 1667. Lieut. Hocquart shipped timber and boards to Rochefort in 1735. In 1823, 300 cargoes were shipped from Quebec.

In the early part of the present century, the Montmorency mills were established by a Mr. Usboirne. Mr. Peter Patterson, a ship carpenter by trade, who had spent some time in Russia, became an employee of Mr. Usboirne's, and finally proprietor of the property, and became one of the largest manufacturers of lumber in Canada. Sir John Caldwell established mills at Riviere-du-Loup en Bas and at Etchemin. The late William Price, father of the Hon. J. Price, of Quebec, established large mills at Chicoutimi, St. Alexis, L'Anse-St. Jean, St. Etienne, Batiscan, Matane and many other places, leaving an immense business to his sons, which is now conducted by the son before named. The late Allan Gilmour, and relations of the same name, carried on for many years a large business on the North Nation, the Gatineau and Mississippi (Canada), and at Trenton, Ont., the younger branches of the family continuing the business.

Philomene Wright, one of the first lumbermen on the Ottawa river, came from Woburn, Mass., in the United States, arriving at the Chaudiere Falls—or the Asticou, as called by the Indians—as early as the year 1796. It was not till 1797 that he finally decided to make his home in Canada, and on the 20th of October, 1799, he and two companions pitched upon the site of the future city of Hull. He finally quitted Woburn for Canada on the 2nd of February, 1800. He was accompanied by five families, and had in his train fourteen horses, eight oxen and seven sleighs. The first tree was felled on the site of the homestead on the 7th of March, of the same year. He brought the first square timber from the Ottawa to Quebec in the year 1807. He built the first slide on the Hull side of the river in 1829. He was elected the first member to represent the County of Ottawa in 1830. He died in 1839, and sleeps, an honored memory, in the little cemetery on the Aylmer road. Philomene Wright built his first saw and grist mills in 1808; they were, unfortunately, burned down, but were rebuilt in 60 days.

About eighteen years prior to this the first saw mill on the Ottawa had been built at Point Fortune, by a Mr. Story. It boasted one upright saw, and it is recorded that when the man in charge gigged back the carriage for a fresh cut, he would sit down on the log to take his dinner, and was about through by the time the cut was finished. With our present saws the same can be done in four seconds.

Among our successful lumbermen have been the late James McLaren, of Buckingham; Peter McLaren, of Perth; Bronson, Weston & Co., Perley & Patee, J. R. Booth, Alex. Fraser, of Westmeath; W. Mackey, and the late firm of Hamilton Bros., whose father was one of the first in the trade at Hawkesbury, Ont. Many others have taken an active part in the business, with more or less success.

West of the Rocky Mountains, Canada, contains vast quantities of valuable timber, the manufacture of which is rapidly increasing, to meet the wants of the Pacific coast and islands. Much of this lumber will find its way east to the treeless prairies.

As to the Canadian method of lumbering, when circumstances will permit, we pile or skid before the snow becomes too deep. When the snow is deep we draw direct from the stump to the lake or river. Our style of living in the shanty, and, in fact, the building itself differs in the various parts of the country. Until very recently, particularly in the Lower St. Lawrence, the fare of the shantyman was very primitive, the commonest tea being quite a luxury, and the only variety in the bill of fare was that it consisted of pea soup, bread, pork and beans for dinner, the same, with the addition of tea for supper, and either, less the pea soup, for breakfast. On the St. Maurice, for many years, the living has been good and substantial, with comfortable shanties provided with stove, tables, and bunks, the cooking being usually done in an outside compartment. The shantyman's condition, however, is improving with the times.

Our shantymen, whether English or French, as a rule, are as good axemen, and expert drivers and canoemen, as can be found in any country. Our people are well up in dam building, as well as in making slides and clearing away the rivers to facilitate driving. Our rivers, as a general thing, being very precipitous and rapid, require extensive improvements, especially for the running of square timber.

I can hardly let the occasion pass without a reference to two of our woods, the first because of its usefulness to the poor aborigine, whose heritage we possess; it served to cover his wigwam, and was the material for his canoe, to aid locomotion; the latter, the great wood of commerce.

The white birch, or boleau, has within a few years become of some value when found within easy reach, having been turned to account for the manufacture of spools and spool wood for thread makers, the white part of the wood only being used. It is made into squares, varying from one inch, in eighths, to say, two inches, and three or four feet long. Many shiploads have been shipped to England and Scotland the past few years, principally from the Lower St. Lawrence. The red, or heart, being worthless to the spoolmakers, is either used as firewood or left to rot. There are vast quantities of this wood in the interior, too far from navigation or rail to be of any value. It is mostly found on poor soil, mixed with balsam, small spruce and cedar. It makes good firewood when dry. The bark is useful to the Indian for the making of his canoe; the vessel for retaining the sap of the maple; his drinking cup and the cover of his wigwam. The yellow birch provides a cough remedy by boiling the sap down to a syrup; and, lastly, though not least, it furnishes the proverbial birch-rod, which, though almost obsolete, sometimes does good service, even in these days of advanced ideas. Vast quantities of the dwarf or black birch have been used as withes in rafting logs, some concerns using as many as thirty or forty thousand in a season, each of them representing a young tree; but little of this is done at present.

We now come to what every lumberman considers the king of the forest, in grandeur, usefulness and value, the white or cork pine, or *pinus strobus* of the scientists, the tree of all others that serves more purposes than we can enumerate. Among them the tiny match, the mast for the great ship, the frame of the sweet sounding piano, and wherever a soft, easy-working wood is wanted, either in the arts, the workshop, or the factory, there it is to be found. As an article of commerce, it far surpasses in value and quantity any other wood, if not all sorts put together. It supplies more freight for vessels coming into the St. Lawrence than any other commodity; it gives more employment to wage-earning men than any industry in our country, except agriculture. It employs more capital in manipulating it from the time the men leave for the woods in the fall, to make, haul and drive the logs and timber to the mills—the building of mills for sawing, the construction of barges and steamboats to convey it to market, as well as the large amount of freight furnished to railroads, the erection of factories to convert it to the various uses to which it is put. It is safe to say, that the value of the output of pine lumber alone, produced in Canada, is at least $25,000,000, or two and a half times as much as that of any other manufacturing industry; and, when we consider that 60 per cent. is paid for labor, and that nearly all to men, representing a large population, it is readily seen how important it is, either by legislation or otherwise, to protect and conserve the source of this great factor in our prosperity. How can we extol sufficiently this monarch of the forest that we are so much indebted to? The tree when growing in the open country is of little or no value, except as a shade tree, its lateral branches reaching almost to the ground. It is in the dense forest we have to look for the great tree of commerce, where nature acts the pruner. There the branches decay and drop off, the trunk shoots upward high above its neighbors, seeking that which it was deprived of below—light and air. By this action of nature we get our clear pine, so much prized by mechanics. As the branches drop off, the wood grows over them, and we get the stately tree carrying its size well up, and often attaining 60 or 70 feet to the branches. I once saw a tree that measured 40 inches in diameter 70 feet from the ground, without a knot or defect visible in this space. Naturally, however, it is very rare to get a log or the best of timber without finding knots or defects as you get near the heart, the remains of the dead branches that fell off during the tree's youth. My experience teaches me that white pine is of slow growth. The smallest trees that ought to be taken for saw logs or timber should be at least fourteen inches at the butt. This would take not less than fifty years to produce, and such a tree as I have before described as much as one hundred and fifty; more than three inches in twenty years. Large groves of pine are usually found on poor light soil, I think, consequently, that the bulk of the pine found under such circumstances is apt to be punky or defective for the want—so to speak—of nourishment. The best pine is usually found on stronger soil mixed with hardwood. It is unpleasant to contemplate the want of this valuable timber. Once gone it is gone forever, and cannot be reproduced in our or our children's time, as unlike mineral or the other products of the soil, the quantity produced from these are limited by the amount of labor employed in producing them. Perhaps, however, time will find a substitute in some artificial wood, or employ metal to take its place.

Hardwoods, to which I will briefly refer, that were once almost discarded, except for burning, are coming largely into use in consequence of the improved wood-working machinery that has been devised of late years, making the work of preparing and completing joiner work much more simple and easy than it was to do the same thing in pine when I served my time over 50 years ago, and when flooring, mortising, tenoning, sticking mouldings out of dry spruce with hard knots, was done by hand. The facilities also for reaching hardwoods and getting them to market will help to make up for the loss of this favorite material, which, I hope, is yet a long way off. I might say before closing this part of my subject that the magnificent cedar of British Columbia will, no doubt, largely take the place of white pine for joiner-work. The Douglas fir will be a valuable substitute for our coarser woods, when they become scarce and high in price. A lumberman's life is not passed on a bed of roses, yet there is a charm about it to those who have the stamina to endure its hardships, and enjoy its excitements, that is not easily forgotten. Who, that has followed it, can forget the log drive from early morn to sun-down, kedging across the lake to the tune of the chanteur, or breaking the jam in the roaring cascade, whose noise is drowned by the yells and shouts of the crew on seeing the great mass move off, each great log as it were, trying to get ahead of its neighbor, until they reach still water. What excitement after the risk run and efforts made! Old lumbermen can and do look back to such scenes with much pride. What other business has so many contingencies connected with it, apart from the ordinary mishaps in trade ?—sometimes too much snow, other times too little. On other occasions the ice or the floods carry away his booms and scatter the logs, to be often stolen by land pirates, who will secrete his property, and annoy him in trying to find it.

As to the utility of the forest, though it may not attract the rain or influence its downfall, there can be no doubt as to its regulating the flowing of the waters by holding them back in the glades and swamps, sheltering the land from the fierce rays of the sun, preventing rapid evaporation to a great extent, and thus preventing oftentimes damaging floods and dried up streams. For the reasons advanced, does it not behoove us to use our influence to bring about such legislation as will have the effect of preserving and protecting our forests, on which so much depends ?

ADDITIONAL NOTES ON RECENT CANADIAN UNIONIDÆ.

By J. F. WHITEAVES.

UNIO CANADENSIS, Lea.

In a letter to the writer, dated June 18th, 1895, Mr. Simpson says, " I think there can be little doubt, from examining the type of *U. Canadensis*, that it is a somewhat injured specimen of the male of *U. ventricosus*, Barnes.

Mr. Bryant Walker, of Detroit, informs the writer that he has, in his cabinet, specimens of each of the following species, from the Detroit River :

MARGARITANA HILDRETHIANA, Lea.

Main channel of the Detroit River off Belle Isle, collected by the Michigan Fish Commission in 1895.

UNIO LEIBII, Lea.

Detroit River, at the upper end of Fighting Island, collected by Mr. Walker in 1873 or 1874, and identified by the late Dr. James Lewis.

UNIO MULTIRADIATUS, Lea.

Same locality, collector and date as for the preceding species; also, Thames River, Ontario, from the collection of the late Dr. George A. Lathrop.

UNIO SULCATUS, Lea. (= *U. perplexus*, var. *perobliquus*, Conrad. **Types from Detroit River, and Wabash R., Indiana.**)

Collected by Mr. Walker in the Detroit River at the upper end of Fighting Island, in 1873 or 1874; at the upper end of Belle Isle in 1894; and in the same river, at the locality first mentioned, by the Michigan Fish Commission, in 1895.

UNIO VERRUCOSUS, Barnes.

Main channel of the Detroit River off Belle Isle, collected by the Michigan Fish Commission in 1895, and Detroit River opposite Grassy Island, collected by Mr. Walker in 1895.

Mr. Walker also states that he has, in his collection, twenty-six species of Unionidæ from the Detroit River and Lake St. Clair, viz., *Anodonta Benedictii*, *A. Footiana*, *A. fragilis* and *A. subcylindracea*; *Margaritana deltoidea*, *M. Hildrethiana*, *M. marginata*, and *M. rugosa*; *Unio alatus*, *U. circulus*, *U. coccin us*, *U. ellipsis*, *U. gibbosus*, *U. gracilis*, *U. Leibii*, *U. luteolus* *U. multiradiatus*, *U. nasutus*, *U. Novi-Eboraci*, *U. phaseolus*, *U. pressus*, *U. Rangianus*, *U. rectus*, *U. triangularis*, *U. ventricosus* and *U. verrucosus*.

OTTAWA, July 9th, 1895.

OBITUARY.

Gaston, Marquis de Saporta.

The Marquis de Saporta was born July 28th, 1823, and died, at the age of 72 years, on January 26th of the present year, at his residence in Aix-en-Provence.

Since the appearance of his first paper on the Fossil Plants of Provence, in 1860, he has been a prominent palæobotanist, and yields to few cultivators of that science in the number, variety and importance of his memoirs and larger works. His largest and most important work is that on the Mesozoic Flora of France, to which he added only last year a valuable report on the Mesozoic Plants of Portugal. A summary of this last work, in connection more particularly with its bearing on the palæobotany of North America, from the pen of Prof. Lester F. Ward, a fellow laborer in the United States, has lately appeared in *Science,* and perhaps with the exception of those of his great rival, Heer of Zurich, who passed away before him, no European works on the botany of the Mesozoic Period are more frequently referred to than those of Saporta.

Though a specialist on the floras of the later geological periods, he could enter with enthusiasm into the whole history of the vegetable kingdom, in a manner at once elaborate, careful and attractive to general readers, and with an enlightened grasp of the succession of plants in time, and of their relations to the various changes of climate and geography in the different periods. This is remarkable in his popular work, "Le Monde des Plantes," which goes over the whole field of geological botany, is written in a clear and vivid style, and illustrated with geological maps and very clever restorations of the forests of different periods.

His memoirs also cover a wide geographical range, as specimens from many regions were submitted to him, and he was always ready, in the kindest and most genial spirit, to give the benefit of his advice and information to his fellow laborers in every part of the world. His work was characterized by much discrimination and care, and by a judicious attention to the geological horizons; but, like many other palæobotanists, he was occasionally carried away by his enthusiasm so as to recognize as plants mere imitative markings. This was especially the case in the controversies in which he took part respecting the nature of certain markings on rocks whose algal nature had been maintained by Delgado and others, while to Northorst and to palæontologists generally who were familiar with the tracks of animals and the imitative tracings on the surfaces of aqueous deposits, they were of animal or of inorganic origin.

In conjunction with Professor Marion, Saporta published a work on the Evolution of Plants, which forms three volumes of the French International Library of Science. It abounds with curious information of a very suggestive character, but was perhaps too ambitious in the present state of knowledge. This the authors frankly admit, stating in conclusion that they can but point out some landmarks to their successors, "who may decipher the inscriptions of which we can but spell out some letters."

But though an evolutionist, Saporta was by no means an agnostic. He saw in the grand succession of vegetable forms a great and profound design, related to the inorganic world and its mutations on the one hand and to the animal kingdom on the other. He sums up this conclusion in his "Monde de Plantes" in the following words, which may serve as an example of his style and of his habit of thought in the wider problems of his science:—

"Mais, si l'on remonte de phénomène en phénomène plus haut que les apparences mobiles et contingentes, il semble que l'on aboutisse forcément à quelque chose d'entier, d'immuable et de supérieur, qui serait l'expression première et la raison e'être absolu de toute existence, en qui se résumerait la diversité dans l'unité, eternel probleme que le science ne saurait resoudre, mais qui se pose de lui-même devant la conscience humaine. La serait la vraie source de l'idéal religieux ; de cette pensée se dégagerait d'une façon lumineuse, cette conception de notre âme à laquelle nous appliquons instinctivement le nom de Dieu.

Saporta was correspondent de l'Institut de France, a Foreign Member of the Geological society of London, an Associate Fellow of the American Academy of Sciences, and an Honorary or Corresponding Member of many other societies on both sides of the Atlantic.

J. W. DAWSON

ANNUAL PRESIDENTIAL ADDRESS.
NATURAL HISTORY SOCIETY OF MONTREAL.

By PROF. WESLEY MILLS, M.A., M.D., ETC.

When, owing to your kindness and continued confidence, you placed me in office for a second term, with all the duties and responsibilities which are associated with this honorable position, I trust you did not expect another presidential address from me on resigning as I now do in favor of some other member who may be thought worthy to occupy this place of greatest responsibility, if not of highest honor in the Society. It is not my intention to do more than make a few remarks on this occasion, and after merely referring to the salient features of the Society's work this year, I shall confine what I have to say pretty much to one thought: The spirit of the naturalist.

You will gather from the various reports presented this evening the state of our affairs, and the lines along which progress, obvious to everyone, has been made, such as the improvement in the large hall, the additions to the library, and the desirable advance made in binding and arranging many valuable publications.

We have, like other societies and individuals, suffered from the financial depression so prevalent, but I cannot allow the occasion to pass without referring to the successful efforts of one of our members, Mr. J. S. Shearer, to collect money from friends to support the RECORD OF SCIENCE, which continues to be the vehicle of much valuable original publication, and in this way still maintains, at home and abroad, the reputation which it long ago acquired, of being a reliable and valuable source of reference for Canadian Science.

It will require strenuous exertion to preserve the reputation it has acquired; but if the Society can do this it will accomplish much.

The course of Somerville lectures, based on the Resources of Canada, as viewed by the Naturalist, was in able hands, and we are deeply indebted to all those who took part, and particularly to those specialists who came from a distance and gave their services gratuitously.

If it were possible for the Society to publish these lectures from year to year in a collective form, both the public and the Society itself would be the gainers.

The regular meetings of the Society have been better attended, perhaps, than in any previous year.

The affiliation brought about between various societies with kindred aims last year and in operation this year, has so far worked well, though there is room for a more vital cennection than as yet seems to exist.

Turning from these details allow me a few moments to develop a thought which does not concern our Association alone, but human beings everywhere.

What is the spirit of the naturalist? Wherein does he differ from other men? Do these differences elevate him or the reverse?

Between all scientists there is a close bond. All seek the truth for truth's sake. To all this is the one—the only finality. Everything else is subordinate at the best.

But the naturalist, in the sense that has attached to the word for centuries, is more closely allied to the poet and the artist than is commonly supposed. A poet or an artist who finds no delight in nature is not genuine—he does not deserve the name.

Those poets who have most readily found access to the hearts of men in all ages have been naturalists—not, it may be, technically, but really. Those who have delighted in mountain, wood, river, sky, insect, bird, the workings of the wondrous soul of man—these are the real naturalists. Now, may a man not work on all these in a dry and formal way, getting results of a certain value, but without the spirit of the naturalist? And may not a man of limited opportunities observe with the acuteness of ken and the glow of feeling that is the very soul of the soul of the poet or the painter?

Landseer portrayed animals well because with the technical skill and the talent for form and color he united the sympathetic love of his fellows lower in the scale of being.

The naturalist is a man of truth through and through. He is equally a being of simplicity of nature. Questions of rank and precedence and power among his fellows trouble him not. The "boss" is as far from the naturalist in spirit as can well be conceived. Men of the latter type cannot be made into naturalists by the bestowment of ordinary or honorary memberships in societies, or by any offices they may attempt to fill. It is not given to them to see the beauties in nature that fascinate or to feel the pulses that thrill. He who would be a naturalist in spirit must, like he who would enter into the Kingdom of Heaven, become as a little child.

Indeed, between the qualities of the true Christian, the real gentleman in heart and the naturalist there is much in common as well as with the poet and the artist. But I must not dwell further on these thoughts.

Last year I expressed my belief that our greatest need was the addition to our ranks of young and enthusiastic workers. That and a more abounding spirit of the kind I have been referring to seem to me still our greatest needs.

Why do not more candidates of this type come knocking at our doors? Why do not our schools and colleges produce such people? Is our education the great success many would have us believe? If education generates little or none of this spirit but simply produces a type of men and women better able to succeed in the commercial and social race—that and nothing more—is it a success? I leave these questions with you to answer. My own reply you will readily divine.

During the past two years I have not found my office a sinecure, but your kind co-operation, with our valued Superintendent's knowledge, energy, tact and courtesy, have made the duties that have fallen to me as light as possible. Mr. Griffin has on all occasions assisted me in the most efficient, cheerful and courteous way. To him and to all who have smoothed my path I am grateful.

Field Day to Philipsburg.

The annual field day of the Natural History Society is looked upon as being the picnic of the year and, with fine weather, it was little wonder that some 300 or so of Montreal's representative people boarded the cars at Windsor station *en route* for Philipsburg. Among those noticed were the following: Mr. and Mrs. S. Finley and family, Mr. and Mrs. Walter Drake, Mr. and Mrs. R. A. E. Greenshields, Mr. and Mrs. John S. Shuter, Mr. and Mrs. J. H. R. Molson, Mr. and Mrs. S. H. Ewing, Mr. and

Mrs. Albert and Miss Holden, the Misses Radford, Master and Miss Holden, J. Donald Morrison, Mr. Matthew Hutchison and party, J. F. Whiteaves, F.R.G.S., Ottawa; Mr. Malcolm Morison, Mr. C. F. Williams, Mr. and Mrs. F. W. Richards, Mr. and Mrs. David Robertson, Dr. Davidson, A. F. C. Ross, Mrs. P. S. Ross, Mr. S. Campbell, Mr. and Mrs. Jos. Fortier, Mr. Robert Law, Miss Law, Miss Ella Law, Mr. E. T. Chambers, Mr. and Mrs. George Boulter, Rev. Dr. Warden, Mrs. Warden, Miss Ida Sumner, Miss Grace Sumner, Master Arthur Sumner, Mr. A. E. Holden, Miss Hill, Mr. Percy Molson, Miss Mabel Molson, the Misses Harrington, Dr. Ker, Mr. and Mrs. John S. Shearer, Miss Marion Shearer, Miss Murray, Rev. Dr. and Mrs. Campbell, Mr. and Mrs. James Slessor, Dr. Stirling, Dr. Deeks, Dr. A. A. Robertson, Mr. W. F. Egg, and Master George Egg, Mr. and Mrs. Vennor, Dr. and Mrs. Lovejoy, Mrs. Edgar Judge, Mr. Geo. Sumner and family, Mr. S. W. Ewing, Mr. and Mrs. F. H. Hart, Mr. J. Stevenson Brown, Miss Louise Brown, Miss Emily Brown, Master F. C. Brown, Mrs. Saxe, Mr. Percy C. Ryan, Mrs. J. C. McArthur, Mrs. Pennington, Mr. and Mrs. R. Harvey, Mrs. J. B. Goode, Mr. and Mrs. S. C. Stevenson, Dr. Baker Edwards, Miss Edwards, Mr. Brissette, Mrs. C. S. J. Phillips, Mr. C. E. H. Phillips, Miss Phillips, Master Allan Phillips, Mr. and Mrs. Albert Ross, Mr. William Reid, Howard T. Barnes, Lachlan Gibb, Master Charles Waterous, Mrs. John Scott, and daughters, Prof. J. B. Williams, Miss Dora Warrington, Miss Lilian Gault, Mr. Arnold Finley, Mr. Wait, Miss Lovejoy, Dr. Burgess, Mr. H. H. Lyman, Dr. Stirling, Miss Ida Boulter, Master George Ewing, Mr. and Mrs. Farquhar Robertson, Mrs. John Gibb, the Misses Hodge, Mrs. Pennington, Mr. W. A. Oswald. The officials of the Philipsburg Junction Railway present were: Messrs. Wells, Manager, and Henry Timmis, Secretary. A large contingent from the Montreal Camera Club and the Montreal Agassiz Society were also present.

After a most enjoyable train ride through the prettiest part of the eastern townships the destination of the party, Philipsburg, was reached about 11.30.

Here the party were met by Major E. L. Bond, who has his handsome summer residence on the shores of the bay.

In a brief but explicit and interesting address Major Bond welcomed the visitors, this pleasant duty devolving upon him in the absence of the Mayor, by virtue of his position as President of the Philipsburg Junction Railway Co. The principal spots of historic interest were described, including the old Methodist Church, the first built in the Eastern Townships, and directions were given to the various sections of the Society as to the most suitable places for the pursuit of the particular hobbies. After the various competition conditions had been announced by the Rev. Dr. Campbell, the party dispersed, to amuse themselves, each in their own particular way.

The botanical section went off in charge of Mr. H. B. Cushing, while Dr. Deeks took charge of the geologists.

All too soon came the end of the day's pleasure and scientific research, and the hoarse whistle of the locomotive was heard summoning the wanderers back to the train. Assembled here, a most interesting address was given by Mr. J. F. Whiteaves, a member of the Royal Geological Society, descriptive of the formation, strata, etc., of Philipsburg and the adjacent country. At the conclusion of this, three cheers for Major Bond were called for and heartily rendered, after which the train was boarded for the return journey.

The collections made during the day were adjudicated upon by the following judges :—

Geological section—Mr. J. F. Whiteaves, F.R.G.S., and Dr. Deeks.

Botanical section—Dr. Burgess, of Verdun, and Mr. H. B. Cushing, of McGill.

Entomological section—Mr. H. H. Lyman.

The results were announced as follows :—

Botanical section—First prize, Mr. John Saxe, with 76 named varieties. In the unnamed class, Miss M. E. Baylis was awarded first prize for a collection of 94 specimens, while Miss F. E. Cushing with 73 specimens received honorable mention.

Geological section—In this section Miss Ethel Radford, B.A., was awarded the prize, with a collection of some 40 specimens.

Entomological section—In this section there were no collections, consequently no prize was awarded, speaking well for the comparative immunity of Philipsburg from beetles and "other creeping things."

Mr. H. B. Cushing has furnished a memorandum of the plants collected during the day, and Dr. Deeks has kindly subjoined a list of the fossils for which the prize was awarded.

LIST OF PLANTS COLLECTED AT PHILIPSBURG, QUE.

June 1st, 1895.

Anemone Virginiana, L. ; Hepatica acutiloba, DC. (past flowering) ; Ranunculus abortivus, L. ; Ranunculus recurvatus, Poir ; Caltha palustris, L. ; Aquilegia Canadensis, L. ; Actæa alba, Bigel ; Chelidonium majus, L. ; Dicentra Canadensis, DC. (past flowering) ; Capsella bursa-pastoris, Mœnch. ; Viola palmata, L. var. cucullata, Gray ; Viola blanda, Willd ; Viola Canadensis, L. ; Stellaria media, Smith ; Malva rotundifolia, L. ; Tilia Americana, L. ; Geranium Robertianum, L. ; Oxalis corniculata, L. var. stricta, Sav. ; Vitis cordifolia, Michx ; Acer spicatum, Lam. ; Acer saccharinum, Wang (in fruit) ; Trifolium pratense, L. ; Trifolium hybridum, L. ; Medicago lupulina, L. ; Robinia Pseudacacia, L. ; Rubus strigosus, Mix. ; Fragaria vesca, L. ; Rosa Blanda, Ait. ; Rosa rubiginosa, L. (not in flower); Tiarella cordifolia, L.: Mitella diphylla, L.; Ribes Cynosbati, L. (in fruit); Osmorrhiza brevistylis, DC.; Osmorrhiza longistylis, DC.; Viburnum Lentago, L.; Antennaria plantaginifolia, Hook.; Chrysanthemum leucanthemum, L.; Taraxacum officinale, Weber; Hydrophyllum Virginicum, L.; Cynoglossum officinale, L.; Lithospermum officinale, L.; Veronica serpyllifolia, L.; Nepeta Glechoma, Benth.; Rumex acetosella, L.; Asarum Canadense, L.; Thuya occidentalis, L.; Orchis spectabilis, L.; Iris versicolor, L.; Sisyrinchium angustifolium, Mill; Maianthemum Canadense, Desf.; Trillium grandiflorum, Salisb, (past flowering); Arisaema triphyllum, Torr.; Eleocharis tenuis, Schultes; Carex intumescens, Rudge; Carex hystricina, Muhl.; Carex arctata, Boott; Carex gracillima, Schwein; Carex .pallescens, L.; Carex Hitchcockiana, Dewey; Carex laxiflora, Lam.; Carex aurea, Nutt.; Carex varia, Muhl; Carex stipata, Muhl; Carex rosea, Schkuhr; Carex cephalophora, Muhl; Carex Deweyana, Schwein; Poa annua, L.; Poa pratensis, L.; Equisetum arvense, L.; Equisetum sylvaticum, L.; Polypodium vulgare, L.; Adiantum pedatum, L.; Camptosorus rhizophyllus, Link; Aspidium marginale, Swartz; Cystopteris bulbifera, Bernh; Onoclea sensibilis, L.; Onoclea struthiopteris, Hoffmann; Osmunda regalis; Osmunda cinnamomea; Botrychium Virginianum, Swartz.

Fossils.

The species collected belonged to the following genera: Bathyurus, Bathymellus, Illaenus, all fragmentary; Orthoceras, Cystoceras, Lituites Pleurotomaria, Murchisonia, Maclurea, Ecculiomphalus, Ophileta, Orthis, Strophomena and Camerella.

Report of Chairman of Council of the Natural History Society of Montreal, for the Year ending 27th May, 1895.

To the President and Officers of the Society:

The meeting this evening makes the seventh regular monthly meeting of the Society for the present session, at all of which very interesting papers have been contributed.

The Council has held nine ordinary and two special meetings, all of which have been well attended.

The Annual Field Day was held at Labelle last year, and although the weather was none too promising, the attendance was larger than usual and the result satisfactory to all concerned.

The Somerville Course of Lectures for the past winter were upon "The Resources of Canada, as viewed by a Naturalist," and proved of such great interest to those able to attend, that a wish has been expressed that the lectures should be published in pamphlet form; a most desirable thing to do if we only had the funds at our disposal. We hope the idea will not be lost sight of.

The conversazione which was in contemplation for last winter had to be postponed.

The Government Grant which the Society formerly received and spent in the publication of the Record of Science, has not been forthcoming again this year,—nevertheless, the Record of Science is still being issued; the Society's being able to continue this work is entirely due to the efforts of Mr. John S. Shearer, who collected the needed funds from the friends of the Society.

A number of repairs and improvements have been made to the building and museum, including the renovating and re-seating of the large lecture hall. This the Society could not have done but for the efforts of Mr. John S. Shearer, who collected the required amount.

The attendance of visitors at the museum shows, on

Saturdays 2,600, on evenings of Somerville course, 350, and ordinary, 209, the Saturday attendance being double that of previous years, but the ordinary visitors were only half of other years, due largely to restricted American travel.

Our President, Dr. Wesley Mills, has given much time and labour to the work of the Society, and through his efforts papers have never been wanting at the Society's meetings.

The whole respectfully submitted,

GEO. SUMNER,
Chairman of Council.

Montreal, May 21st, 1895.

NATURAL HISTORY SOCIETY OF MONTREAL.

REPORT OF THE HON. CURATOR.

Gentlemen,—During the past season a number of valuable donations have been made to the Society, duly reported at the monthly meetings and acknowledged.

Considerable work has been done at the Museum by Mr. Winn, Mr. Williams and Mr. Dunlop, and the Superintendent, Mr. Griffin, has overhauled all the mammals, clearing them of moths, but I would suggest that they be re-arranged to show off to better advantage.

The monkeys and marsupials have been cleaned and renamed and placed in a case on the landing. The British birds have been properly named and placed in two cases on the landing. All the birds have been carefully inspected, properly arranged and a large number renamed on fresh labels. The reptiles have been sorted out, cleaned and named on fresh labels, and placed in two cases on the lower flat. This work was creditably done by Mr. Williams.

The Birds' Eggs have been overhauled, and the collection was found to be in a dilapidated condition, but Mr. Dunlop has endeavoured to clean them, and for the present placed them in a cabinet in the Curator's room. I hope to have shortly a very large and valuable collection of Birds' Eggs donated to the Society.

The Insect Cabinet is being attended to by Mr. Winn, and good progress has been made in arranging the collection of Insects.

Among the Birds, a number of specimens are badly attacked by moths, requiring immediate attention, and making it necessary to have a bath made, with proper chemicals, to rid them of moths. Otherwise the whole collection of mammals and birds in the Museum will gradually be destroyed. I have given a description of the bath and chemicals required to the superintendent, and they can be procured at a cost of about fifteen dollars.

No meetings of the Museum Committee have been called, but I think it would be well to have such in the future.

The number of visitors to the Museum on "free days" has more than doubled that of last year, showing a gratifying and more lively interest taken in the Museum by the public.

I regret that I could not give more time to the Museum, although I have kept a general supervision over the work done the past year; but there is a great deal of work yet to be done in the preservation of the valuable specimens in the Museum, and I would suggest that a proper Museum catalogue should be made and printed for the use of the Society, and to be sold to the public. I would also suggest that somebody should be appointed Curator who could give the greater part of his time in the interest of the Museum.

Respectfully submitted,

ERNEST D. WINTLE,

Montreal, May 27, 1895. *Hon. Curator.*

Natural History Society of Montreal,

in account with

F. W. Richards, *Hon. Treas.*

Dr.

To 145 Ordinary Members, Sub.........	$580 00		
" 5 Associate " "	5 00		
		$585 00	
" Rents..		985 50	
" Collected by Mr. Shearer for R. & S..........		300 00	
" Field Day Receipts..............	$454 50		
" " " Disbursements..........	356 15		
" " " Surplus.................		97 35	
" Tenants' proportion of Renovations...........		72 62	
" Entrance Fees to Museum..................		12 95	
" Interest Merchants' Bank.....................		6 87	
" Cash for 6 old Benches........................		6 00	
" Donation J. R. Dougall.......................		3 00	
" One sub. to Record of Science..............		3 00	
			$2,072 29

Cr.

By Superintendent's Salary.............	$456 00		
" " Commission........	48 50		
		$504 50	
" Record of Science........................		375 84	
" Repairs, Reseating and Renovations..........		333 64	
" Light..		191 90	
" Fuel...		128 32	
" Taxes..		33 95	
" Sundry Expenses............................		180 07	
" Lectures.......................................		58 70	
" Museum.......................................		87 80	
" Cash in hand................................		177 57	
			$2,072 29

F. W. Richards,
Treasurer.

Audited and found correct,

A. Holden
John S. Shearer. } *Auditors.*

May 21st, 1895.

Report of the Library Committee.

The Library Committee have little to report at the present meeting. Much time has been taken up in collecting together the parts of the various volumes of exchanges which have for some time been accumulating in the library. These have been arranged and put into the hands of the binder to the number of 248 volumes, the Council having voted $150 for binding. These books, it is expected, will be placed on the Library shelves before the next meeting of the Society. Many valuable works which were lying about in the closets under the library cases will be found among them, as also useful works in the French and German languages. Your Committee have also obtained in exchange for duplicates, by permission of the Council, twelve volumes of *Popular Science Monthly*, of recent date. The exchanges for the Record of Science have been duly acknowledged and recorded.

The donations to the Library received during the year are as follows:—

Donors.	
Sir J. W. Dawson:	"The Canadian Ice Age,"
	"Life of Peter Redpath,"
	"Notes on Genus Naiadites."
Dr. G. Dawson:	"Presidential Address to the Royal Society of Canada."
McMillan & Co., N.Y.	"Ampleoxus and the Ancestry of the Vertebrates."
	"From the Greeks to Darwin."
E. D. Wintle:	"Birdnesting."

Respectfully submitted,

E. T. Chambers,
Hon. Librarian.

Report of the Natural History Society of Montreal, for 1895, to the Royal Society of Canada.

The Natural History Society of Montreal has, this year again, availed itself of the privilege of sending a delegate to represent it at the annual meeting of the Royal Society of Canada.

The work of the Society has been carried on during the present year in an efficient manner, and it is a cause of satisfaction to be able to state that there has been an increased attendance at the monthly and other meetings of the Society, showing that the members appreciate the importance of its work.

The Museum is now being thoroughly overhauled and all the specimens are being renamed. During the present year a larger number than usual of donations from friends of the Society have been made, including one from the Council of Arts, through the Secretary, Mr. S. C. Stevenson, showing that the public as well as the members have an interest in the work of the Society. It is also pleasing to note that the attendance, during the present year, of outsiders at the Museum on Saturdays, on which days the Museum is free to the public, has been nearly double that of previous years.

The Society is fully impressed with the desirability of continuing the publication of the Canadian Record of Science, and has made arrangements to do so. It has appropriated from its funds an annual sum of $200, and it hopes in the future, as it has done this year, to replace the annual grant of $400, which the Government has discontinued, by the subscriptions of the generous patrons of science to be found in Montreal. It may be mentioned that the circulation of the Record has increased, and that in view of this fact and of the value of the work, the Society is firmly determined, even at the cost of a heavy inroad on its finances, to continue its quarterly publication.

The project of the affiliation with it of other kindred associations is still engaging the attention of the Society. Besides the increase to its membership from the members of the affiliated societies who have become associate members, there has also been an increase this year on the roll of ordinary members.

The Annual Field Day last year took place on the 2nd June, and was largely attended. The excursion was on the Montreal and Western Railway to the village of Sault aux Iroquois, now called Labelle in honor of the great colonizing priest of that name, where the excursionists were most cordially received, and while the excursion afforded both enjoyment and an opportunity for research to the members and their friends, it also realized a profit which was an acceptable addition to the funds of the Society. This year, the excursion on the annual field day will be to Phillipsburg, on Missisquoi Bay.

The following papers were read and discussed at the Monthly Meetings of the Society :—

Oct. 29th.—"Bivalve Shells in the Coal Formation, and what they teach," by Sir Wm. Dawson, LL.D., F.R.S. ; "The Effects of Great Pressure on Rock Structure," by Prof. F. D. Adams, M.A., Sc., Ph.D.

Nov. 26th.—"The Mechanism of the Horse's Foot and its management, from a Humane Standpoint," by Prof. D. McEachran, F.R.C.V.S., Eng. ; "The Psychic Development of Young Animals, and its Physical Correlation," by Prof. Wesley Mills, M.A., M.D.

Jan. 28th.—"Meteorites and what they Signify," by Prof. B. J. Harrington, B.A., Ph.D. ; "Unusual occurrence ofthe Razor-Billed Auk at Montreal, Remarkable Flight of Certain Birds from the Atlantic Coast up the St. Lawrence to the Great Lakes," by E. D. Wintle, Esq.

Feb. 25.—"Dimorphism and Polymorphism in Butterflies," by H. H. Lyman, M.A. ; "Additional Remarks on the Flora of the Island of Montreal," by Rev. R. Campbell, D.D.

March 25th.—"Ancient Engineering," by Prof. J. T. Nicholson, B.Sc.

April 29th.—"Canada's Timber Resources and Lumber Industry, with some Reminiscences of those Connected with the Trade," by the Hon. J. K, Ward.

On the last mentioned date, Mr. J. B. Williams was to have read a paper on "Birds: What are they? Where are they? and whence are they?" but time did not allow it to be done; he will, however, favor the Society by reading it at the next Monthly Meeting.

The course of the Somerville lectures this year was on "The Resources of Canada, as viewed by a Naturalist." The lectures were delivered on the Thursdays from the 7th February to the 21st March, inclusively; they were free to the public and were well attended. The Museum was open to the public for one hour previously to each lecture.

The lectures were as follows:

1.—"The General Geographical Relations of Canada," by Sir J. W. Dawson, LL.D., F.R.S.

2.—"The Useful Minerals of Canada," by Captain R. C. Adams.

3.—"Some of the Agricultural Products of Canada," by Prof. Wm. Saunders, Director of Dominion Experimental Farms.

4.—"Wheat, and Canada's Relation to the Wheat Supply of the World," by Edgar Judge, Esq.

5.—"The Remedy for the Scarcity of Wood in the Old Settlements, and the Care of Growing Trees," by the Hon. H. G. Joly de Lotbinière.

6.—"Our Native Mammals of Economic Value," by Dr. Robert Bell, of the Geological Survey.

7.—"Canada's Fish and Fisheries," by Prof. E. E. Prince, of the Department of Fisheries, etc.

The gentlemen whose names now follow are the present officers and members of the Council of the Society :—

Patron : His Excellency Lord Aberdeen.

Honorary President : Sir J. William Dawson, C.H.G., LL.D., F.R.S., F.R.S.C.

President : Dr. T. Wesley Mills.

First Vice-President : John S. Shearer.

Vice-Presidents : Hon. Edward Murphy, J. H. R. Molson, Sir Donald A. Smith, Dr. B. J. Harrington, Rev. Dr. R. Campbell, George Sumner, Edgar Judge, J. H. Joseph, Mr. Justice Wurtele.

Recording Secretary : R. W. McLachlan.

Corresponding Secretary : Dr. J. W. Stirling.

Treasurer : F. W. Richards.

Curator : E. D. Wintle.

Members of Council : Frank D. Adams, Albert Holden, L. A. H. Latour, N. N. Evans, James Gardner, Joseph Fortier, Hon. J. K. Ward, A. F. Winn, J. Stevenson Brown.

Chairman of Council : George Sumner.

Superintendent : Alfred Griffin.

Before concluding, the Society offers its thanks to the Royal Society for the volumes containing its proceedings and papers.

(Signed) J. WURTELE, D.C.L.,

Delegate.

Montreal, 13th May, 1895.

REPORT OF EDITING AND EXCHANGE COMMITTEE.

The four issues of the "Record of Science" for the year were got out in good time, and were of a fair average as to the quality of their contents. The "Record" continues to command the attention of scientists in all parts of the world, as the exchanges received for it indicate. These exchanges are of great value, and constitute in themselves a very important addition annually to our Library. The Committee feel much indebted to Mr. Shearer for his successful efforts in raising the funds necessary for carrying on the publication, since the Legislative grant was withdrawn. Of course, if larger means were at their disposal, they could add greatly to the value of the "Record," by more numerous and costly illustrations, than the funds at present at command admit of; but they are striving to do the best they can under the circumstances, and they hope to continue to justify, by the variety and excellence of the contents of the "Record," the liberality of the members of the Society in furnishing the extra amount required for its maintenance.

Respectfully submitted, on behalf of the Committee, in the absence of the Editor, Dr. F. D. Adams, by

ROBERT CAMPBELL,
Acting Editor.

ABSTRACT FOR THE MONTH OF MARCH, 1895.

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 vapor.	‡ 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	34.78	39.9	23.0	16.9	29.4457	29.544	29.401	.143	.1903	93.0	33.0	S.W.	12.5	10.0	10	10	13	0.04	0.1	0.05	1
2	8.38	23.1	6 0	17.1	29.8573	29.911	29.783	.128	.0537	84.3	4.7	S.W.	14.5	5.8	10	0	54	....	Inap.	Inap.	2
SUNDAY......3	.....	29.0	5.0	24.0	....	.....	......	....	.....	....	....	S.W.	19.7	....	...	..	00	....	Inap.	Inap.	3..........SUNDAY
4	0.42	9.9	— 6.0	15.9	29.9115	30.194	29.611	.583	.0400	93.7	2 2	N.	20 3	8.3	10	0	00	....	4.2	0.42	4
5	8.52	15.3	1.7	13.6	30.0783	30 236	29.858	.378	.0543	85.3	5 0	S.W.	23.8	2.3	0	0	96	....	0.1	0.01	5
6	17.23	26.5	9.0	17.5	30.2932	30.362	30.251	.111	.0858	89.3	14.5	S.W.	14.4	2.8	10	0	95	....	0.1	0.01	6
7	26.58	35.2	12 6	22.6	30.0245	30.244	29.809	.435	.1230	83.0	22.3	S.	10.8	5.8	10	0	40	....	....	....	7
8	33.17	39.0	27.0	12.0	29.6312	29.790	29.477	.313	.1683	88.7	30.2	S.W.	4 0	2.3	4	0	89	....	Inap.	Inap.	8
9	25.02	33.7	19.5	14.2	29.5447	29.636	29.462	.174	.1138	84.3	21.2	S.W.	17.4	5.7	10	0	69	....	Inap.	Inap.	9
SUNDAY......10	.....	26.7	11.5	15.2	......	......	......	....	.....	....	....	S.W.	16.6	....	....	..	84	....	....	....	10..........SUNDAY
11	11.12	17.6	— 0.2	17.8	30.3672	30.314	30 211	.103	.0533	73.7	4.2	S.W.	6.0	0.0	0	0	89	....	....	....	11
12	14.87	24.8	5.0	19.8	30.1653	30 230	30 091	.139	.0738	82.5	10.7	N.E.	2.4	3 2	10	0	78	....	....	....	12
13	29.37	38.6	18.0	20 6	29.9632	30 107	29.803	.304	.1443	84.8	25.5	S.E.	8.3	9.8	10	9	09	0.09	....	0.09	13
14	15.52	36.5	4.8	31.7	30 0985	30.266	29.807	.459	.0845	82.8	11.2	W.	26.5	5.7	10	0	63	0.11	Inap.	0 11	14
15	10.33	16.2	2.0	14.2	30.0045	30.184	29 799	.385	.0550	78.3	5.0	W.	14.3	3.5	10	0	78	....	....	....	15
16	17.58	25 8	11.8	14.0	29.6942	29.773	29.611	.162	.0775	79.8	12.7	W.	14.3	4.7	10	0	73	....	....	....	16
SUNDAY......17	.....	30.2	11.2	19.0	....	.....	....	....	.....	....	....	W.	27 5	....	....	..	74	....	0.1	0.01	17..........SUNDAY
18	16.30	25.1	4.2	20.9	29.5702	29.627	29.474	.153	.0763	79.3	11.0	W.	35.2	8.3	10	0	00	....	0 4	0.04	18
19	24.35	30.3	16.8	13 5	29.8547	30.018	29 702	.316	.1065	80.2	19.5	W.	25 5	2.0	10	0	91	....	....	....	19
20	20.78	25.9	15 2	10.7	30.0795	30.110	30.062	.048	.0853	76.3	14.5	N.W.	6.5	0.7	2	0	96	....	....	....	20
21	22.83	29.3	14.2	15.1	30.1305	30.191	30.082	.109	.1027	82.0	18.3	W.	10 8	6.3	10	0	87	....	....	....	21
22	32.18	36.5	26 0	10.5	30.3332	30.410	30 243	.167	.1562	86.2	28.5	N.	7.4	4.7	10	0	50	...	....	....	22
23	33.07	38.9	25 4	13.5	30.4195	30.496	30 .292	.204	.1553	81.7	28 0	S.W.	11.3	0.0	0	0	97	....	....	....	23
SUNDAY......24	.....	38.2	28.8	9.4	.....	......	.....	....	.....	....	....	S.	19.0	....	......	..	12	....	0.2	0.02	24..........SUNDAY
25	35.92	40.7	33 5	7.2	29.6725	29.941	29 602	.339	.1955	92.7	33 7	S W.	21.0	7.8	10	0	21	0 21	...	0.21	25
26	31.02	35.3	29 4	5 9	29.6668	29.717	29 623	.094	.1568	90.2	28.5	S.W.	21.0	7.7	10	0	10	....	Inap.	Inap.	26
27	27.45	30.8	23.0	7.8	29.7030	29.820	29.481	.339	.1288	85.5	23.8	S.W.	18.1	6.7	10	0	56	....	0.2	0.02	27
28	30.07	35 3	24.0	11.3	29.6233	29 892	29.381	.511	.1462	87 3	27.0	N.W.	17.9	8 8	10	3	26	....	0.2	0.02	28
29	26.25	31.9	21.0	10.9	29.9972	30.036	29 956	.080	.1197	83.7	22.0	N.W.	16.4	8 5	10	0	83	...	....	...	29
30	23.13	31.8	15.5	16.3	30.2018	30.300	30.059	.241	.0952	74.7	16.5	N.W.	18.2	0.0	10	0	98	....	....	...	30
SUNDAY......31	....	30.2	15.3	14.9	......	......	.....	...	.....	....	....	S.W.	16.8	....	0	5	94	....	....	....	31..........SUNDAY
........Means	22.16	29 94	14.65	15 29	29.9327	30.052	29.805	.247	.1093	84.0	18.2	S. 67¼° W.	16.1	5.1	8.3	1.0	59.0	0.45	5.6	1.01	Sums ....
21 Years means for and including this month	24 28	31 63	16.64	14.75	29.9688	....	......	.262	.1087	75 9	....	......	....	6.0	..	..	¶47.1	0.94	22.8	3.21	21 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	898	95	19	616	677	5077	3009	1578	
Duration in hrs .	58	13	3	52	53	275	161	96	33
Mean velocity...	15 5	7.3	6.3	11.8	12.8	18.4	18 7	16.4	

Greatest mileage in one hour was 52 on the 18th.

Greatest velocity in gusts 60 miles per hour on the 18th.

Resultant mileage, 7810.
Resultant direction, S. 67¼° W.
Total mileage, 11969.
Lightning on 1st.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 14 years only.

The greatest heat was 40.7° on the 25th; the greatest cold was —6.0° on the 4th, giving a range of temperature of 46.7 degrees.

Warmest day was the 25th. Coldest day was the 4th Highest barometer reading was 30.496 on the 23rd. Lowest barometer 39,381 on the 28th, giving a range of 1.115 inches. Maximum relative humidity was 98 on the 4th and 25th.

Minimum relative humidity was 64 on the 30th

Rain fell on 4 days.

Snow fell on 15 days.

Rain or snow fell on 17 days.

Auroras were observed on 1 night on 22nd.

Lunar halos 2, on 8th and 31st.

Solar halos, 9 on 7th, 12th, 15th, 16th, 18th, 21st, 27th, 29th, 31st.

ABSTRACT FOR THE MONTH OF APRIL, 1895.

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 vapor.	‡Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches	Snowfall in inches.	Rain and snow melted.	DAY.
1	30.05	34.8	25.0	9.8	29.7998	29.991	29.640	.351	.1202	71.0	22.0	S.W.	5.2	8.3	10	0	00	....	Inap.	....	1
2	33.95	38.5	29.1	9.4	29.6278	29.649	29.608	.041	.1533	78.7	28.0	S.W.	7.0	9 2	10	5	00	....	....	....	2
3	32.32	36.9	28.9	8.0	29.6107	29.653	29.550	.103	.1463	80.0	27.0	W.	12.1	9.0	10	4	19	Inap.	....	Inap.	3
4	30.57	35.8	25.3	10.5	29.8325	29.939	29.728	.211	.1458	84.8	26.7	S.W.	18.7	7.3	10	0	40	....	....	....	4
5	35.90	41.4	29.8	11.6	30.1305	30.214	30.030	.184	.1382	65.8	25.5	S.W.	16.9	2.2	10	0	56	....	....	....	5
6	37.48	46.0	30.0	16.0	30.3285	30.357	30.276	.081	.1605	71.7	29.0	N.E.	6 0	0.8	5	0	90	....	....	....	6
SUNDAY........7	.....	50.0	28.2	21.8	....	.....	......	...	.....	....	....	S.E.	12.2	....	....	..	50	0.02	....	0.02	7........SUNDAY
8	41.32	46.0	38.2	7.8	29.8958	30.098	29.631	.467	.2565	98.2	41.0	S.E.	11.3	10.0	10	10	00	0.61	....	0.61	8
9	45.03	47.6	39 0	8.6	29.3613	29.544	29.236	.308	.2888	95.3	43.7	S.E.	15.2	10.0	10	10	00	1.05	....	1.05	9
10	29.15	39.5	24.0	15.5	29.8948	30.252	29.575	.677	.1152	71 3	21 2	N.W.	24.8	2.3	10	0	95	....	....	....	10
11	25.92	33 4	16.0	17.4	30.5690	30.656	30.431	.225	.0952	66 3	16.5	S.W.	11.8	1.0	4	0	93	....	. ..	....	11
12	37.57	46.6	25.9	20.7	30.3698	30.555	30.135	.420	.1497	66.3	27.0	S.E.	13 4	7.0	10	0	03	0 01	....	0.01	12
13	42.03	47.2	38.7	8 5	29.8927	30.016	29.826	.190	.2548	95.0	40 7	S.E.	9 3	10.0	10	10	00	0.49	....	0.49	13
SUNDAY....... 14	.....	45.0	36.5	8.5	....	......	......	....	....	...	....	N.	10.2	....	....	..	00	0.87	....	0.87	14........SUNDAY
15	38.73	43.5	36.2	7.3	29.8730	30.088	29.732	.356	.2125	90 3	36.0	N.E.	33.0	9.7	10	8	00	0.32	....	0.32	15
16	39.22	48.3	34.0	14.3	30.2237	30.269	30.168	.101	.1737	72.3	30.8	N.	24.6	6.3	10	0	28	....	....	....	16
17	44.83	57.2	32.8	24.4	30 1505	30.242	30.077	.165	.1642	56.2	29.5	N.E.	9.2	0.0	0	0	96	....	....	....	17
18	49.37	59.8	38.0	21.8	30.0885	30.149	30.014	.135	.1760	49.8	31.2	N.	9.5	0.0	0	0	94	....	....	....	18
19	54.03	67.4	40.2	27.2	29.9755	30.050	29.910	.140	.2222	55.0	37.3	N.W.	13.4	1.2	7	0	85	....	....	...	19
20	48.87	58 6	38.2	20.4	30.0518	30.091	30.015	.076	.2465	71 0	39.7	N.	10 5	1.3	5	0	95	....	....	....	20
SUNDAY........21	.....	64.0	40.0	24.0	....	......	......	....	.....	....	....	S.	13.2	....	....	..	95	....	....	....	21..........SUNDAY
22	44.82	50.9	38.0	12.9	29.7993	29.893	29.715	.178	.2532	85.3	40.5	S.	15.6	5 0	10	0	23	0.37	....	0.37	22
23	39.32	42.8	36.0	6 8	29.7333	29.875	29.621	.254	.2160	89.3	36.3	S.E.	21.5	8.3	10	0	00	0.02	....	0.02	23
24	45.33	60.3	31.2	29.1	29.8162	29.960	29.671	.289	.2143	70.2	35.5	S.W.	17.1	6.7	10	0	20	Inap.	....	Inap.	24
25	50.27	59.2	40.0	19.2	29.9267	30.098	29.864	.234	.2527	70.2	40.5	S.W.	15 3	7.7	10	0	28	....	....	....	25
26	43 47	51.6	34.2	17.4	30.2517	30.283	30 214	.069	.1885	66.5	33 0	N.	7.6	4.3	10	0	67	....	....	...	26
27	44.22	53.7	34.0	19.7	30.3265	30.389	30.281	.108	1717	59.3	30.7	N.	15 0	1.7	10	0	81	....	....	....	27
SUNDAY........28	.....	60.0	38.0	22.0	.....	......	......	....	.....	....	....	N.	5.3	....	......	.	92	....	....	....	28..........SUNDAY
29	57.13	68.6	42.0	26.6	30.1713	30.256	30.086	.170	.2687	59.3	42.0	S.	9.7	4.2	10	0	94	....	....	....	29
30	49.60	58.3	43.5	14.8	30.2562	30.387	30.147	.240	.2433	68.0	39.2	N.	15.4	6 3	10	0	31	Inap.	....	Inap.	30
31	.....	....	....	....	....	......	......	....	.....	....	..	......	....	....	....	..	..	....	....	....	31
....Means	41.17	49.76	33.70	16 06	29.9984	30.113	29.890	.222	.1934	73.4	32 7	N. 33¾° W.	13.7	5.4	8.5	1.8	45.8	3.76	0.0	3.76	Sums ....
21 Years means for and including this month	40.00	48 49	32.29	16.19	29.9523	.....	......	.206	.1699	66.5	....	......	....	6.2	..	..	¶51.2	1.64	6.1	2.26	21 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............	2264	1476	197	1382	693	1867	848	1118	
Duration in hrs..	158	97	29	113	42	120	62	75	24
Mean velocity...	14.3	15.2	6.8	12.2	16.5	15.6	13.7	14.9	

Greatest mileage in one hour was 38 on the 15th.

Greatest velocity in gusts 48 miles per hour on the 15th.

Resultant mileage, 1320.
Resultant direction, N. 33¾° W.
Total mileage, 9845.
Average mileage per hour, 13.7.
Slight earthquake shock on 17th at 11.15 a.m., lasting about 10 seconds, travelling in a S.E. direction.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 14 years only.

The greatest heat was 68.6° on the 29th; the greatest cold was 16.0° on the 11th, giving a range of temperature of 52.6 degrees.

Warmest day was the 29th. Coldest day was the 11th. Highest barometer reading was 30.656 on the 27th. Lowest barometer was 29.236 on the 9th, giving a range of 1.420 inches. Maximum relative humidity was 100 on the 8th, 9th and 14th.

Minimum relative humidity was 32 on the 29th.

Rain or snow fell on 12 days.

Auroras were observed on 4 nights, 10th, 11th, 20th and 26th.

Lunar corona on the 2nd.

Fog on 2 days, 8th and 9th.

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THE

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VOL. VI. JULY, 1895. No. 7.

DESCRIPTIONS OF EIGHT NEW SPECIES OF FOSSILS FROM THE (GALENA) TRENTON LIMESTONES OF LAKE WINNIPEG AND THE RED RIVER VALLEY.

By J. F. WHITEAVES.

The following descriptions are communicated, by permission of the Director of the Geological Survey of Canada, for publication in advance of an official Report on the fossils of the Cambro-Silurian rocks of Lake Winnipeg and its vicinity, now in course of preparation by the writer, in which it is hoped that these and many other species will be fully illustrated. This Report is intended to form the third part of the third volume of the "Palæozoic Fossils" of Canada.

ALGÆ.

CHONDRITES PATULUS. (Sp. nov.)

Thallus frondose, continuous, spreading widely in the same plane, and consisting of a thin, uniformly flat expansion, devoid of midrib or veins, which is doubly, deeply and widely trifurcate at a short distance from the laterally expanded base of attachment, with the secondary divisions again once or twice cleft at their summits; the undivided and partially divided portions narrowest below, widening above and widest at the commencement of each division, averaging from three to four millimetres in breadth in the narrowest places, and from fourteen to fifteen mm. in the widest.

Inmost or Birch Island, Kinwow Bay, Lake Winnipeg, T. C. Weston, 1884: four nearly perfect and well-defined specimens, and seven similar but imperfect ones.

Chondrites cupressinus. (Sp. nov.)

Thallus frondose, continuous and consisting of a long, slender and extremely narrow rhachis, with numerous short, crowded and variously divided lateral ramifications: base of attachment unknown. The rhachis is flat, erect, nearly straight and scarcely more than half a millimetre in its maximum breadth. The lateral ramifications are linear, pinnately partite, or possibly verticillate, opposite, divergent and spreading outward and a little upward. They decrease very gradually in length from below upward, and are either doubly bifurcate, bifurcate with both of the ultimate ramifications trifurcate, or bifurcate with one of the ultimate branchlets trifurcate and the other single.

Cat Head, Lake Winnipeg, D. B. Dowling and L. M. Lambe, 1890: one specimen, which has been split longitudinally down the centre into two pieces of nearly equal size.

To the naked eye this specimen has much the appearance of the polypary of a recent hydroid, and especially of that of the well-known *Sertularia cupressina*, L., which Professor Allman now refers to *Thuiaria.* When viewed under an ordinary simple lens, however, it has obviously more the aspect of a plant, although its minute tissues are not preserved. There are no indications of any corneous or chitinous structures, of articulations,—of a central virgula, as in the Graptolitidæ, or of marginal hydrotheca, as in the hydroids and graptolites. The species may form the type of a new genus of palæozoic marine algæ, for which the name *Trichochondrites* might not be inappropriate, and characterised by a continuous frondose thallus, an extremely slender rhachis, and crowded linear lateral ramifications.

CHONDRITES GRACILLIMUS. (Sp. nov.)

Thallus frondose, continuous, pinnately partite, with a slender rhachis, which is nearly a millimetre in breadth about the mid-height, but narrower at and near the base and apex, and apparently flattened, with no indications of a central axis or virgula. Lateral ramifications simple, unbranched, narrower than the rhachis, averaging about one millimetre apart, the longest about fifteen mm. in length, divergent in the same plane outward and a little upward, but shewing no traces of hydrothecæ or cell openings on their margins: basal attachment unknown.

Inmost Island, Kinwow Bay, Lake Winnipeg, T. C. Weston, 1884: one well defined and nearly perfect specimen, though its minute structure is not preserved.

This specimen is so similar in general shape to some of the Devonian and Carboniferous species of *Plumalina* that the writer has long been under the impression that it could be referred to that genus. It is also equally similar in general shape to the *Buthograptus laxus* of Hall, from the Trenton shales of Wisconsin. According to S. A. Miller,[1] *Ptilophyton,* Dawson, is a synonym of *Plumalina,* and the writer is informed by Sir J. W. Dawson that he has recently ascertained that *Buthograptus laxus* is exactly congeneric with *Ptilophyton.* In Hall's original description of *Plumalina,*[2] the specimens described are said to

1 North American Geology and Palæontology, 1889, p. 136.

2 Canadian Naturalist and Geologist, Vol. III., p. 175.

have a "well-preserved corneous structure;" and Whitfield has shown that the lateral branches of *Buthograptus laxus* are articulated. Under a lens, the specimen from Inmost Island shows no indication of corneous structure, and its lateral ramifications are apparently continuous with the rhachis. It would, therefore, seem to be the most prudent course to refer it provisionally to the genus *Chondrites.* Whether viewed with or without a lens, it has so many characters in common with *C. cupressinus* that practically the only difference between them is, that the one has long and undivided pinnæ or lateral ramifications, and the other short and much divided ones.

CŒLENTERATA.

ANTHOZOA.

STREPTELASMA ROBUSTUM. (Sp. nov.)

Corallum simple, elongate conical, usually rather strongly curved, though some specimens are not so much curved as others, very large for the genus, attaining to a length of seven inches as measured along the curve of the convex side, to a height of nearly five inches, and to a breadth or width of nearly two inches and a quarter at the summit. In some adult or nearly adult specimens the sides are so much compressed (perhaps abnormally so), that the convexly arched region is obtusely angulated in the centre, longitudinally; in some young specimens this region is distinctly flattened; but others are circular in outline in transverse section, or as seen from above. Septa alternately long and short, varying in number in large specimens from 160 to 170 in all, the longer ones extending to the centre at the bottom of the calyx. Surface marked with transverse wrinkles and numerous fine striæ of growth in well-preserved specimens, but often so much worn, apparently prior to fossilization, as to be almost smooth.

Longitudinal sections through the centre of large specimens shew that the calyx is not very deep, and that its cavity occupies but a small proportion of the entire length. Below the calyx the corallum is filled with strongly developed and apparently thickened septa, with well-marked dissepiments between them, and these septa, with their dissepiments, unite in the centre in such a way as to form a large irregularly reticulated pseudo-columella, which projects slightly above the centre of the base of the calyx, as a boss of irregular shape, but with a narrowly rounded summit.

This fine coral is especially abundant, and attains to a large size in the Red River valley, at St. Andrews, Lower Fort Garry and East Selkirk, Manitoba, where it was collected by Dr. R. Bell in 1880, by T. C. Weston and A. McCharles in 1884, by L. M. Lambe in 1890, and by D. B. Dowling in 1891. On the western side of Lake Winnipeg a few rather smaller and much less perfect specimens of this coral were collected at Jack Head Island, Manitoba, by D. B. Dowling and L. M. Lambe in 1890, at Dog Head, Manitoba, Selkirk Island, Keewatin, and on the main shore off the north end of Selkirk Island, Saskatchewan, by D. B. Dowling in 1891. A small specimen, which is apparently referable to this species, was collected at the junction of the Little and Great Churchill rivers by Dr. R. Ball in 1879.

Streptelasma robustum appears to be readily distinguishable, by its very much larger size and much more robust habit of growth, from the well-known *S. corniculum* of Hall. It seems to bear somewhat the same kind of relationship to *S. corniculum* that the *Receptaculites Oweni* of the Cambro-Silurian rocks of the west does to the eastern fossil known by the rather inappropriate name of *R. occidentalis,* and that *Murchisonia teretiformis* (or *M. major*) of the same rocks does to the eastern *M. bellicincta.*

MOLLUSCOIDEA.

Brachiopoda.

Rafinesquina lata. (Sp. nov.)

Shell large, adult specimens measuring as much as three inches along the hinge line, deeply concavo-convex, much broader than long, and broadest at the hinge line: cardinal angles produced. Ventral or pedicle valve strongly convex exteriorly, usually regularly arched from back to front, most prominent and in some specimens gibbous and even obtusely subangular about the mid-length, with the visceral disc flattened obliquely, in others most tumid in the umbonal region posterior to the mid-length, its beak moderately prominent, its cardinal area wide and about four millimetres and a quarter in height. with a broadly triangular deltidium in the centre. Dorsal or brachial valve deeply concave, closely following the curvature of the ventral, its cardinal area about one mm. and a quarter in height, and its beak apparently small.

Surface of both valves marked with very numerous and closely disposed, threadlike radiating raised lines or minute ridges. In the only well-preserved dorsal valve known to the writer these radii are very nearly equal in size, but upon the ventral valves of several specimens they are unequal in size and irregular in their disposition. In some places the larger radii alternate with the smaller ones, but in others there are from two to four, or even more, of the smaller radii between two of the larger ones. In addition to these radii, the visceral disc of the ventral valve of some specimens is marked with comparatively coarse, undulating, concentric but somewhat interrupted corrugations.

Hinge dentition and characters of the interior of both valves unknown, but an imperfectly preserved cast of the interior of the shell of a ventral valve shews that the flabellate diductors of that valve are very similar in shape to those of *R. alternata*, as figured by Hall on Plate 8, figure 4, of the eighth volume of the "Palæontology of the State of New York," though their external margins are very much less distinctly defined.

Apparently not uncommon in the Red River valley at Lower Fort Garry,—where it was collected by Donald Gunn in 1858, by Dr. R. Bell in 1880, by T. C. Weston in 1884, and D. B. Dowling in 1891,—and at East Selkirk,—where specimens were obtained by T. C. Weston and A. McCharles in 1884. From the limestones of Lake Winnipeg it has so far been collected only at Cat Head (by T. C. Weston in 1884 and D. B. Dowling in 1891), and at Jack Head Island (by D. B. Dowling and L. M. Lambe in 1890).

Altogether, the writer has seen fourteen specimens of this shell, three of which shew the characters of the hinge area of both valves fairly well, though the beak of the dorsal valve cannot be seen in either, as it is either broken off or buried under the matrix. The ventral aspect of these specimens is remarkably similar to that of the fossil figured by Professors Winchell and Schuchert on Plate xxxi., figures 35 and 36, of the "Lower Silurian Brachiopoda of Minnesota," as *Rafinesquina alternata*, var. *loxorhytis*, but which, Mr. Schuchert has recently informed the writer, he now regards as a form of *R. Kingii*, the *Strophomena Kingii* of Whitfield. Mr. Schuchert, however, who has seen all the specimens from Manitoba upon which the preceding description is based, states that their hinge areas are always nearly three and even four times as high as those of the Minnesota specimens of *R. Kingii* which he has studied, and regards this as a valid distinction between them. Professor Whitfield, also, who has seen some of the most perfect Manitoba specimens of *R. lata*, regards them as specifically distinct from his

Strophomena Kingii, on the ground that the umbones of ventral valves of the former are more full, and the valves themselves proportionally more convex, than those of *S. Kingii.*

MOLLUSCA.

CEPHALOPODA.

ASCOCERAS COSTULATUM. (Sp. nov.)

Shell large, elliptic-subovate, longer than broad and broadest in advance of the mid-length, the neck or anterior prolongation of the body chamber being broken off in the only specimen known to the writer: outline of transverse section in the broadest part apparently elliptical, the dorsum and venter being compressed and the sides slightly expanded.

Surface transversely but rather finely ribbed, the ribs averaging from seven to nine in the length of one centimetre, and rather closer together near the aperture than in the more expanded portion.

Sigmoidal septa apparently three in number, though their distances apart, on the dorsum, cannot be ascertained. The suture, however, which forms the line of demarcation between the decurrent extremity of the body chamber and the septate portion, on both sides, is clearly defined. It shows that the body chamber extends as far backward as to within about half an inch from the blunted pointed posterior end, that it is dilated or produced laterally, towards the dorsum, for a short distance posteriorly, and concavely constricted for a much longer distance anteriorly.

Black Island,[1] Swampy Harbour, Lake Winnipeg, D. B. Dowling and L. M. Lambe, 1890: a badly preserved cast of the interior of the shell, with one side much worn, but with portions of the test preserved on both the venter and dorsum.

[1] A small island close to, but a little to the west of, Beren's or Swampy Island.

This species bear some resemblance to *A. Bohemicum* of Barrande, particularly in size and in the general style of its surface markings. The ribs or riblets of this Bohemian species, however, are represented as finer and very much more numerous. Thus, according to Lindström, in *A. Bohemicum* there are as many as twenty-two riblets in a length of five millimetres, and hence, presumably, forty-four to a centimetre, but in the present species there are only from seven to nine ribs to a centimetre. Among Canadian species, *A. costulatum* would seem to be nearest to *A. Canadense*, Billings, the type of Hyatt's genus *Billingsites*, and hence may be referable to that genus. The surface markings of *A. Canadense,* however, are still unknown, or at least not preserved in any of the specimens in the Museum of the Geological Survey.

CYRTOCERAS LATICURVATUM. (Nov. sp.)

Shell large (attaining to a length of about twelve inches, as measured along the convex and presumably ventral curve), narrowly fusiform and broadest at a short distance from the body chamber, elongated, slender, and so much curved as to form a broad semi-circular arch, which is straighter anteriorly than posteriorly: sides compressed, the outline of a transverse section of the broadest part being elliptical: body chamber compressed cylindrical, more than twice as long as broad, and occupying about one-third of the entire length.

Surface markings unknown, though there are indications of faint longitudinal ribs on one of the casts.

Longitudinal sections show that the septa (thirty-five of which can be counted in one specimen) are strongly concave and about seven or eight millimetres apart near the body chamber, but much closer together at the posterior end, also that the siphuncle is almost cylindrical, but slightly contracted at the septa, exogastric and placed at a distance about equal to its own breadth from the margin of the convex (ventral) side.

Black Island, Swampy Harbour, Lake Winnipeg, J. B. Tyrrell, 1889 (four specimens), and D. B. Dowling and L. M. Lambe, 1890 (three specimens). Jack Head Island, Lake Winnipeg, Messrs. Dowling and Lambe, 1890 (one specimen), Commissioners or Cranberry Island (one specimen), and Point off Moose Creek, eight miles south-west of Whiteway Point (one specimen), D. B. Dowling, 1890. All the specimens from these localities are mere casts of the interior of the shell, but the septa and siphuncle are usually well preserved.

This large, elongated, slender and sickle-shaped *Cyrtoceras* is so unlike any other species of that genus known to the writer, as to call for no special comparisons.

Eurystomites plicatus. (Sp. nov.)

Shell involute, volutions apparently one and a half, coiled closely on the same plane but without embracing, strongly compressed on the venter and dorsum and increasing very slowly in the ventro-dorsal diameter, but expanding and widening rapidly at the sides, which are rounded and gibbous, the outline of a transverse section of the chamber of habitation near the aperture being broadly reniform, with the lateral diameter about three times greater than the dorso-ventral, and the dorsum impressed by a shallow and rather narrow furrow of contact: umbilical perforation large and deep.

Surface marked with rather broad, low, rounded, flexuous, transverse plications, and crowded striæ parallel to the plications, both between and upon them.

A longitudinal section through the centre of one of the specimens shews that the cut edges of the concave septa are about two millimetres apart on the dorsum, and seven mm. on the venter, near the body chamber, that the siphuncle is placed about half-way between the centre and the venter, and that it is almost cylindrical, but slightly constricted at or near each of the septa.

Black Island, Swampy Harbour, Lake Winnipeg, J. B. Tyrrell, 1889, two specimens, and D. B. Dowling and L. M. Lambe, 1890, two specimens.

These are referred to the genus *Eurystomites,* Schröder, on the authority of Professor Hyatt, to whom one of the most perfect specimens was sent for examination. In a letter recently received, Professor Hyatt says of this specimen: "The suture has a decided broad ventral lobe and lateral lobes, and internally there is an impressed zone shewing a true close coiled nautilian form. The siphuncle is ventrad of the centre, small and with delicate walls." *Nautilus Hercules* of Billings, from the Hudson River formation of the island of Anticosti, which Hyatt doubtfully refers to the genus *Litoceras,* has a broad flattened venter and a similar kind of coiling to that of *E. plicatus,* but both sides of the outer volution of *Nautilus Hercules* are distinctly angular.

The Flora of Montreal Island.

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

I have continued collecting as I have had opportunity, and since the list was made of specimens of the plants to be found in the two counties of Hochelaga and Jacques Cartier, published in Vol. V., pp. 208 to 234, gathered up to 1893, the following have been added :—

Anemone nemorosa, L.—Windflower—St. Michel—May.

Ranunculus multifidus, Pursh.—Yellow Water Crowfoot—Lachine, ditch near Convent Station—(*Ranunculus delphinifolius,* Holmes.) July.

RANUNCULUS PENNSYLVANICUS, L.f.—Bristly Crowfoot—Lachine—September.

DELPHINIUM EXALTATUM, Ait.—Tall Larkspur—Lane off Pine Avenue.

MENISPERMUM CANADENSE, L.—Moonseed—Bagg's Wood, near Back River—(Holmes at St. Martin.) July.

NYMPHÆA ODORATA, Ait.—Sweetscented Water Lily—Pointe-aux-Trembles—July.

NYMPHÆA RENIFORMIS, DC.—Tuber-bearing Water Lily—St. Lawrence River at Verdun—August.

DICENTRA CANADENSIS, DC.—Squirrel Corn—Mount Royal Cemetery, near gate. (Holmes, *Corydalis Canadensis*)—May.

CARDAMINE ROTUNDIFOLIA, Michx.—Mountain Water Cress—Ditch, Elmwood Grove, Longue Pointe—reported for the first time in this district—June.

ARABIS HIRSUTA.—Hairy Rock Cress—Bagg's Wood—July.

ARABIS CANADENSIS.—Sickle-Pod—Smaller Mountain—July.

HESPERIS MATRONALIS, L.—Dame's Violet, Sweet Rocket—Mountain, west of McGibbon's—escaped from cultivation—July.

SISYMBRIUM SOPHIA, L.—Flax Weed—Lachine—July.

VIOLA BLANDA, var. RENIFOLIA, Gray.—Sweet White Violet—Lachine, Cedar swamp, west from Convent Station.

CERASTIUM VISCOSUM, L.—(in former catalogue viscosum should have read vulgatum)—Mouse-ear Chickweed—Cote des Neiges Road—June.

MALVA CRISPA, L.—Curled Mallow—Vacant lot, Montreal—September.

VITIS RIPARIA, Michx.—Frost or Chicken Grape—Western spur of Mountain Park—June. (Holmes.)

NEGUNDO ACEROIDES, Moench.—Ashleaved Maple—introduced from the west, and making rapid headway round the city—April.

TRIFOLIUM HYBRIDUM, L.—Alsike Clover—getting common—June.

VICIA TETRASPERMA, L.—Fourseeded Vetch—Mountain Park—July.

APIOS TUBEROSA, Moench.—Ground Nut, Wild Bean—Vacant field off St. Antoine street west—August. (Holmes, *Glycine apios.*)

PHYSOCARPUS OPULIFOLIUS, Maxim.—Nine-Bark—(Holmes, *Spiræa opulifolia*)—Bagg's Wood—July.

GEUM VIRGINIANUM, L.—Hairy Avens—Low part of Park beyond McGibbon's—(Holmes, *Geum Canadense*)—July.

CRATÆGUS COCCINEA, var. macracantha, Dudley—Scarlet Haw—Mountain Park—May.

CRATÆGUS PUNCTATA, Jacq.—Yellow Haw—head of Metcalfe Avenue, Westmount—(Holmes, *tomentosa* var. *punctata*)—May.

CRATÆGUS FLAVA, Ait.—Summer Haw—Mountain Park, south of McGibbon's—May.

DECODON VERTICILLATUS, Ell.—Swamp Loose Strife—Lachine—(Holmes, *Lythrum verticillatum*)—August.

OENOTHERA LINIFOLIA, Nutt.—Evening Primrose—Hochelaga Bank—June.

CALLITRICHE VERNA, L.—Water Starwort—Pointe-aux-Trembles and Verdun—June.

EPILOBIUM ADENOCAULON, Haussk.—Willow Herb—(in former catalogue, *Epilobium coloratum*; but recent determination has made it distinct)—Common—August.

THASPIUM AUREUM, Nutt.—Meadow Parsnip—Smaller Mountain—(Holmes' *Smyrnium aureum*)—June.

PIMPINELLA INTIGERRIMA, Benth. & Hook.—Burnet saxifrage—(Holmes, *Smyrnium intigerrimum*)—rare on smaller Mountain—Common, shore of Lake Huron—June.

SIUM CICUTÆFOLIUM, Gmellin.—Water Parsnip—(Holmes, *Sium lineare*)—Lachine—August.

BERULA ANGUSTIFOLIA, Koch.—Gaelic Cress—(Holmes' *Sium latifolium*)—Cote St. Paul—August.

CICUTA MACULATA, L.—Spotted Cowbane—Mountain Marsh—(Holmes)—July.

CONIUM MACULATUM, L.—Poison Hemlock—Bagg's Woods—July.

GALIUM TRIFIDUM, L.—Small bedstraw—most common—June—(Holmes.)

GALIUM ASPRELLUM, Michx.—Rough bedstraw—common—July—(Holmes.)

GALIUM TRIFLORUM, Michx.—Sweet scented bedstraw—all over the island, in the woods—June—(Holmes.)

GALIUM APARINE, L.—Cleavers, goose-grass—common—(Holmes)—July.

GALIUM PILOSUM, Ait.—Hairy bedstraw—Bagg's Woods—July.

GALIUM BOREALE, L.—Northern bedstraw—common—July—(Holmes.)

CEPHALANTHUS OCCIDENTALIS, L.—Button bush—St. Michel—August—(Holmes.)

SOLIDAGO PETIOLARIS, Ait.—Golden rod—St. Michel—August.

SOLIDAGO SEROTINA, Torr & Gray.—Golden rod—Mountain Park—August.

SOLIDAGO RUGOSA, Mill.—Golden rod—Mountain Park—August.

SOLIDAGO CANADENSIS, var. PROCERA, L.—Golden rod—Mountain Park—August—(Holmes.)

SOLIDAGO MACROPHYLLA, Pursh.—Golden rod—Mountain Park—August—(Holmes.)

SOLIDAGO NEMORALIS, Ait.—Golden rod—Mountain Park—August—(Holmes.)

SOLIDAGO SEROTINA, var. GIGANTEA, Frank.—Golden rod—Marsh in Mountain Park—August.

CNICUS HORRIDULUS, Pursh.—Yellow Thistle—St. Michel—September.

ARALIA SPINOSA, L.—Angelica tree—McGill College grounds, but extending itself rapidly, as it has done on the banks of the Grand River, near Galt—July.

CORNUS SERICEA, L.—Silky Cornel, Kinnikinnik—Park south of McGibbon's—June—(Holmes.)

CORNUS PANICULATA, L'Her.—Panicled Cornel—Mountain Park—June.

CORNUS ALTERNIFOLIA, L.—Alternate leaved dogwood—back river, Bagg's Woods—June—(Holmes.)

SAMBUCUS EBULUS, L.—Dwarf elder, Danewort—Up and down Metcalfe Avenue, extending itself rapidly—not reported in Macoun's catalogue—July—(Holmes.)

VIBURNUM LANTANOIDES, Michx.—Hobble bush—St. Michel woods—May—(Holmes.)

LONICERA SEMPERVIRENS, Ait.—Trumpet Honeysuckle—Mountain Park, south of McGibbon's—June.

ASTER CORYMBOSUS, Ait.—Starwort—Mountain Park—August.

ASTER NOVÆ-ANGLIÆ, L.—Aster—Mountain Park—September.

ASTER UMBELLATUS, Willd.—Aster—Mount Royal Park—August.

ASTER VIMINEUS, Law.—Starwort—Mount Royal Park—August.

ASTER TRADESCANTI, L.—Aster—Mount Royal Park—August.

ASTER PANICULATUS, Lam.—Aster—Mount Royal Park—August.

ASTER PTARMICOIDES, Torr & Gray.—Aster—Mount Royal Park—August.

ANAPHALIS MARGARITACEA, Benth. & Hook—Pearly Everlasting—August—(Holmes' *Gnaphalium margaritaceum.*)

INULA HELENIUM, L.—Elecampane—East side Cote St. Antoine Road, spreading rapidly, as it is a strong grower, and in the struggle for life it beats off every competitor.

This has been its history in several localities in Ontario—August.

HELIANTHUS STRUMOSUS, L.—Sunflower—Mount Royal Park—August.

GALINSOGA PARVIFLORA, Cav.—For the last three years I have observed a numerous colony of this plant on the McGill College grounds, in front of the new Workman buildings, on a piece of recently made-up ground. This is the first time the plant is reported from Canada, although in the 6th edition of Gray, p. 286, it is said to occupy "waste places, especially eastward." It is a modest plant, about nine inches high, its rays inconspicuous, so that it is not likely to attract the attention of any but a practised eye. There is a risk that the plant will disappear, however, as several feet more of earth has been filled in over where it grew, unless it has managed to extend itself beyond the sidewalk, into the grass, among which it maintained a successful struggle. I secured several specimens of it in successive years.—August.

ERECHTHITES HIERACIFOLIA, Raf.—Fireweed—Mount Royal Cemetery—(Holmes' *Senecio hieracifolia*)—August.

PRENANTHES CREPIDINEA, Michx.—Rattlesnake root—Mount Royal Park—August.

PRENANTHES SERPENTARIA, Pursh.—Lion's foot, Gall of the earth—Mount Royal Park, west of McGibbon's—August.

LOBELIA PUBERULA, Michx.—Silky Lobelia—Bagg's Woods—July—(Holmes' *Lobelia Kalmii.*)

CYNOGLOSSUM VIRGINICUM, L.—Wild comfrey—Bagg's Woods—June—(Holmes' *Cynoglossum amplificaule.*)

LITHOSPERMUM LATIFOLIUM, Michx.—Broadleaved Groundsel—Bagg's Woods—July.

SOLANUM DULCAMARA, L.—Bittersweet—over the island—June.

SOLANUM NIGRUM, L.—Common nightshade—Bagg's clearing—July—(Holmes.)

VERONICA AGRESTIS, L.—Field Speedwell—Lachine, west of Convent Station—August.

VERONICA AMERICANA, Schweinitz.—American Brooklime—Ditch at Lachine—July.

GERARDIA PURPUREA, var. PAUPERCULA, Gray.—Lachine swamp, west of Convent Station—August—(Holmes.)

MELAMPYRUM AMERICANUM, Michx.—Cow wheat—Bagg's Woods—July—(Holmes' *Melampyrum arvense.*)

CATALPA BIGNONIOIDES, Watt.—Indian Bean—McGill College grounds—flowered in 1893—June.

CALAMINTHA NEPETA, Link.—Basil Thyme—Mountain Park—July—rare.

MONARDA DIDYMA, L.—Oswego Tea, Bee-Balm—River side, below the Convalescent Hospital, Longûe Pointe—July.

PLANTAGO RUGELII, Decaisne.—Taller Plantain—St. Famille street and on Mountain—July.

APOCYNUM CANNABINUM, L.—Indian Hemp—River bank, Verdun—June.

AMARANTUS PANICULATUS, L.—Red Amaranth—Lachine—September.

AMARANTUS ALBUS, L.—Tumble weed—common—August.

RUMEX VERTICILLATUS, L.—Swamp Dock—Mount Royal Park—July—(Holmes.)

POLYGONUM LAPATHIFOLIUM, var. INCANUM, Koch.—Lachine—September (Holmes.)

POLYGONUM VIRGINIANUM, L.—Bout de l'Isle—September.

POLYGONUM ARIFOLIUM, L.—Halbard-leaved Tear-thumb—August—Mountain Park.

POLYGONUM CILINODE, Michx.—Downy bindweed—Mount Royal Park—July.

DIRCA PALUSTRIS, L.—Leatherwood, moosewood—Bagg's Woods—rare now though formerly plentiful—April—(Holmes.)

DAPHNE MEZEREUM, L.—Daphne—Several places in Mountain Park—May.

EUPHORBIA COMMUTATA, Engelm.—Spurge—Field near Bagg's Woods—rare—July.

CELTIS OCCIDENTALIS, L.—Sugarberry, Hackberry—Lower Lachine Road—a great colony of large trees on north end of St. Helen's Island—May—(Holmes.)

URTICA URENS, L.—Nettle—common—wrongly described as *urtica gracilis,* in former catalogue, though urtica gracilis is occasionally found—August.

BŒHMERIA CYLINDRICA, Willd.—False nettle—vacant field off St. Antoine street, St. Henri, Verdun—July.

CARYA PORCINA, Nutt.—Pig nut Hickory—McGill College grounds—June.

BETULA LUTEA, Michx.—Yellow birch—Mountain Park, McGill College grounds—May.

SALIX NIGRA, Marsh.—Black willow—very common—May.

SALIX LUCIDA, Muhl.—Shining willow—very common—May.

SALIX FRAGILIS, L.—Crack willow—introduced into Mountain Park—May.

SALIX ROSTRATA, Richardson.—in former catalogue, *salix livida* var. *occidentalis*—very common—May.

PINUS RESINOSA, Ait.—Red Pine—an occasional tree on the island—August.

SPARGANIUM EURYCARPUM, Engelm.—Large Bur-reed—Pointe-aux-Trembles—September.

SPIRANTHES CERNUA, Richard.—Ladies' tresses—Bagg's Woods—July.

EPIPACTIS HELLEBORINE, Crantz.—This European orchid was discovered on Mount Royal Park in 1894 by Mr. H. B. Cushing—previously reported in Gray's 6th edition as near Syracuse and Buffalo, N.Y., the only known stations—July.

ORCHIS SPECTABILIS, L.—Showy orchis—several places in Mount Royal Park—July—(Holmes.)

HABENARIA HYPERBOREA, R. Br.—Rein Orchis—Mountain Marsh—August—(Holmes' *Habenaria dilatata.*)

CYPRIPEDIUM PARVIFLORUM, Salis.—Smaller yellow Lady's Slipper—Bagg's Woods—June.

SMILAX ROTUNDIFOLIA, L.—Common greenbrier—Bagg's Wood and Mountain Park—June.

TRILLIUM CERNUUM, L.—Wakerobin—common—May.

LILIUM CANADENSE, L.—Wild Yellow Lily—Mountain swamp—July.

ACORUS CALAMUS, L.—Sweet Flag—Pointe-aux-Trembles—June.

ZIZANIA AQUATICA, L.—Indian Rice—Mouth St. Pierre River, Verdun—August—(Holmes' *Zizania clambosa.*)

PHEGOPTERIS POLYPODIOIDES, Fee.—Beech fern—Mount Royal Park—July.

PHEGOPTERIS DRYOPTERIS, Fee.—Beech fern—Mount Royal Park—July.

CYSTOPTERIS BULBIFERA, Bernhardi.—Bladder fern—shaded ravines on Mount Royal Park—July.

ONOCLEA STRUTHIOPTERIS—Hoffman.—Ostrich Fern—August—Mountain swamp—(Holmes' *Struthiopteris Pennsylvanica.*)

LYCOPODIUM COMPLANATUM, L.—Ground Pine—common—August—(Holmes.)

CONTRIBUTIONS TO CANADIAN BOTANY.

By JAMES M. MACOUN.

VII.

ANEMONE NARCISSIFLORA, L.

Mount Head, Burrough Bay, B.C., 1894. (*H. W. E. Canavan.*) Not before recorded from Canada.

RANUNCULUS AQUATILIS, L., var. CONFERVOIDES, Wat.

In pools, Cape Chudleigh, Hudson Strait, 1884. (*Dr. Robt. Bell.*) Only Canadian record.

CIMICIFUGA ELATA, Nutt.

Mount Chean, Chilliwhack, Fraser Valley, B.C., Aug. 1st, 1895, alt. 7,000 feet, (*Rev. Herbert H. Gowen.*) New to Canada.

LATHYRUS PRATENSIS, Linn.

Well established in old fields at The Ledge, Dufferin, a few miles from St. Stephen, N.B. 1895. Collected by F. A. Pickett; communicated by Mr. J. Vroom. Only other record, Hamilton, Ont.

LEPTARRHENA PYROLIFOLIA, R. Br.

Additional stations for this species are: mountains in the vicinity of West Kootanie Lake, B.C.; mountains of the Selkirk Range, above 4,000 feet; and mountains of the Gold Range, B.C., above 5,000 feet. Not found east of the Columbia River along the line of the Can. Pac. Ry., though collected by Dr. Dawson in the Rocky Mountains in Lat. 49° 30′, and by Drummond in Lat. 52°.

SAXIFRAGA AIZOON, Jacq.

In moist gravel, Charlton Island, James Bay, 1887. (*Jas. M. Macoun.*) Not recorded before from Hudson Bay.

SAXIFRAGA BRONCHIALIS, L.

Mountains north of Griffin Lake, B.C.; Eagle Pass, B.C. (*John Macoun.*) Harry Creek, Lake Okanagan, B.C. (*Jas. McEvoy.*) Not before recorded between the Coast Range and the Rocky Mountains.[1]

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

SAXIFRAGA HETERANTHA, Hook.

Toad Mountain, Kootanie Lake, B.C. (*Jas. M. Macoun.*) Protection Island, Nanaimo, Vancouver Island, and Mount Arrowsmith, V.I. (*John Macoun.*) Not before recorded from Vancouver Island.

SAXIFRAGA INTEGRIFOLIA, Hook.

Hillsides at Sproat, Columbia River, B.C., 1890. (*John Macoun.*) Not before recorded from interior of British Columbia.

SAXIFRAGA LYALLII, Engler.

By alpine rivulets, Queest Creek, Shuswap Lake, B.C.; mountains at Griffin Lake, B.C., 1890. (*Jas. M. Macoun.*) Western limit.

SAXIFRAGA NIVALIS, L.

Borders of coulees, Cypress Hills, Assa., 1894. (*John Macoun*, Herb. No. 4921.[1]) Cornwall Hills, west of Ashcroft, B.C. (*Jas. McEvoy.*) Francis River, Lat. 61°, Yukon District. (*Dr. Geo. M. Dawson.*)

SAXIFRAGA OCCIDENTALIS, Wat.

Eagle Pass, west of Revelstoke, B.C., 1890. (*John Macoun.*) All western references under *S. Virginiensis*, in Prof. Macoun's Catalogue, go here.

SAXIFRAGA OPPOSITIFOLIA, Linn.

Mount Queest, Shuswap Lake, B.C., alt. 6,500 feet. (*Jas. M. Macoun.*) Not known to occur elsewhere near the line of the Can. Pac. Ry. between the Rocky Mountains and the Pacific.

SAXIFRAGA PUNCTATA, L.

Lat. 63°, Long. 102°, 1893. (*Jas. W. Tyrrell.*) First

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

record east of Rocky Mountains. Mountain slopes south of Tulameen River, B.C., alt. 5,000. (*Dr. Geo. M. Dawson.*) Mount Chean, Fraser Valley, B.C. (*Rev. H. H. Gowen.*) On rocks in a torrent, Mount Arrowsmith, Vancouver Island, alt. 2,000 feet. (*John Macoun.*) Mount Rapho, Bradfield Inlet, B.C. (*H. W. E. Canavan.*) Not before recorded in Canada west of Selkirk Mountains.

SAXIFRAGA RANUNCULIFOLIA, Hook.

Crevices of damp rocks at Sproat, Columbia River, B.C., alt. 4,000 feet. (*John Macoun.*)

SAXIFRAGA RIVULARIS, L.

On lateral moraines at Roger's Pass, Selkirk Mountains, B.C., alt. 7,500 feet; crevices of rocks, Mount Queest, Shuswap Lake, B.C., alt. 6,000 feet. (*Jas. M. Macoun.*) Not before recorded west of Rocky Mountains.

BOYKINIA NUTTALLII,

Saxifraga elata, Nutt.; Torr. & Gray, Fl., Vol. I., p. 575.

Grassy thickets, Cowichan River, Vancouver Island, 1887. (*John Macoun.*) Near Victoria, Vancouver Island. (*J. K. Anderson.*) American botanists, since the publication of Torrey and Gray's Flora, have, with few exceptions, made *Saxifraga elata,* Nutt., a synonym of *Boykinia occidentalis,* Torr. & Gray. Prof. Greene in Flora Franciscana (Pts. I.–II., p. 190) adopts Nuttall's specific name, but describes *Boykinia occidentalis.* Nuttall says "more or less hirsute with long brownish hairs;" Greene says "glabrous or glandular pubescent;" Nuttall says "a very remarkable, robust species;" Greene says "slender." The leaves of *Boykinia occidentalis* are "thin—membranaceous," in our specimens referred here they are thick—coriaceous. The stem and petioles in our specimens are densely clothed with *long* brown or brownish hairs, and this character with the thick leaves makes it impossible to include them with *Boykinia occidentalis*. Nuttall's description of *Saxifraga elata* answers so well for these plants that they must be referred to that species. We have many sheets of *Boykinia occidentalis* as described by Prof. Greene.

There seems no good reason why *Saxifraga elata* should ever have been made a synonym of *Boykinia occidentalis*, but since this has been done and the name *Boykinia elata* used it seems necessary to re-name Nuttall's plant.

TELLIMA TENELLA, Walp.

Eagle Pass, west of Revelstoke, B.C.; Lytton, B.C.; Yale, B.C.; Cedar Hill and Burnside Road, near Victoria, Vancouver Island. (*John Macoun.*) Telegraph Creek, Lat. 58°, B.C. (*Dr. Geo. M. Dawson.*) Recorded before only from Cypress Hills, Assa.

TIARELLA LACINIATA, Hook.

Additional stations for this plant are Union Village, Comox, Vancouver Island. Herb. No. 227, and Goldstream, Vancouver Island, Herb. No. 228. (*John Macoun.*) Dr. Robinson considers this merely a form of *T. trifoliata*, but the characters separating it from that species are so well marked in all our specimens that Hooker's *T. laciniata* seems certainly to be at least a good variety. The conspicuous characters are terminal leaflet deeply 3-cleft, the lateral ones 2-cleft, the segments laciniate-pinnatifid. We have no intermediate forms between this and *T. trifoliata*.

MITELLA BREWERI, Gray.

New stations for this species are Queest Creek, Shuswap Lake, B.C., alt. 5,000 feet. (*Jas M. Macoun.*) Mountains at Griffin Lake, B.C., alt. 6,000 feet; mountains near Ainsworth, Kootanie Lake, B.C., alt. 5,500 feet; Asoulcan

Glacier, Selkirk Mountains, B.C., alt. 5,500 feet. (*John Macoun.*)

CHRYSOSPLENIUM ALTERNIFOLIUM, L.

New stations for this species are Kicking Horse Lake, Rocky Mountains. (*John Macoun.*) Between the North Thompson and Bonaparte Rivers, B.C. (*Jas. M. Macoun.*) Lat. 62° 40′, Long. 103°. (*Jas. W. Tyrrell.*) Dease River, Lat. 59°, B.C. (*Dr. Geo. M. Dawson.*)

PARNASSIA FIMBRIATA, Kœnig.

Mount Queest, Shuswap Lake, B.C., alt. 6,000 feet. (*Jas. M. Macoun.*) Mountains north of Griffin Lake, B.C.; Barclay Sound, Vancouver Island. (*John Macoun.*) Not before recorded west of Selkirk Mountains.

PARNASSIA KOTZEBUEI, Cham. & Schl.

Damp banks, North Twin Island, James Bay, Hudson Bay; Mount Queest, Shuswap Lake, B.C.; Avalanche Mt., Selkirk Mts., B.C., alt. 7,500 feet. (*Jas. M. Macoun.*) Not before recorded from Hudson Bay or west of Rocky Mountains in Canada.

PARNASSIA PARVIFLORA, DC.

Grassy banks, Severn River, Keewatin; head of Deadman River, B.C. (*Jas. M. Macoun.*) Western limit.

RIBES AUREUM, Pursh.

Seven Persons' Coulee, Medicine Hat, Assa. (*John Macoun,* Herb. No. 4929.)

RIBES BRACTEOSUM, Dougl.

Low grounds, New Westminster Junction, B.C.; Burrard Inlet, B.C. (*John Macoun.*) Not before recorded from mainland of British Columbia.

RIBES HUDSONIANUM, Rich.

In swamps at Madoc, Hastings Co., Ont. (*W. Scott.*) Eastern limit.

RIBES LAXIFLORUM, Pursh.

In damp woods near the summit of the Selkirk Range, B.C. (*John Macoun.*) Eastern limit.

RIBES VISCOSISSIMUM, Pursh.

New stations for this species are Sicamous, B.C., and Deer Park, Lower Arrow Lake, B.C. (*John Macoun.*)

SEDUM DOUGLASII, Hook.

Deer Park and Sproat, Columbia River, B.C.; Sicamous, B.C.; Mount Finlayson and Victoria Arm, Vancouver Island. (*John Macoun.*) Not before recorded west of Rocky Mountains.

DROSERA ANGLICA, Hudson.

Revelstoke, B.C.; Horne Lake, Vancouver Island. (*John Macoun*). Not before recorded from interior of British Columbia nor from Vancouver Island.

MYRIOPHYLLUM SPICATUM, L.

In pools on the Indian Reservation at Kamloops, B.C.; Somas River, near Sproat Lake, Vancouver Island. (*John Macoun.*) Not before recorded west of Selkirk Mountains.

MYRIOPHYLLUM VERTICILLATUM, L.

Rivière des Aulnais, Hebertville, Que. (*St. Cyr.*) Not before recorded from Quebec.

HIPPURIS MONTANA, Ledeb.

Peaty places on all the higher mountains of the Selkirk

Range, B.C., near the Can. Pac. Ry.; mountains north of Griffin Lake, B.C. (*John Macoun.*)

Œnothera pumila, L.

On a barren, uncultivated slope at New Westminster, B.C., 1895. (*A. J. Hill.*) Not before recorded west of Ontario. Perhaps introduced, but thought to be indigenous by Mr. Hill.

Œnothera andina, Nutt.

In a depression on the prairie near Police Point, Medicine Hat, Assa., 1894, Herb. No. 7531. On prairies near Pend d'Orielle Post, Milk River, Assa., 1895. Herb. No. A1001. (*John Macoun.*) New to Canada.

Lythrum Salicaria, L.

Near the old rifle range, Ottawa, Ont., 1895. (*A. L. Tourchat.*) Not recorded from Eastern Ontario. Mr. Tourchat's specimens are of the glabrous form with long style and medium stamens. All our other specimens are pubescent or hoary and have medium styles and long stamens.

Solidago lanceolata, L.

Okanagan Lake, B.C. (*Jas. McEvoy.*) Not recorded west of Rocky Mountains.

Adenocaulon bicolor, Hook.

Indian Reserve, Cape Croker, North Bruce, Ont., 1895. (*A. Y. Massey.*) Eastern limit. Not before collected in Canada east of the Rocky Mountains.

Ambrosia trifida, L.

Along the Can. Pac. Ry., at Revelstoke, B.C.; barn-yards near Victoria, Vancouver Island, Herb. No. 437. (*John Macoun.*) Probably introduced in both cases. Not recorded west of Manitoba. The Cypress Hills specimens referred here in Prof. Macoun's Catalogue of Can. Plants are var. *integrifolia.*

RUDBECKIA PINNATA, Vent.

Vicinity of Sandwich, Ont. (*John Macoun. Alex. Wherry.*) New to Canada.

MICROSERIS NUTANS, Gray.

Amongst grass on hillsides at Deer Park and Sproat, Columbia River, B.C., 1890. (*John Macoun.*) Credited to British Columbia by Gray, but not before collected by Canadian botanists.

CREPIS RUNCINATA, Torr. & Gray.

Dampish spots at Revelstoke, B.C., 1890. (*John Macoun.*) Not recorded west of Rocky Mountains.

CREPIS INTERMEDIA, Gray, var. GRACILIS, Gray.

Dry slopes at Spence's Bridge, B,C., 1889. (*John Macoun.*) New to Canada.

LOBELIA KALMII, L.

Rocky shores of Kootanie Lake at Ainsworth, B.C. (*John Macoun.*) Western limit.

SPECULARIA PERFOLIATA, A. DC.

Sproat, Columbia River, B.C. (*Dr. Geo. M. Dawson.*) Ainsworth, Kootanie Lake, B.C., and Agassiz, B.C. (*John Macoun.*) Not before recorded from interior of British Columbia.

HETEROCODON RARIFLORUM, Nutt.

Grassy slopes at Sproat, Columbia River, B.C. (*John Macoun.*) Not before recorded from mainland of British Columbia.

PTEROSPORA ANDROMEDA, Nutt.

Wooded mountain slopes west of Lake Okanagan, B.C., 1890. (*Jas. McEvoy.*) Not before recorded from mainland of British Columbia.

GENTIANA DOUGLASIANA, Bong.

Mount Head, Burrough Bay, B.C., 1894. (*H. W. E. Canavan.*) Yakoun Lake, Queen Charlotte Islands, 1895. (*Dr. C. F. Newcombe.*)

GENTIANA HUMILIS, Stev.

On the north side of an old creek bed on the south bank of the Bow River at Langevin Bridge, Alberta, 1894. (*J. J. Morgan.*) New to Canada.

GENTIANA LINEARIS, Frœl.

Not rare in the interior of Labrador from the East Main River on the west to the Hamilton River on the east. (*A. P. Low.*)

PHLOX MACULATA, L.

Ravine at Granby, Que., 1892. (*Wm. Scott.*) High Falls, Lièvre River, Que., 1895. (*R. B. Whyte.*) New to Canada.

BARTSIA ALPINA, L.

Lake Petitsikapau, Hamilton River, Labrador, 300 miles from the coast. (*A. P. Low.*) Not before recorded from interior of Labrador.

BRUNELLA VULGARIS, L.

Attikonak Branch, Hamilton River, Labrador, 1894. (*A. P. Low.*) Not before recorded from Labrador.

QUERCUS PRINUS, L.

A few trees grow near the St. Lawrence River at Lansdowne, Ont. Noted by the Rev. C. J. Young in 1894, fruiting specimens collected in 1895. This is the only authentic record for this species east of Niagara. The undulately-crenate leaves of this species, pale and minutely downy beneath, make it very easy of determination. Specimens from the Bay of Quinté are *Quercus Muhlenbergii*, (*Q. prinoides* of Macoun's Cat. of Can. Plants.)

TOFIELDIA GLUTINOSA, Willd.

Attikonak Branch, Hamilton River, Labrador, 1894. (*A. P. Low.*) Not before recorded from Labrador.

DULICHIUM SPATHACEUM, Pers.

Craigellachie, Eagle Pass, B.C.; Stanley Park, Vancouver, B.C. (*John Macoun.*) Not before recorded between the Saskatchewan and Vancouver Island.

CAREX SCIRPOIDEA, Michx.

On the route between Sandy Lake and Lake Michikamau, Labrador, 1894. (*A. P. Low.*) Not before recorded from Labrador.

CAREX CAPILLARIS, Linn.

On the route between Sandy Lake and Lake Michikamau, Labrador, 1894. (*A. P. Low.*) Not before recorded from Labrador.

ALOPECURUS GENICULATUS, Linn., var. ARISTULATUS, Munro.

On the route between Sandy Lake and Lake Michikamau, Labrador, 1894. (*A. P. Low.*) Not before recorded from Labrador.

MUNROA SQUARROSA, Torr.

Near the police barracks, Medicine Hat, Assa., 1894. (*John Macoun*, Herb. No. 7452.)

On the Norian or "Upper Laurentian" Formation of Canada.

By Frank D. Adams, M.A.Sc., Ph.D.

(Translated from the German by N. J. Giroux, Esq., C.E., of the Geological Survey of Canada.)—*Concluded.*

IV. VARIOUS OTHER ANORTHOSITE AREAS.

(*a*) In Labrador.

Although the first specimens both of labradorite and hypersthene, so characteristic of the anorthosite, were brought from the coast of Labrador, their distribution and mode of occurrence in this distant region is as yet but comparatively little known. That they really come from anorthosite areas which are similar to those above described, and which belong to the same great system of intrusions, is, however, evidenced by what has been reported of them by several travellers.

The opalescent labradorite and the hypersthene of Labrador were mostly found in loose blocks and fragments which belong to the drift formation, and lie abundantly scattered about on St. Paul's Island and in the neighbourhood of Nain. But, according to Reichel,[1] Steinhauer,[2] and Bindschedler,[3] a rock which contains them is found *in situ* in the neighbourhood of the latter place. The main mass, however, according to the statements of Lieber,[4] Steinhauer, and Bindschedler, must be situated farther inland; the latter gives the most accurate information about it in stating that it occurs at the north-west end of a large lake about 30 or 35 nautical miles north-west of Nain. He was there himself in the

1 Reichel, Labrador, Bemerkungun uber Land und Leute. Petermann's Mitth. 1863, p. 121.

2 Steinhauer, Note relative to the Geology of the Coast of Labrador. Trans. Geol. Soc., Vol. II., 1814.

3 Bindschedler, quoted by Wichmann, Zeitschr. d. Deutsch. geol. Ges. 1884, p. 486.

4 Lieber, Die amerikanische astronomische Expedition nach Labrador im Juli 1860. Petermann's Mitth. 1861, p. 213.

year 1882 and found the rock only in one place, where. however, it formed a high cliff. The extent of this mass is therefore not known, and for that reason its position only is indicated on the accompanying map.

It is to Packard that we are mostly indebted for our present knowledge of the geology of the coast of Labrador. In his memoir entitled "Observations on the Drift Phenomena of Labrador and Maine," published in 1865, he gives a general review of the geology of the southern half of the east shore of the peninsula, which is repeated, with a few trifling alterations, in his book entitled "The Labrador Coast," published in 1891. In the latter he gives a small geological sketch map. Speaking generally, the peninsula of Labrador consists, as far as we know, of Laurentian gneiss, with certain occurrences of eruptive rocks. The gneiss has, generally, a rather granite-like character, and probably belongs to the Lower Laurentian or Ottawa gneiss. On the latter, however, there lies, in a trough (almost 125 miles long by 25 miles wide, which follows the coast all along from Domino harbour to Cape Webuc), a series of beds of a light-coloured gneiss, rich in quartz, better foliated, and often containing much hornblende. Lieber called this rock the "Domino-gneiss." A peculiar variety of trap is constantly found in connection with this. Packard says that it represents a higher, and probably an unconformable, group of Laurentian rocks which correspond with the Grenville division of the interior of Canada.

Near Square Island, toward the southern end of the coast, in the neighbourhood of the strait of Belle-Isle, there occurs, along with the lower gneiss, a rock concerning which Packard says: "There occurs in large conical hills what I judge to be the great anorthosite formation of Logan and Hunt, composed of large crystalline masses of labradorite, with a little quartz, and coarse crystalline masses of hornblende. The labradorite is of a smoky colour, very lustrous, translucent, and opalescent, with cleavage surfaces often two inches in diameter, and on some of the faces presents a greenish reflection. This is but a slight approach to the green-blue reflections of the precious labradorite, which I have seen only at Hopedale, where we obtained specimens brought from the interior by the Eskimos. As the rock weathers, the greenish hornblende crystals project in masses, sometimes two inches in diameter. The gneiss rests on the south side of the hills. From the top of the hills here can be seen huge gneiss mountains at least two thousand feet high, rising in vast swells at a distance of fifteen to twenty miles in the interior, while the bay is filled with innumerable skiers and islets of gneiss."

This quotation is taken from the book. In the above-mentioned essay he calls the mineral which accompanies plagioclase, hypersthene and not hornblende. We probably have here, as Packard says, a large area of anorthosite in the southern part of Labrador. As already mentioned, the "Domino" or upper gneiss is invariably accompanied by what Packard designates as "overflows of a peculiar trap rock evidently of the age of the Domino gneiss, which it has somewhat disturbed." The trap is said to have a coarse porphyritic structure, and to consist of coarsely foliated masses of hypersthene and smoke-grey labradorite, and to resemble exactly that which has been described from Square Island, and which, according to Packard, has originated from the remelting and extrusion of the other anorthosite.

This goes, therefore, to prove that in Labrador the anorthosite occurs in two entirely different and widely different regions: First to the north, in the interior, and in the neighbourhood of Nain, where the precious anorthosite occurs; and secondly, in the southern part of the peninsula, in the neighbourhood of Square Island.

The mineralogical composition of the rock which contains the precious labradorite has been the subject of investigation ever since this mineral has been known. Occasional hand specimens of the rock which have come to Europe with shipments of labradorite have been there examined by many petrographers, and it has been found to vary considerably. It has been called a gabbro,[1] a norite,[2] an olivine-norite,[3] a labradorite rock, etc.; and whilst considered a volcanic rock by some, it has been considered by others, on account of its irregular granulation, to be rather referable to the crystalline schists.[4]

Wichmann also described, from the same region, a diallage-magnetite rock, with olivine, plagioclase and biotite as accessories.

The anorthosite masses of this northern area have evidently the same character as those described above from the Morin and Saguenay districts, where hand specimens of all the varieties may sometimes be collected in one and the same locality. Wichmann has analysed the labradorite rock, which consists of plagioclase and only a little augite (see table of analyses, p. 436, No. XIX.) He says that this is the prevailing rock about Nain. Bell,[5] on the contrary, in his geological description of this part of the coast of Labrador, does not mention any such rock as occurring in the neighbourhood of Nain; he mentions that the mountains in the immediate vicinity consist of a "pale grey gneiss." Cohen also mentions quartz as an ingredient of the hand specimens he examined. This mineral was also found in small quantity in the anortho-

1 M. Cohen, Das Labradorit-fuhrende Gestein an der Kuste von Labrador. Neues Jahrb. 1885, I., p, 183.—H. Vogelsang, Sur le Labradorite coloré de la Côté du Labrador. Arch. Néerland, T, III., 1868.

2 J. Roth, Uber die Verkommen von Labrador. Sitz. Berlin. Akad. 1883, p. 697.

3 Van Werveke, Eigenthumliche Zwillingsbildungen, etc. Neues Jahrb. 1883, II., p. 97.

4 A. Wichmann, Uber Gesteine von Labrador. Zeitschr. d. Deutsch. Geol. Gesellsch. 1884, p. 485.

5 Bell, Report of the Geol. Surv. of Canada, 1882-84, D. D., p. 11.

site of Chateau Richer, as well as in that of St. Pauls Bay and of New York. It is, however, probably of secondary origin.

(*b*) In Newfoundland.

This occurrence was first mentioned by Jukes,[1] and was later briefly described by Murray in his "Report of the Geological Survey of Newfoundland, 1873," p. 335. The anorthosite occurs, along with Laurentian gneisses, in the region of the Indian Head, Cairn Mountain, and of the Little Barachois River at the south-west extremity of the Island of Newfoundland. Its exact composition is not yet known. On Murray's geological map of Newfoundland, the indicated area has a length of 60 miles; it is comparatively narrow, and is divided into two parts by a tongue of Carboniferous rocks which partly cover it.

The only hand-specimen of this rock which could be obtained came from Cairn Mountain. It is rather coarsely granular and exactly resembles many of the anorthosites of Morin and the Saguenay, except that it is reddish in colour while those from the latter places are dark blue or grey. It consists almost exclusively of plagioclase; under the microscope, as in the case of so many anorthosites, cataclastic structure in all stages is to be observed. Some individuals have curved twinning lamellæ others are already bent and broken; granular plagioclase is found between them. This finely granulated material forms the principal part of the rock, and in the hand-specimens the larger cystal fragments are imbedded in it. The ordinary inclusions in the plagioclase are very numerous but very fine, and resemble a fog or mist, giving, as already mentioned, a reddish and not a dark blue colour to the rock. Of other ingredients only a few grains of pale green augite were found, often altered into a mixture of chlorite, epidote, and pale green hornblende, with a few small grains of iron ore.

1 Jukes, A General Report on the Geological Survey of Newfoundland, 1839-1840. London, 1843.

(*c*) On the North Shore of the Gulf of St. Lawrence.

We know that anorthosites occur, associated with Laurentian gneisses, at many points of this coast, but we possess little information concerning the extent and stratigraphical relations of the several occurrences.

Hind[1] and Cayley,[2] who ascended the Moisie River and its arm, the Clearwater, met with a mass of this rock which extends from the mouth of the North East River to a point four miles up the Clearwater. This is a distance of nearly twenty miles, after which the gneiss occurs again. We do not yet know how wide this area is, but Hind ascertained that the Clearwater flows through a gorge, 2,000 feet deep, cut in the anorthosite. Details of the structure and composition of the rock have not yet been ascertained.

Westward of the Moisie, anorthosite was found in large exposures at different places along the whole coast as far as Pentecost River. Richardson undertook a geological survey of this region in the year 1869.[3] The anorthosite, which here again presents many varieties in character and appearance, was described by him as coloured bluish or greenish and nearly identical with that of the Morin area. Gneiss occurs, likewise, on the coast, and we have no knowledge as to how far the anorthosite may extend to the north. These occurrences are, however, of particular interest, because the anorthosite is here often "bedded," or foliated. The parallel structure is indicated by grains of mica, garnet, iron ore, hypersthene, etc.; and the apparent strike is on an average east by west, generally with a northerly dip varying from 10° to 80°. The general strike of the gneiss in this region is nearly north and south, according to Richardson, who concludes from

1 Hind, Explorations in the Interior of the Labrador Peninsula. London, 1863. Observations on the Supposed Glacial Drift in the Labrador Peninsula, etc.—Quart. Jour. Geol. Soc., Jan. 1864.

2 Cayley, Up the River Moisie.—Tr. Lit. & Hist. Soc. of Quebec, 1862, p. 73.

3 Richardson, Report of the Geological Survey of Canada, 1866-1869.

this that the anorthosite is a sedimentary formation which lies unconformably on the gneiss.

This occurrence became frequently cited as a proof that the anorthosite forms a series of beds which overlie the gneiss unconformably.

Richardson's examination of the district was, however, very general, and no one has visited the district to corroborate his observations. It may therefore be advisable not to draw from the evidences adduced by him the hasty conclusion that these rocks here exhibit stratigraphical relations differing widely from those in other places.

The gneiss often shows, according to him, "little or no evidence of stratification;" and in the only place where the anorthosite was found in contact with the gneiss, the latter was a "reddish quartzose granitoid rock offering no evidence of stratification." He does not adduce any example of gneiss and anorthosite being found in close proximity with different strikes. A careful investigation of the geognostical relations would probably show that here, as in the Morin area and elsewhere, the alleged proof of the unconformity is only apparent, and that in reality the schistose varieties of the rock are really only portions of eruptive masses which acquired their schistose structure through pressure. The only hand-specimen of anorthosite of this part of the coast which I have seen came from the "Bay of Seven Islands," and exhibited throughout the properties of a massive eruptive rock.

At Sheldrake, about 60 miles east of the mouth of the Moisie, the coast, according to Selwyn,[1] likewise consists of "massive labradorite rocks," with beautiful opalescent labradorite. The rock extended to a considerable distance inland, but it is not known how far. It is possible, as Selwyn conjectures, that it is continuous with the area above described on the Moisie River, and that the latter

1 Selwyn, Summary Report of the Geological Survey of Canada, 1889, p. 4.

is in turn continuous with the area described by Richardson further west along the coast.

As early as the year 1833, Bayfield[1] mentioned labradorite and hypersthene as occurring farther eastward on the coast of the St. Lawrence, at a place about five leagues east of Ste. Genevievre, or about north of the middle of the Island of Anticosti.

(*d*) ON THE NORTH SHORE OF THE RIVER ST. LAWRENCE.

Anorthosite occurs in extended areas on the north shore of the River St. Lawrence, east of the City of Quebec, at two localities. The first, near Chateau Richer, below Quebec, and the second in the neighbourhood of St. Urbain and St. Paul's Bay, further east. Both occurrences are quite extensive and probably parts of the same great mass, which may possibly have an extension of about 70 miles along the river. These areas have not yet been carefully investigated; a short description of them is found in the Report of the Geological Survey of Canada for 1863. They are now being mapped by Mr. A. P. Low, of the Geological Survey of Canada, whose report on them will appear shortly.

Particular attention has been directed to the St. Urbain area, because considerable beds of ilmenite were found in it. This mineral is very rich in titanic acid, and is here and there associated with rutile. Many years ago an attempt was made on a large scale to smelt this bed for iron; blast furnaces were erected and plans made for the establishment of a whole settlement. The work, however, was abandoned, as the ore was too refractory owing to its high percentage of titanic acid.

I am indebted to Mr. Low for a series of small hand-specimens of the rocks of both these localities, from which thin sections were prepared. Their study shows that

1 Bayfield, Notes on the Geology of the North Coast of the St. Lawrence.—Trans. Geol. Soc. of London, Vol. V., 1833.

the rock consists almost entirely of plagioclase. Nearly all the sections show a distinct cataclastic structure; and the remnants of the larger individuals of plagioclase are sometimes still to be observed. Moreover, a few grains of iron ore are always present, and in many other thin sections a few grains of pyroxene, hornblende, or biotite were likewise observed. A little quartz is also present at times, and may be of secondary origin.

The rock of Chateau Richer occupies a peculiar position in as far as its plagioclase, at least in one case, was more acidic than in any of the anorthosite occurrences heretofore investigated. Analyses made by Sterry Hunt are noted on page 436, No. I., II., III. These analyses also furnish the proof that the large individuals of plagioclase and the crushed plagioclase, which forms the ground mass or paste, have, as above mentioned, the same chemical composition.

(*e*) In the State of New York, U. S. A.

As early as 1842, Emmons mentioned in his "Report on the Geology of the Second District of the State of New York," the presence of a large mass of this rock in the County of Essex, New York. It occurs at the eastern point of the large peninsula, or, properly speaking, island, of Laurentian rocks, which, as above mentioned, here extend from Canada into the United States. The extent of the area is such that its boundaries approximately coincide with those of Essex County. Emmons gives an excellent general description of the rocks in the area; but since his report was written long before the beginning of modern petrography it refers only to their macroscopical character. In the year 1876, Leeds, in his paper entitled "Notes upon the Lithology of the Adirondacks,"[1] gives the results of a further examination of several hand-specimens of these rocks, treating, however exclusively,

1 Thirtieth Annual Report of the New York State Museum of Natural History, 1876.

of their chemical composition. Four analyses made by him are noted on page 436.

If we add to these works a short essay by Hall,[1] we have all that has been published up to date on this area, which certainly deserves a more careful study.[2] The precise relations of these anorthosites to the surrounding gneiss are not yet known. Emmons says they gradually pass into one another, whereas Hall maintains that the anorthosites lie unconformable on the gneiss. He goes even so far as to pronounce the crystalline limestone which occurs with the gneiss to be a distinct series unconformably overlying the gneiss and the anorthosite. All the other geologists have considered these here as in Canada to be members of the Laurentian. These conclusions were, moreover, drawn by him without making an accurate geological investigation of the whole district, which alone, in such a series of folded rocks, would render it possible to form an accurate opinion. Such an investigation would in all probability show that the anorthosite here cuts through the gneiss as it does in Canada.

The rock is sometimes massive, sometimes indistinctly streaked or foliated, showing sometimes very clearly the peculiar brecciated structure which was described in the rocks of Morin and of the Saguenay, where fragments, often of considerable size, of the dark coloured and frequently opalescent plagioclase are imbedded in a lighter coloured mass of the same mineral. Here likewise the plagioclase predominates, the rock consisting often entirely of this mineral. Hypersthene, diallage, hornblende, biotite, garnet and iron ore sometimes occur along with the plagioclase. Epidote and prehnite were found as secondary

1 Hall, Note on the Geological Position of the Serpentine Limestone of Northern New York, etc.—Am. Jour. Sc., July, 1876.

2 NOTE.—Since the publication of the present paper, in 1893, several important contributions to our knowledge of this district have appeared by J. F. Kemp, C. H. Smyth, Jr., and C. R. Van Hise. See list of papers on page 442.

constituents. According to Emmons, quartz is not found in the rock itself, but occurs only in small infiltrated veins and fissures.

A hand-specimen of this anorthosite from the neighbourhood of the Poke o' Moonshine Pass, in Essex County, for which I am indebted to Professor G. H. Williams, did not differ at all from the more highly granular varieties of the Morin and Saguenay areas. It is rather coarse, granular, grey in colour, and composed almost exclusively of plagioclase. This mineral has a white or grey colour, but a few dark blue fragments of larger grains indicate that the rock has undergone a thorough granulation. We find, furthermore, a little pyroxene, which is almost completely changed into zoisite, epidote and chlorite, and a few small red, isotropic garnets, whose presence indicates that the hand-specimens probably came from near the limit of the area, and a few grains of rutile. A little quartz is also present, the grains of which are at times intermixed with the feldspar, producing a kind of granophyric structure. It might be inferred from this that the quartz is an original constituent, but this cannot be definitely demonstrated.

The relation existing between these rocks, and the character of the iron ores which accompany them, which has already been discussed above, is also discernible in this area. Whenever iron ores are found in the anorthosite, they without exception contain titanic acid, while the large deposits in the Laurentian gneisses, in the neighbourhood of Port Henry and elsewhere, consist of magnetite free from titanic acid. As far as can be ascertained from existing descriptions, these New York anorthosites resemble in all respects those found in the Canadian Laurentian.

(*f*) On the East Coast of the Georgian Bay, on Lake Huron.

Bigsby[1] described, long ago, an occurrence of anorthosite on the north-east coast of Lake Huron, which, according to him, has a breadth of five miles. He also mentions that the rock is well exposed and has a massive character, but gradually merges into gneiss. The feldspar is greenish-blue and grey in colour; it forms crystals of an average diameter of about one inch, and sometimes much larger. Unfortunately, the locality is not indicated exactly, but according to his description it must be in the neighbourhood of Parry Sound, and I have therefore on the map indicated the occurrence in that vicinity. According to Bell,[2] Long Inlet, ten and a half miles long and situated farther south on the same coast, is likewise cut in a band of white granular plagioclase, mixed with a little quartz and black mica.

(*g*) Elsewhere in Canada.

The occurrences of anorthosite above described are the only large and important ones that are known. Elsewhere in the Laurentian, small bands and bosses of the rock are found, but they are too small and unimportant to deserve further mention. They occur, for the most part, in the neighbourhood of the masses above described. Other occurrences have been referred to this group of rocks, but it is not known as yet whether they really belong to it. Vennor, for example, mentions one in the Laurentian, north of the east end of Lake Ontario. There is also an occurrence in the vicinity of Dolin's Lake, near the City of St. John, New Brunswick. An examination of a specimen from the last mentioned locality shows it to be an olivine-gabbro.[3]

1 Bigsby, A List of Minerals and Organic Remains occurring in the Canadas.—Am. Jour. of Sc., 8, 1824.

2 Bell, Rep. of the Geological Survey of Canada, 1876-77, p. 198,

3 Note.—See also a paper by Dr. A. C. Lawson, which has appeared since the publication of the present paper, entitled "The Anorthosytes of the Minnesota Coast of Lake Superior."—Geol. and Nat. Hist. Surv. of Minn. Bull. No. 8, 1893.

V. AGE OF THE ANORTHOSITE INTRUSIONS AND THEIR RELATION TO THE MARGIN OF THE ARCHÆAN PROTAXIS.

The North American Continent, as is well known, is built up around a skeleton or nucleus of crystalline rocks, called by Dana the protaxis of the continent, and by which the general outline of the continent is defined.

The most important portion of this protaxis is the large area of Laurentian, together with the Huronian, which lies almost entirely within the boundaries of the Dominion, forming the "Canadian shield," with the bordering ranges of the coast of Labrador. It is a large triangular area, whose sides, towards the south-east and the south-west, form tangents to the arctic circle, and which, towards the north, extends up into the polar regions far beyond the limits of exploration, where, however, it is overlaid to a considerable extent by more recent rocks. A range of these Archæan rocks extends likewise along the Atlantic coast, where it appears, with certain interruptions, in the Appalachian chain, extending from Georgia, in the United States, to the Gaspé peninsula in Canada. It is succeeded to the east by a second range, partly under water, and portions of which are seen in Nova Scotia and elsewhere along the Atlantic coast. Corresponding to these two areas, there occur also, on the western side of the continent, nuclei of these old crystalline rocks, which appear in the line of the Rocky Mountains and in the coast Ranges.

The greater portion of the main protaxis, as well as the distribution of the Laurentian and Huronian rocks, with that of the palæozoic beds overlying them, are represented on Map No. 1. The southern limit of the protaxis extends westward beyond the map, and runs in a north-westerly direction nearly as far as the Arctic Ocean, which it almost reaches in the region of Franklin's Bay, east of the mouth of the Mackenzie River.

It is not necessary here to discuss at greater length the origin of this great complex of gneisses and other crystalline rocks which make up the protaxis. Let it suffice to remark that sedimentary deposits doubtless participate in the composition, at least of the Upper Laurentian (Grenville division) and the Huronian.

The Appalachian protaxis, especially that part which lies in Canada, has probably been uplifted through more recent foldings, but it had attained the main features of its present form as early as the Cambrian period. It is probable, however, that at that time, just as later, in the Lower Silurian period, a large area in the interior of the chief protaxis around the Hudson Bay was covered by the sea. Round about this already folded protaxis the sediments were deposited during the Cambrian, Silurian, Devonian and later periods, while the intrusions of anorthosite took place along the edge of the main protaxis—that is, of the old continent—and formed a belt around the oceanic basin, in which the Cambrian rocks were afterwards deposited. These sediments were, first in Upper Silurian times but repeatedly during subsequent ages, subjected to great lateral pressure, exerted from the direction of the Atlantic basin. These sedimentary rocks, together with the crystalline rocks of the Apalachian protaxis, were. in this manner thrown up in a series of great folds which form the Apalachian chain.

These foldings were naturally accompanied by deep-seated alteration and metamorphism, and resulted in the development of a great fault along the west side of the chain, which extends in a southerly direction into the United States. To the west of this fault lie the horizontal and unaltered Cambrian and Silurian strata which form the great plains of Central Canada.

These horizontal and unaltered beds of Cambrian (Potsdam and Calciferous) and Silurian age, lie directly on the tilted edges of the folded Laurentian rocks of the chief protaxis as well as upon the accompanying anorthosites, both of which had been deeply eroded before their deposition.

The intrusions of anorthosite are therefore undoubtedly of pre-Cambrian age.

Furthermore, although somewhat younger than the Laurentian, which they cut, the eruptions must have taken place before the pre-Cambrian dynamic movements, by which the Laurentian was folded, had ceased, for the anorthosites were in part at least crushed with the Laurentian, and then, with them, eroded in pre-Cambrian times.

Their relation to the Huronian is not known, since they have not yet been found in contact with it. But they are probably not of Huronian age, since enormous eruptions of volcanic rocks took place also during the Huronian time, and these have quite a different character, being diorites.

The anorthosite intrusions, therefore, took place toward the close of, or soon after, the Laurentian period.

A noteworthy fact in connection with these anorthosites is their distribution along the southerly and easterly limits of the protaxis, bordering the great ocean basin in which the Cambrian rocks were deposited later on. In those ancient times the eruptive rocks apparently followed the same law as now obtains in the distribution of volcanoes, namely, that they occur along the borders of the continents as belts around great oceanic depressions. It might be objected that this regular distribution is perhaps more apparent than real, the protaxis having been more thoroughly explored along its borders than elsewhere; but this objection is not valid. A few more small areas may perhaps occur elsewhere in the Laurentian, but Dr. Bell, Mr. Low,[1] and Mr. Tyrrell, who have been chiefly engaged in its exploration, consider it to be very improbable that any other considerable undiscovered area should still exist in the interior of the great Laurentian continent. The courses of the large rivers which flow from the east and from the west into the southern half of the Hudson Bay, have been explored, but no trace of these rocks have been found. Dr. G. M. Dawson also informs me, that in carefully going over the whole literature concerning the arctic regions of Canada, when constructing his geological map of the northern part of the Dominion of Canada, he could find no mention of rocks of this character. We may, however, expect that similar occurrences will be found on the south-west limit of the protaxis between Lake Superior and the Arctic Sea; but up to the present time none have been discovered. It is, however, quite possible that they may exist, covered by the palæozoic strata; for strata of Silurian and Devonian age extend along the side of the protaxis, and the underlying Cambrian rocks which would indicate more exactly the border of the old continent are here, if they exist at all, overlaid and concealed by these more recent deposits.

VI. THE OCCURRENCE OF SIMILAR ANORTHOSITES IN OTHER COUNTRIES.

The largest developments of anorthosite with which we are acquainted outside of Canada is probably found in Norway. The rock called by the Norwegian geologists Labrador rock, as well as some of Esmark's norites and many of the so-called gabbros, are anorthosites.

These rocks have been described by Kjerulf,[2] Reusch,[3] and others. They form enormous mountain masses, and

1 Report of the Geological Survey of Canada, Part R., 1886.

2 Kjernulf, Die Geologie des sudl. und mittleren Norwegen, p. 261, ff.

3 Reusch, Die fossilien fuhrenden krystall. Schiefer von Bergen, p. 84 ff.

are, as in Canada, sometimes of a violet, sometimes of a brown colour, and again, sometimes, as white as limestone. They are sometimes massive and sometimes banded or foliated. Many of these hand-specimens can not be distinguished at all from the corresponding varieties of Canadian anorthosites.

They are intrusive rocks, and generally break through the gneiss. But in Laerdal and Vos-Kirchspiel, according to Kjerulf, these cut through beds of the primordial age, and are therefore probably somewhat more recent than the Canadian anorthosites, which are overlaid by strata of Upper Cambrian age. An accurate comparison of the rocks cannot yet be made since the Norwegian occurrences have not yet been investigated in detail. But so far as we know at present, the rocks of the two countries are identical.

In southern Russia, near Kamenoi-Brod, in the government of Kiew, and in many other places in the governments of Volhynia, Podolien and Cherson, large areas of anorthosite also occur. In these the labradorite predominates to such an extent that all the other constituents almost disappear. The rock occurs in some places in a coarsely granular form, which is dark violet or almost black in colour, and elsewhere as a porphyritic variety with large dark-coloured individuals of plagioclase in a light grey ground mass. These varieties are said to pass into one another. Where the coarsely granular variety contains pyroxene, it shows ophitic structure like that observed in some parts of the Saguenay area. According to the description of these rocks by several authors,[1] they must resemble in a remarkable manner the anorthosites described in this paper, and also exhibit the same varieties.

1 Schrauf, Studien an der Mineralspecies Labradorit. Sitzungsber Wiener Akad. 1869, p. 996.—W. Tarrasenko, Uber den Labradorfels von Kamenoi Brod. Abhandl. d, Naturw. Ges. in Kiew. 1886, p. 1-28.—M. K. De Chroustchoff, Notes pour servir a l'étude lithologique de la Volhynia. Bull. Soc. Min. France, IX., p. 251 (weitere Literaturangaben enthaltend).

They are found in the great district of granitic rocks which occupy this portion of the Russian Empire. The portion which lies in the government of Volhynia is classified by Ossowski as Laurentian. The magnificent pillars of labradorite in the Church of Our Saviour in Moscow, are from the quarries in these rocks.

Another occurrence of anorthosite of particular interest is found in Egypt. Sir William Dawson, while on a visit to that country in the year 1883, observed a rock that resembles exactly the bedded variety of the Morin anorthosite, and which had been used for the magnificent statue of Kephren, the builder of the second pyramid. This statue now stands in the Gizeh Museum, with a few other fragments of statues of the same material. Through the kindness of the curator of the Museum, Sir William obtained a few small pieces of the rock for examination. In the hand-specimen the rock cannot be distinguished from the granular anorthosite which is found in the neighbourhood of New Glasgow in the Morin area. It is fresh,[1] bright grey in colour, and almost entirely composed of plagioclase, with a little hornblende, which mineral is occasionally intergrown with pyroxene. It is the foliated variety of the anorthosite, and the dark lines which are caused by the presence of hornblende can plainly be distinguished in the statue, especially on the right side. Sir William did not find the rock in place, but Newbold appears to have found it among the very ancient rocks which form the mountain chain stretching along the coast of the Nile. It probably has there the same geognostical relations as in Canada. It was probably prized by the Egyptian sculptors for the reason that it possesses a pleasing colour, similar to marble, and that it takes a better polish, being considerably harder.

These anorthosites, therefore, are found in four of the countries where the Archæan has an extensive develop-

1 Dawson, Notes on Useful and Ornamental Stones of Ancient Egypt.—Trans. of the Victoria Institute, London, 1891.

ment: in Canada, in Norway, in Russia, and in Egypt. They are found in enormous masses in the first three countries, and their extent is not yet known in the last mentioned. To these occurrences others will probably be added as the Archæan of other parts of the world is carefully studied.

VII. SUMMARY OF RESULTS.

1. The "Upper Laurentian," or the "Anorthosite group" of Sir William Logan, does not exist as an independent geological formation.

2. The anorthosite, which was considered to be its principal constituent, is an intrusive rock of the gabbro family, and is characterized by a great preponderance of plagioclase, of which mineral the rock is, in fact, often entirely composed.

3. The rock is in places perfectly massive, but it generally exhibits the irregular structure which is so often observed in the gabbros, and which is brought about by a variation in the size of the grain or of the proportion of the ingredients from place to place. In addition to this original structure, the rock almost always shows a peculiar cataclastic structure which is especially well developed in the foliated varieties. This differs from the structures characteristic of dynamic metamorphism in the great mountainous districts of the world, being produced by movements in the rock mass while this was still deeply buried in the crust of the earth, and probably very hot—perhaps near its melting point.

4. In all the cases of supposed unconformable superposition of the anorthosite upon the Laurentian gneisses, which have been carefully investigated, the unconformability is found to be due to intrusion.

5. The rock occurs in a series of isolated areas, some ef which are of enormous extent.

6. These areas are without exception at or near the

margin of the main Archæan protaxis of the North American continent, exactly as the volcanoes of the present time lie along the edges of continents.

7. They are undoubtedly of pre-Cambrian age, and have probably originated toward the close of the Laurentian.

8. The Laurentian system in the eastern part of Central Canada consist of two sub-divisions, which were by Logan classed as Lower Laurentian:

(1) Upper, or Grenville division;
(2) Lower, Ottawa or Fundamental gneiss.

The Grenville division contains crystalline limestones, quartzites, and various kinds of gneiss, which are mostly distinctly foliated, banded, or stratified, dipping very often at a low angle and extending over large areas, the rocks being in many places rich in finely disseminated graphite, beds of iron ores, etc.

The Lower, or Ottawa, gneiss alone is present in the western part of Central Canada, where Lawson made his well-known investigations on the relations of the Huronian to the Laurentian gneiss.

The lower and the upper divisions are so closely related to one another that it is generally difficult to determine accurately their geographical limits. It is possible that they may form a continuous series laid down under conditions which approached more and more closely to those of modern times, or that the Grenville division lies unconformably on the older gneisses and represents quite another set of conditions from those under which the lower series originated.

The latter view is probably the correct one.

9. The Canadian anorthosites resemble exactly certain other anorthosites which are found associated with Archæan rocks in Norway, Russia, and in Egypt. The Norwegian occurrences are probably more recent in age than those found in Canada.

TABLE OF ANALYSES.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
$Si O_2$	59,55	59,80	58,50	51,85	51,35	—	57,20	57,55	54,45	54,20	54,47	54,62
$Ti O_2$	—	—	—	—	—	39,86	—	—	—	—	—	—
$Al_2 O_3$	25,62	25,39	25,80	3,90	3,70	—	26,40	27,10	28,05	29,10	26,45	26,50
$Fe_2 O_3$	0,75	0,60	1,00	—	—	—	0,40		0,45	1,10	1,30	0,76
Fe O	—	—	—	20,20	20,56	56,64	—	—	—	—	0,67	0,56
Mn O	—	—	—	Spur	—	—	—	—	—	—	—	—
Ca O	7,73	7,78	8,06	1,60	1,68	—	8,34	8,73	9,68	11,25	10,80	9,88
Mg O	Spur	0,11	0,20	21,91	22,59	1,44	—	—	—	0,15	0,69	0,74
$Na_2 O$	5,09	5,14	5,45	—	—	—	5,83	5,38	6.25	[3,80]	4,37	4,50
$K_2 O$	0,96	1,00	1,16	—	—	—	0,84	0,79	1,06	--	0,92	1,23
$H_2 O$	0,45	—	0,40	0,20	0,10	—	0,65	0,20	0,55	0,40	0,53	0,91
	100,15	99,82	100,57	99,66	99,88	102,84	99,66	99,75	100,49	100,09	100,20	99,70
Spec. grav.	2,66	2,66	2,67	3,409	3,409		2,68		2,69	2,68	2,72	2,70
	—2,67	—2,67		—3,417	—3,417		—2,69			—2,69		

	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.
$Si O_2$	50,33	46,28	56,0	55,59	58,1	53,56	53,43	54,09	52,23	54,34	54,26	54,36
$Ti O_2$	0,07	0,59	—	—	—	—	—	—	—	—	—	—
$Al_2 O_3$	3,36	7,38	27,5	25,41	27,9	27,78	28,01	27,82	26,96	29,36	29,29	29,36
$Fe_2 O_3$	1,03	2,21	0,7	2.73		1,15	0,75	—	—	—		
Fe O	19,40	14,80	—	—	—	—	—	1,50	1,98	0,22	—	—
Mn O	0,71	—	—	—	—	—	—	Spur	Spur	Spur	Spur	Spur
Ca O	2,77	18,78	10,1	11,40	9,4	12,01	11,24	11,20	13,25	10,79	11,26	11,16
Mg O	21,40	8,91	0,1	—	Spur	Spur	0,63	0,05	0,12	—	Spur	Spur
$Na_2 O$	—	—	5,0	4,83	5,1	4,10	4,85	4,76	5,23	5,49	4,87	4,81
$K_2 O$	—	—	0,4	0,32	—	1,68	0,96	0,43	0,23	0,46	0,48	0,63
$H_2 O$	1,14	1,11	—	—	—	—	Spur	—	—	—	0,22	0,22
	100,21	100,06	99,8	100,28	100,5	100,28	99,87	100,04	100,00	100,66	100,38	100,54
Spec. grav.	3,459	3,386	2,697				2,673					

I. & II. Large fragments of reddish plagioclase from the anorthosite of Chateau Richer. (T. S. Hunt, Geology of Canada, 1863).

III. Fine-grained plagioclase ground mass, in which the former are imbedded. (*Ibidem*).

IV.&V. Hypersthene from the same rock. (*Ibidem*).

VI. Ilmenite from the same rock, with 4·9 p.c. of insoluble matter, quartz, etc. (*Ibidem*).

VII. Bluish plagioclase in large fragments from another hand-specimen of the Chateau Richer anorthosite occurring imbedded in a fine granular ground mass of plagioclase. (*Ibidem*).

VIII. Similar plagioclase from an anorthosite boulder from the neighbouring parish of St. Joachim. (*Ibidem*).

IX. Very fine grained, almost white anorthosite, from Rawdon (Morin area). (*Ibidem*).

X. Blue opalescent plagioclase from the Morin anorthosite. (*Ibidem*).

XI. Bluish opalescent plagioclase from the summit of Monnt Marcy in the State of New York, U.S.A. (A. R. Leeds, 13th Ann. Rep. New York State Museum of Natural History, 1876).

XII. Very fine-grained yellowish anorthosite from the State of New York, U.S.A. (*Ibidem*).

XIII. Hypersthene from the anorthosite of Mount Marcy in the State of New York, U.S.A. (*Ibidem*).

XIV. Diallage from anorthosite, New York State, U.S.A. (*Ibidem*).

XV. Labrador feldspar, Pauls Island, Labrador. (G. Tschermak, in Rammelsberg's Mineralchemie).

XVI. Labrador feldspar, Pauls Island, Labrador. (*Ibidem*).

XVII. Plagioclase from a fine-grained whitish anorthosite from Labrador (granular ground mass). (H. Vogelsang, Archives Nierlandaises, T. III., 1868).

XVIII. Bluish-grey untwinned labradorite, Paul's Island, Labrador. (G. Hawes, Proc. Nat. Mus., Washington, 1881).

XIX. Labrador-rock. The chief rock of the vicinity of Nain, Labrador. (A. Wichmann, Z. d. D. g. G., 1884).

XX. Labradorite, Paul's Island. With traces of Li_2O and SrO; v. 19 lost on ignition, (Jannasch, Neues, Jahrb. für Min. 1884, II. 43).

XXI. Labradorite, Paul's Island. The part soluble in HCl. With traces of Li_2O and SrO. (*Ibidem*, p. 43).

XXII. Labradorite, Paul's Island. The part insoluble in HCl. (*Ibidem*, p. 43).

XXIII. Labradorite, Paul's Island. With traces of Li_2O. (Ber. Deutsch. Chem. Ges. 1891, XXIV. 277).

XXIV. Labradorite, Paul's Island. With traces of Li_2O. (*Ibidem*).

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OBITUARY NOTICE.

William Crawford Williamson, LL.D., F.R.S.

The most eminent structural palæo-botanist of our time has passed away—ripe in age, in accumulated work, and honour; though the field to which in his later years he devoted himself is not one that courts notoriety or attracts much of the attention even of that part of the novelty-seeking crowd which addicts itself to new things in science. Nevertheless, the work done by Williamson must live, and can never cease to be regarded as marking a new departure in regard to our knowledge of the real structure and affinities of that old vegetation to which we owe our most important beds of coal.

Williamson was a naturalist from his youth. Born at Scarborough in 1816, and the son of a man noted in his day as an amateur geologist and collector, before he was of age he had written papers on local zoology and geology, and had contributed to Lindley and Hutton's Fossil Botany drawings and descriptions of Mesozoic fossils from Yorkshire, among which was the remarkable cycadaceous plant that bears his name, the *Williamsonia gigas.* He was educated for the medical profession, but from the first devoted himself rather to scientific than professional work; and while still in practice he had attained so great a reputation that in 1851 he was appointed to the chair of geology and natural history in Owen's College, Manchester. As the college developed, he parted with the less congenial portion of the complex duties of this chair, but retained the professorship of botany till 1892, when he retired, and established himself in the neighbourhood of London, where, with his devoted and amiable wife—a lady intellectually a fit companion for any scientific man—and his youngest son, a promising student of art, he enjoyed the leisure necessary to pursue his favourite studies and the companionship of the many scientific men of that great centre.

Like most of the greater men of his time, he was less a specialist than is usual with the younger men of science. His earlier papers relate to a variety of zoological and geological subjects, as well as to fossil botany; and one of his larger publications, that on British Feraminifera, issued by the Ray Society, has long been a standard work of reference on both sides of the Atlantic.

In later years, however, he restricted himself to the fossil plants of the coal-formation, and more especially to the investigation of their structures as revealed by the microscope. He was attracted to this by the specimens retaining their structure, which are found in nodules in the coal-fields near Manchester as well as in the Scottish coal-fields; and he laboured day after day on this apparently unpromising material, making with his own hands slices for the microscope in the directions necessary to reveal the minute structures. As a mere labour for the eye and hand. this was a herculean task; but with Williamson it was much more, for he possessed the scientific knowledge and insight which enabled him to put together the structure of a plant from detached fragments, and to interpret the true meaning of the parts of mineralized and often distorted specimens. The writer had the pleasure of his friendship, and of more than once enjoying his hospitality at Egerton Road, near Manchester, where he not only had his studio, as it might be called, but a botanical garden on a small scale, replete with rare and interesting plants more or less illustrative of ancient vegetation. To those who had the privilege of seeing him at work, nothing could be more charming than his enthusiastic pursuit of new facts, and the exultation with which he welcomed them when found. In this he resembled Lyell more than any other scientific man of my acquaintance.

As a worker in fossil plants and in the microscopic structure of coal, Williamson's collections were most attractive to me, but showed at once that it was hopeless to rival his work; and from the time when I made his acquaintance I recognized this fact, and directed to his mill any palæo-botanical grist of the structural kind that came in my way.

In explanation of the nature of his work, it may be stated that while some coal-formation plants—as the ferns, the smaller Lycopods or club-mosses, and some trees allied to the pines—have structures very similar to their modern allies, others are widely different from any modern plants both in structure and in those characters of their surfaces and appendages which are related to the characters of the stem. In addition to this, while their fruits ally them with the flowerless or cryptogamous plants, their stems assume complexities of structure which, in the modern world, we find only in the flowering plants, and in the kinds of these that possess woody stems. After all, this is merely an arrangement to give strength to larger and better developed forms than those of modern times; but at first it was wholly at variance with orthodox botanical rule, and Williamson had first to reconcile himself to it and then to convince his scientific friends. The work is not yet complete. I have sent to Williamson slices of stems from Canada quite as anomalous as any he had figured, and which he admitted he had seen nothing like ; but he would work seriously only at his own British material, and things directly connected with it.

Williamson's discoveries in this way were, many of them, almost as strange as if he were to find in the older geological formations, mollusks and crustaceans with backbones similar to those now restricted to vertebrate animals.

It was a necessity of the kind of investigation pursued by Dr. Williamson that it could only to a limited degree be methodical and continuous. Hence, a structure, followed up and described as far as material would permit, might in a short time be further illustrated by new specimens, and had to be returned to perhaps more than once. Thus, the numerous and beautifully illustrated papers published in the *Philosophical Transactions* require careful study, even on the part of special palæo-botanists, before they can be fully appreciated. Their author was himself endeavouring, of late years, to remedy this by a systematic index, and by gathering into later memoirs the substance of the previous work; but he did not live fully to complete the task, and a systematic and arranged summary of his life's work has still to be given to the world. The German botanist, Solms-Laubach, has largely availed himself of it in his work on "Fossil Botany," but he has used Williamson's material very imperfectly.

There are few, therefore, yet, who can walk in imagination through the carboniferous forests, and regard their productions with the advantage of the new light thrown on them by Williamson. Now and then, when in Manchester, he endeavoured, in popular lectures—which were gems in their way—to explain the substance of his discoveries; but only partially.

The twenty memoirs in the *Transactions of the Royal Society* (the last in conjunction with his friend Dr. Scott) will form his most enduring monument. They constitute a truly gigantic work, since every single fact which they describe or delineate is the result of laborious collecting, of skilful and painstaking preparation of slices, of careful scrutiny under the microscope, of thoughtful study and comparison, of nice and accurate drawing, and, finally, of lucid description and scientific interpretation.

No man had a better title to indulge in large generalizations respecting the origin and development of the vegetable kingdom, but he rarely referred to such subjects, except now and then in conversation or in private letters. He usually, like the greater naturalists of our time, displayed in these matters that modesty which attends on wide knowledge, and leaves hasty and presumptuous theories to those who are inflated with a little wisdom and fail to realize how small it is. He expressed, some years ago, his position in one respect by saying that the time had not yet come for constructing a genealogical tree of the vegetable kingdom; and in his address as president of the Geological Section at the Southport meeting of the British Association, after discussing in some detail the various types of fossil vegetation, and insisting that if the Carboniferous and Devonian floras were evolved from pre-existing types, we have to look for these in rocks which have afforded no trace of land vegetation, he refers to the few places in which Carboniferous plants with well preserved structures are found, and the wonderful revelations which these have afforded. He then sums up as follows:

"Hence I conclude that there is a vast variety of Carboniferous plants of which we have as yet seen no traces, but every one of which must have played some part, however humble, in the development of the plant races of later ages. We can only hope that time will bring these now hidden treasures into the hands of future palæontologists. Meanwhile, though far from wishing to check the construction of any legitimate hypothesis calculated to aid scientific inquiry, I would remind every too-ambitious student that there is a haste that retards rather than promotes progress, that arouses opposition rather than produces conviction, and that injures the cause of science by discrediting its advocates."*

* British Association Report, 1883.

Professor James Dwight Dana.

The following notice, extracted from *Nature*, is of especial interest as showing the estimation in which the late distinguished geologist was held on the other side of the Atlantic:—

By the sudden death of Prof. J. D. Dana, from heart-failure, on April 15, America has lost a veteran man of science, who in his time has not only played many widely varied parts, but has reached the highest excellence in each. As a mineralogist he published, so long ago as 1837, the first edition of a "Descriptive Mineralogy," which by reason of its completeness and accuracy soon became a standard work of reference throughout the civilized world, and of which the sixth edition (1134 pages), issued in 1892 under the superintendence of his distinguished son, Prof. Edward Salisbury Dana, still maintains the high reputation attained by the original work. As a geologist and palæontologist, he published in 1863 a similarly excellent and well-illustrated "Manual of Geology," having special regard to the geology of the North American continent, and of which the fourth edition (1087 pages) was issued only two or three months ago. Of his work as a zoologist, we may cite as example his elaborate report on the zoophytes, collected by an expedition in which he took a very active part. The report is illustrated by 61 plates, and in it are described no fewer than 230 new species. Attainments so diverse belong only to the few.

James Dwight Dana was born on Februray 12, 1813, at Utica, in the State of New York, U.S.A., and was therefore in his eighty-third year at the time of his death. He was educated at Yale College, New Haven, Connecticut, receiving there a sound training in mathematics, physics and chemistry, which was of the greatest service to him in his subsequent career; he proceeded to his degree in the year 1833. His appointment as Instructor of Mathematics to the midshipmen of the United States Navy gave him splendid opportunities for the study of nature in various parts of the world, particularly in France, Italy, and Turkey, opportunities of which he was not slow to avail himself; more especially was his attention attracted to the study of volcanic phenomena by an ascent of Vesuvius, a sight of Stromboli, and an excursion in the Island of Milo in the year 1834. Settling down for a short time, he acted as chemical assistant at Yale College to his old teacher and friend, Prof. Silliman (1836-38); but an opportunity again presenting itself of making a long voyage of marine observation, he accepted the appointment of mineralogist and geologist to the United States exploring expedition, which was to proceed round the world. This expedition, under Charles Wilkes as Commander, was admirably equipped for the objects in view, and consisted of two sloops-of-war, a store-ship, and a brig; the cruise extended over four years (1838-42), and the scientific staff included, in addition to Dana, Pickering, Couthoy, and Peale as zoologists, Rich and Breckenridge as botanists, and Hale as philologist. The memory of the events, scenes and labours of this cruise was a constant joy to him during the remaining fifty-three years of life. On at least two occasions, however, he was in imminent peril: at one time his vessel narrowly escaped destruction on the rocks of Southern Fuegia, when the sea was dashing up the cliffs to a height of two or three hundred feet, and all the anchors had given way; at another time his party had to take to the boats empty-handed, and some hours afterwards they saw the last vestige of the vessel which had been their home for three years disappear beneath the waves.

The study of the material collected by the expedition and the preparation of his reports occupied all the available time during the next thirteen years. The first two or three years were spent at Washington, but after his marriage to the daughter of Prof. Silliman he removed back to New Haven, where he passed the rest of his life. In 1850 he was appointed Silliman Professor of Geology and Natural History at Yale College. In 1846 Mr. Dana had become associate-editor of the *American Journal of Science*, and after the death of Prof. Silliman, in 1864, he became the principal editor of that important scientific organ.

Dana gave special attention to corals and coral islands, and also to volcanoes. The Wilkes expedition of 1838-42 followed in part the course taken by the *Beagle* in 1831-36, and even where it diverged from that route visited coral and volcanic islands such as have been carefully described by Charles Darwin. When the Wilkes expedition reached Sydney in 1839, Dana read in the papers a brief statement of Darwin's theory of the origin of the atoll and barrier forms of reefs; this mere paragraph was a great help to him in his later work, and he afterwards regarded Darwin with feelings of the deepest gratitude. A visit to the Fiji Islands in 1840 brought before him facts such as had been already noticed by Darwin elsewhere; but there they were on a still grander scale and of a more diversified character, thus enabling him to speak even more positively of the theory than Darwin himself had thought it philosophic to do. On other points the conclusions arrived at by Darwin and Dana, independently of each other, were for the most part the same, and differed only in comparatively unimportant details. Dana's special labours relative to corals ceased with the publication of his report on the zoophytes collected by the expedition, but an elaborate account (406 pages) of Corals and Coral Islands was prepared by him and issued in 1879: this was an extension of his expedition-report on Coral Reefs and Coral Islands, which had been separately published in 1853. In 1890 appeared another considerable work (399 pages) entitled "Characteristics of Volcanoes, with contributions of facts and principles from the Hawaiian Islands," which placed on record much useful information collected by him during his travels.

In addition to these larger works, he was the author of about two hundred separate papers. Some of them are of a physical character: his first paper, published as far back as 1833, dealing with the connection of electricity, heat and magnetism; subsequent papers treated of galvano-magnetic apparatus and the laws of cohesive attraction as exemplified by crystals. Other papers, of a purely crystallographic character (1835-52), treated of the drawing and lettering of crystal figures, of crystallographic symbols, and of the formation of twin growths; a series of volcanic papers discussed both lunar and terrestrial volcanoes, the latter including those of Vesuvius, Cotopaxi, Arequipa, Mauna Loa, and Kilauea (1835-68); a set of coral papers treated of the temperature limiting the distribution of corals, on the area of subsidence in the Pacific as indicated by the distribution of coral islands, on the composition of corals and on fossil corals (1843-74).

About forty papers are on mineralogical topics: many of them are descriptive of particnlar mineral species; others treat of general subjects, such as nomenclature, pseudomorphism, homœomorphism, the connection between crystalline form and chemical constitution, and the origin of the constituent and adventitious minerals of trap and the allied rocks. As illustrations of the variety met with in his geological publications, we may cite his papers on the origin of the grand outline features of the earth, the origin of continents, mountains and prairies, the early condition of the earth's surface, the analogies between the modern igneous rocks and the so-called primary formations, on erosion, on denudation in the Pacific, on terraces, on southern New England during the melting of the great glacier, on the degradation of the rocks of New South Wales, and the formation of valleys. The remaining papers, about seventy in number, deal with biological subjects, both recent and fossil, and have a similarly varied character; some being descriptive of species, others treating of classification and similarly general problems.

The importance of this scientific work was widely recognized, and many marks of distinction were conferred upon him, both at home and abroad. He was an original member of the National Academy of Sciences of the United States, and in the year 1854 occupied the presidential chair of the American Association for the Advancement of Science. In 1851 he was elected a Foreign Member of the Geological Society of London, and in 1872 received from that Society the Wollaston Medal, the highest compliment the Geological Society can pay to the man of science; in the same year the University of Munich honoured him with the degree of Ph.D.; in 1877 he was the recipient of the Copley Medal of the Royal Society, and in 1884 was elected one of the foreign members; in 1886 Harvard conferred upon him the degree of LL.D.; he was also an honorary member of the Academies of Paris, Berlin, Vienna, St. Petersburg and Rome, and of the Mineralogical Societies of England and of France.

THE RIGHT HON. T. H. HUXLEY, D.C.L., F.R.S., &c.

Thomas Henry Huxley was in many respects the most prominent English naturalist of our time. His early training was that of a medical man, but his first serious employment was in the scientific study of the pelagic animals of the Southern Ocean, when assistant-surgeon of H. M. S. *Rattlesnake* in her surveying expedition in the years 1846–50. This work he did so ably as at once to establish a high scientific reputation, though the government, on his return, declined to publish the results. Huxley was not officially naturalist to the expedition, and was at the time unknown to fame. During his absence he had sent several communications to the Linnean Society, but, as he says, "with the same result as Noah when he sent the raven out of the ark." At length, in 1849, he sent a paper to the Royal Society which was accepted and printed; but this was only at the end of the voyage. He was, however, in 1854, appointed, on recommendation of Sir H. De la Beche, naturalist to the Geological Survey, and Professor of Palæontology in the Royal School of Mines, and thenceforth held with much ability many and varied scientific and educational positions. Active and versatile in thought, and gifted with remarkable powers of expression and illustration as a writer, he was now a biologist, now a geologist or an educationist, or a social reformer, a philosopher, or a theologian or anti-theologian, as the case might be. He was the prominent and successful advocate of the Darwinian evolution before the court of public opinion, and gave to that revival of an old philosophy a vitality and an interest into which it could never have been galvanized by Darwin or Spencer or Wallace or Hæckel.

In all his various *roles* he was clever, incisive, subtle, intensely interesting, and full of unexpected and startling trains of thought and of happy analogies. Even those who most thoroughly differed from many of his opinions could not but be charmed with his manner of expressing them. He himself has said that he was not one of those fortunate persons who are able to regard "a popular lecture as a mere *hors d'œuvre,* unworthy of being ranked among the serious efforts of a philosopher; and who keep their fame as scientific hierophants unsullied by attempts, —at least of the successful sort—to be understood by the people." On the contrary, he had found that "the task of making truths learned in the field, the laboratory, and the museum, at once intelligible and accurate, taxed such scientific and literary faculty as he possessed to the utmost." This was no doubt true, for he was nervously anxious as to public appearances, and careful that everything he did was well done; but he was evidently a man of genius, to whom the precise light in which a complex truth could be best seen came like a flash of inspiration. With this he combined that realistic and pictorial turn of mind to which a fact presented itself not merely as a bare fact, but surrounded with all its accessories and results, and glorified with a halo of fancy.

Huxley's real scientific work, owing partly to his own versatility and partly to the varied demands made on him, was spread over so many fields—cultivated in patches by specialists—that few are able to grasp its whole amount. Yet his clearness of insight was so great that he commended himself to all classes of specialists as an eminent worker in every department which he undertook, while he brought forth and made plain to the understanding of the outer world multitudes of researches which would scarcely have been heard of beyond the range of a few special experts.

One thing only he wanted to raise his surpassing gifts to the highest possible level, and that was, faith in nature as a realization of infinite thought within the domain of the finite. The finite he saw and understood, but not the Infinite unseen that lay beyond; and being thus short-sighted, he was too honest to pretend to more distinct vision, and too independent to be indebted to the vision of others; so he called himself an agnostic—one who does not know—a most gross misnomer in so far as all natural knowledge is concerned. But he wished to distinguish himself from those who thought they had attained to a certain "gnosis" which enabled them to "solve the problem of existence." To him this problem was utter darkness, as it must be to all who limit their views to the material alone. So he says, "I took thought and invented what I conceived to be the appropriate title of 'Agnostic;' it came into my head as suggestively antithetic to the 'Gnostic' of Church history, who professed to know so much about the very things of which I was ignorant." Yet his position was really of the same character with that of the original Gnostics, who professed to reduce all mysteries of faith to things merely of sight.

There is something heroic and pathetic in the attitude of such a man, holding that there is no alleviation of the sufferings of mankind except by taking them as inevitable and inexplicable, and resolutely facing the world without any of the garments "furnished by pious hands to cover its deformities." It was as if, rejecting the hopes of Christianity, he had sought to combine the two hardest features of ancient philosophy—the unbelief of Epicurus with the stoicism of Zeno; yet so great was the fascination of the man that he could make this pessimistic attitude even attractive to multitudes of minds. From what I knew personally of Huxley, I fear that his position in this respect was not so much a result of unbiassed inquiry as of a moral repulsion from what he called "the garment of make-believe," woven in the interest of clericalism, and that "ecclesiastical spirit" which he regarded as the worst enemy of science, and consequently of human welfare. The follies and hypocrisies which have assumed the name of Christianity, albeit the extreme opposites of the religion of Jesus of Nazareth, have alienated from it some of the best and most honest minds. Huxley's straightforward and vigorous thrusts against what he believed to be shams and fallacies, were, after all, not meant for honest and upright believers so much as for the Pharisees who assumed their garb, and were far less harmful than the blunders of the unwise or the misstatements of those who are "wolves in sheep's clothing." His controversial writings, like most others of that class, will not survive the special crises to which they belong. His clear and attractive delineations of natural facts, processes and relations, cannot be surpassed, and form the basis of his permanent reputation. Agnostic though he called himself, he was one of the divinely-gifted prophets of nature to whom is given more than to other mortals to penetrate and explain the plans of the All-wise in the structure of the world.

As Huxley was so largely the apostle of evolution, it may be well to refer to his position in that connection. He knew well that the word is one liable to much abuse, and that a modal evolution or development should not be confounded with a causal evolution, which is nothing unless founded on well ascertained proximate and ultimate causes. The first is merely a mode of development; the second leads back to origins. Yet in the loose popular writings of the day they are often identified and interchanged. The perception of this made him more cautious than many of his contemporaries in his statement of the great problem. The processes by which, from an apparently homogeneous egg, all the parts of a complex animal are derived, is an evolution, and fulfils precisely the conditions of Spencer's definition of that process. But it will not satisfy the scientific mind to say that the development arises simply from evolution. We know that there are involved a variety of proximate conditions from the incubation of the parent animal (or heat otherwise obtained) to the complex causes which lead to the growth and fertilization of the egg itself, and which we can fathom only to a very limited extent. Behind all these, again, lie the causes which produced the parent animal, and these we may have to follow back into past eras of geological time without reaching the first and ultimate cause. All this was clearly before the mind of Huxley; hence he was not satisfied with the merely analogical argument which seems sufficient to Hæckel and some other biologists, or with the doctrine of struggle for existence and survival of the fittest. The analogy between the cycle of development of the individual animal and the supposed development of modern animals in geological time is imperfect, and behind both lies the question—Has the ultimate germ or simple animal hereditary properties? If it has, we have to look for a parent of more developed organism than itself; if not, then it is a product of creation, or, as Clerk Maxwell phrased it in the case of chemical elements, a "manufactured article."[1] He therefore sought to find the evidence of evolution in the past history of living beings as represented in their fossil remains, where alone, if it is to be found at all, the actual evidence must lie concealed. Here he had, in the long lapse of geological time, an evident development from the simpler to the more complex, along the lines of a scheme or plan which manifestly preserves its unity from the dawn of life on our planet to the present day. It naturally occurred to him that the record, even if imperfect, might show portions at least of the links of connectian between successive forms of life. Here, however, he had to distinguish, and

[1] This dilemma of evolution was lucidly explained at the meeting of the British Association this year by Miss Layard.

did honestly endeavour to distinguish, between mere succession of forms, among which there might be no genetic bond, and those which show at least a probability of such connection. The difficulties in securing such facts he frankly stated; and if, for example, he held it probable that the horse had been derived from an animal of the type of Hipparion of the middle tertiary, he knew that this required, not merely the successive changes in foot and tooth, but a vast variety of correlated changes, and these occurring under varied geographical and climatal conditions, and movements of migration, accompanied with partial extinctions, isolations and intermixtures, none of which are certainly known to us in their detail, and the greater part have to be imagined. Of these points he gives intimations in his discourse of 1870 on Palæontology and Evolution, reprinted under his own supervision as late as last year. In face of all this, it is obvious that the doctrine of natural selection becomes quite insignificant as a factor in evolution, or is mixed with so many questions as yet unsolved that the problem becomes intensely complex. Small minds can easily cut this knot, but Huxley strove to untie it, and that without the help he might have derived from the belief in a pre-determined plan of development.

Tracing back the evolutionary history of animals, he further finds that he can by no means reach its beginning. As he puts it, "If there is any truth in the doctrine of Evolution, every class must be vastly older than the first record of its appearance upon the surface of the globe. But if considerations of this kind compel us to place the origin of vertebrated animals at a period sufficiently distant from the silurian in which the first elasmo-branchii and ganoids[1] occur, to allow of the evolution of such fishes from a vertebrate as simple as the Amphioxus, I can only repeat that it is appalling to speculate upon the

[1] Sharks and bony pikes.

extent to which that origin must have preceded the epoch of the first recorded appearance of vertebrate life."

But beyond this lies the unfathomable gulf of the origin of the living and organized from the merely mineral; of this "abiogenesis" science knows nothing, and even Huxley can only fall back on the probability that at some almost infinitely distant point of past time physical conditions may have been so different from those now existing as to admit of the spontaneous origin of life. Here there is no scope for natural selection, but we stand face to face with what to our present ideas would be a miracle of creation. But such abiogenesis must once, at least, have occurred; and if once, why not oftener? Yet now it seems impossible, and by some is dismissed as unthinkable. We can only say, "To man it is impossible, but to God all things are possible;' and, leaving Him out of the account, we must be content to leave ourselves no rational standing-place over the infinite void. This position Huxley avowedly assumed, as an honest agnostic whose mind was so constituted that he could not move one step beyond phenomena, and declined to infer from these phenomena any power or divinity behind them.

In point of fact, without God and without the Redeemer and the great truths revealed by Him, it is impossible to solve the "problem of humanity;" and it is impossible wholly to divest the mind of the idea of a rational First Cause, and a relation between Him and the spiritual nature of man. The lines which it is said were by Huxley's request to form his epitaph, declare this:—

"And if there be no meeting past the grave,
If all is darkness, silence yet is rest.
Be not afraid, ye waiting hearts that weep,
For God still giveth His beloved sleep,—
And if an endless sleep He wills, so best."

Here we have God recognized as giving even the sleep of death, and if so, why not also the future life and the re-union of human souls to the loved ones long lost and gone before. Thus the existence of a God is still at least possible even to the agnostic; and this possibility carries with it that of all the dread and glorious realities of the unseen world.

Huxley's great merits gained for him a wide distinction and many honours. Few scientific men in England could boast so long a list of foreign honorary titles; and in his own country he was loaded with University honours and the Presidencies of the greatest scientific bodies, as well as distinctions in the gift of the crown.

It was on the early voyage in the *Rattlesnake* that Huxley met his future wife, at Sydney, New South Wales. They became engaged after a short acquaintance, but the ship had to leave Sydney in a few days, and it was seven years before they met again. But so soon as Huxley secured a fixed position he claimed his bride. Their union was a most happy one, and Mrs. Huxley still survives her husband.

ABSTRACT FOR THE MONTH OF MAY, 1895.

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 vapor.	‡ 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	47 98	59.0	34.9	24.1	30.3788	30.498	30.266	.232	.1455	43.7	26.7	N.	14.4	3.0	7	0	96	....	....	....	1
2	54.33	64.5	46.0	18.5	30.1767	30.282	30.062	.220	.2572	59.7	40.3	S.	5.5	7.3	10	0	18	....	....	....	2
3	67.20	79.0	52.0	27.0	30.0075	30.100	29.925	.175	.3730	58.5	50.8	S.W.	15.6	2.3	9	0	89	....	....	....	3
4	63.27	76.8	47 0	29.8	30.0515	30.130	29.998	.132	.4315	73.8	54.3	S.W.	13 2	5 2	10	0	43	....	....	....	4
SUNDAY........5	.....	79.8	44.8	35.0	....	......	.....	....	. .	...	...	N.	13.6	....	....		79	....	....	....	5 ....SUNDAY
6	73.72	85.3	59.8	25.5	30.0760	30.143	30.018	.125	.4840	60.0	57.8	S.W.	15.5	0.0	0	0	80	....	....	....	6
7	72.08	84 6	61.0	23.6	30.0052	30.096	29.915	.181	.5588	70 8	61.8	S.W.	12.1	2.8	10	0	73	0.27	....	0.27	7
8	67.78	75.8	63.6	12.2	29.9000	29.967	29.830	.137	.5670	83.5	62.3	S.W.	16.4	9 2	10	7	20	Inap.	..	....	8
9	71.45	81.9	61.2	20.7	29.8350	29.861	29.798	.069	.5257	69.2	60.3	S.W.	18.5	1.5	8	0	93	....	....	....	9
10	74.22	84.0	62.8	21.2	29.8153	29.883	29.748	.135	.4960	58.5	58.5	S.W.	24.3	4.2	8	0	88	....	....	....	10
11	72.67	87.1	61.2	25.9	29.5562	29.765	29.429	.336	.5250	67.2	59.8	S.	13 0	4.7	10	0	65	0.45	....	0.45	11
SUNDAY.... ...12	.....	65.5	42.9	22.6	....	.....	.....	....	.....		....	S W.	22.0	...	...	..	00	0.53	....	0.53	12 ....SUNDAY
13	40.52	48.0	36.6	11.4	29.9848	30.089	29.899	.190	1760	69.8	31.5	W.	11.4	6.7	10	0	00	....	....	....	13
14	45.27	54 0	32.8	21.2	30.0353	30.161	29.907	.254	.1772	58.8	31.5	N.	14 0	5.8	10	0	86	....	.....	....	14
15	45.17	51.5	40.7	10.8	29.8985	29.933	29.871	.062	.2245	75.2	37.3	N.	21.5	8.8	10	3	21	0 10	....	0.10	15
16	45.05	53.8	38.2	15.6	29.8,97	29.937	29.858	.079	.1877	65.0	32.8	W.	15.4	6.0	10	0	75	Inap.	....	Inap.	16
17	51.32	63.8	37.0	26.8	29.9565	29.991	29.897	.094	.1990	53.5	34.2	W	17.0	4.7	10	0	75	Inap.	....	Inap.	17
18	56.07	66.2	42.5	23.7	29.9497	30.008	29.893	.115	.2152	43.3	35.3	S.E.	8 6	6.0	10	0	85	....	....	....	18
SUNDAY.. 19	.....	66.8	49.2	17.6	....	.....	.....	....	.....	....	....	S.E.	18.2	....	......		47	0.66	....	0.66	19 ....SUNDAY
20	43.52	49.4	38.0	11.4	30.0597	30.127	29.962	.165	.2115	74.3	35.7	W.	15.3	7.8	10	0	20	0.01	....	0.01	20
21	42.77	47.5	37.0	10.5	30.1615	30.201	30 125	.076	.1730	63 2	30.8	W.	11 1	10.0	10	10	15	Inap	Inap.	Inap.	21
22	49.25	57.2	36 9	20.3	30.0352	30.160	29.925	.235	.2073	59.8	35.2	W.	19.7	3.5	10	0	79	...	....	..	22
23	53.45	62.5	46 6	15.9	30 0162	30.056	29.969	.087	.2883	71.2	44.0	W.	12.7	4.7	10	0	48	Inap.	....	Inap.	23
24	53.97	62.9	44.5	18.4	30.1408	30.215	30.066	.149	.2612	63.8	41.5	N.E.	7.1	1.0	4	0	89	....	....	....	24
25	65.05	78.9	45.5	33.4	29.9630	30 067	29.865	.202	.3520	58.3	49.0	S.W.	10.5	4.2	10	0	83	Inap.	....	Inap.	25
SUNDAY........26	.....	74.8	58.5	16.3	.....	.....	.....	....	.....	....	....	S.	13.9	....	...	..	43	0.05	....	0.05	26..........SUNDAY
27	57.78	64.0	50.0	14.0	29.6245	29.668	29.559	.109	.4462	92 5	55 7	S.W.	16.8	10.0	10	10	00	0.57	....	0.57	27
28	54.72	61.0	48.2	12.8	29.8123	29.951	29 685	.266	.3897	90 8	52.2	S.W.	18.5	10.0	10	10	00	0.53	....	0.53	28
29	64.15	72.9	56.2	16.7	29.9950	30.051	29 931	.130	.4963	83 0	58.5	S.E.	4.5	4 3	10	0	68	....	....	....	29
30	73.97	86.1	60 0	26.1	29.8608	29.927	29.785	.142	.6480	76.3	67.0	S.W.	12.4	2.7	10	0	72	0 06	...	0.06	30
31	66.65	70 6	60.8	9 8	29.8955	29,927	29.846	.081	.5345	82.0	60.5	S.W.	9 3	10.0	10	10	00	0.08	....	0.08	31
....Means	58.27	68.23	48 27	19 96	29.9663	30.044	29.889	.155	.3537	67 8	46.9	S. 59½° W.	14.6	5 4	9 1	1.8	53.1	3.31		3 31	Sums ....
21 Years means for and including this month	54 61	63 91	45.63	18.75	29.9334	....	.....	.169	.2867	65.6	....	.....	...	6 2	..	..	¶50.4	2.95		2 96	21 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	1299	328	101	492	1463	4057	2482	317	
Duration in hrs..	93	27	20	42	116	247	172	24	3
Mean velocity....	14	12.1	5.0	11.7	12.6	16.4	14 4	13.2	

Greatest mileage in one hour was 44 on the 12th.

Greatest velocity in gusts 60 miles per hour on the 12th and 30th.

Resultant mileage, 5686.
Resultant direction, S. 59½° W.
Total mileage, 10539.
Thunder and lightning on 4 days, 7th, 8th, 11th and 30th.
Rainbow on 17th.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 14 years only

The greatest heat was 87.1° on the 11th; the greatest cold was 32.8° on the 14th, giving a range of temperature of 54.3 degrees.

Warmest day was the 10th. Coldest day was the 13th. Highest barometer reading was 30.498 on the 1st. Lowest barometer was 29.429 on the 11th, giving a range of 1.069 inches. Maximum relative humidity was 99 on the 19th and 28th. Minimum relative humidity was 29 on the 18th.

Rain fell on 17 days.

Snow fell on 1 day.

Rain or snow fell on 17 days.

Fog on 1 day, 30th.

ABSTRACT FOR THE MONTH OF JUNE, 1895.

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 vapor.	‡ 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	71.10	80.3	59.8	20.5	29.8453	29.928	29.754	.174	.6310	82.5	65.3	S.W.	12.3	7.2	10	0	64	....	....	....	1
SUNDAY........2	.....	86.2	64.4	21.8	....	......	......	....	... .	....	....	S.W.	14.5	....	....	.	69	0.47	....	0.47	2..........SUNDAY
3	63.92	71.0	59.0	12.0	29.9078	29.939	29.850	.089	.5025	84.7	59 2	N.	6.6	9.3	10	8	06	0.06	....	0.06	3
4	68.05	77.2	60.0	17.2	29.9757	30.028	29.897	.131	.5682	82.8	62.5	S.E.	13.0	3.8	10	0	87	Inap.	....	Inap.	4
5	64.38	70.0	60.3	9.7	29.8055	29.918	29.701	.217	5510	90.8	61.7	S.W.	22 1	10 0	10	10	00	0.43	....	0 43	5
6	61.03	66.2	56 0	10.2	29.9270	30.120	29.806	.314	.4025	75.2	52.8	S.W.	17 2	6.0	10	0	64	Inap.	....	Inap.	6
7	62.75	72.0	52.9	19.1	30.3010	30.356	30.223	.133	.3473	62 0	48.7	N.	5.2	1.5	4	0	88	....	....	....	7
8	66.20	76.9	52.8	24.1	30.2802	30.366	30.205	.161	.4395	69.2	55.0	S.W.	5 8	2 7	10	0	85	....	....	....	8
SUNDAY........9	.....	83.5	58.0	25.5	....	......	......	....	.....	..	....	S.W.	10.7	....	....	..	92	....	....	....	9..........SUNDAY
10	75.17	83.2	67.5	15.7	30.1082	30.159	30.071	.088	.6140	70.3	64.7	S.W.	9.0	4.3	9	0	65	....	....	....	10
11	75.92	86.4	62.0	24.4	30.1003	30.173	30.015	.158	.6313	70.8	65.3	S.W.	13.3	3.8	10	0	82	....	....	....	11
12	74.60	84.8	67.0	17.8	29.9295	30.034	29.812	.222	.6308	73.7	65.5	S.W.	17.7	2.8	10	0	82	0.12	....	0.12	12
13	68.48	77.5	65.0	12.5	29.6900	29.804	29.603	.201	6283	90.5	65.5	S.	13 5	7.3	10	0	00	0.49	....	0.49	13
14	64.92	75.3	62.3	13.0	29.6598	29.723	29.626	.c97	.5393	88.2	61.2	S W.	21.2	9.5	10	7	31	0.06	....	0.06	14
15	66.92	75.5	60.3	15.2	30.0770	30.275	29.872	.403	.4215	65.0	54.2	N.	10.8	4.2	10	0	84	....	....	....	15
SUNDAY........16	.....	76.2	55.2	21.0	....	......	......	...	.....	....	....	N.	[illegible].6	....	......	..	91	....	....	....	16..........SUNDAY
17	70.12	81 0	57.5	23.5	30.2620	30.428	30.110	.318	.4868	67.2	58.0	S.	11 7	0.3	2	0	92	....	....	....	17
18	74.68	85.0	62.0	23.0	30.0592	30.130	29.972	.158	.5565	64.3	61.7	S.W.	13 4	0.0	0	0	91	....	....	....	18
19	77.17	85.2	65.0	20.2	29.9583	29.995	29.905	.090	.5750	61 5	62.5	S.W.	12.8	3.7	10	0	77	....	....	....	19
20	76.62	85.5	69.3	16.2	30.0068	30.038	29.980	.058	.5777	63.7	63.2	N.	6.4	6.8	10	4	58	....	....	....	20
21	66.43	75.5	64.3	11.2	30.0230	30.062	29 952	.110	.6128	94.7	64.5	S.E.	5.8	10.0	10	10	00	0.71	....	0.71	21
22	68.43	76.0	63.0	13.0	29.9133	29.954	29.862	.092	.6040	87.3	64.2	W.	8.0	7.7	10	3	31	Inap.	....	Inap.	22
SUNDAY........23	.....	78.0	62.3	15.7	.....	......	......	....	.....	....	....	S.W.	15 6	....	...	..	80	0.41	....	0.41	23..........SUNDAY
24	69.72	77.5	62.9	14.6	29.9090	29.942	29.859	.083	.5270	73.2	60.2	S.W.	9.5	4.5	9	0	81	....	....	....	24
25	71.07	80.0	62.3	17.7	29.9682	29.993	29.950	.043	.5427	72.3	61.2	N	4.6	4.7	9	0	84	....	....	....	25
26	71.87	83.0	59.5	23.5	29.9430	30 006	29.863	.143	.5725	74.2	62.7	S.E.	12.5	4.7	10	1	82	....	....	...	26
27	67.12	70.9	65.0	5.9	29.9192	29.968	29.892	.076	.6173	93.2	65 2	S.	16.6	9.9	10	9	00	0.99	....	0.99	27
28	70.42	79.2	62.0	17.2	30.0227	30.056	29 989	.067	.6042	81.9	64.3	S.	10.1	8.3	10	7	67	....	....	....	28
29	71.35	79.2	64.8	14.4	30.1009	30.124	30 049	.075	.4652	61.5	56.5	S.W.	10.5	3.7	10	0	97	....	....	....	29
SUNDAY........30	.....	77.8	59.8	18.3	....	......	......	.. .	.....	....	....	S.W.	9.0	....	..	..	60	....	....	....	30..........SUNDAY
31	.....	....	...	....	....	......	......	....	.....	....	....	......	....	....	..		..	....	....	....	31
...........Means	69.54	78.53	61.40	17.14	29.9877	30.061	29.913	.148	.5489	79.2	61.0	S. 51½° W.	13.4	5.5	8.9	2.36	63.0	3.74		3.74	Sums ....
20 Years means for and including this month	65.03	73.83	58.50	17.33	29.9053	.....	.....	.151	.4378	69.9	....	......	....	5.7	..	..	¶53.0	3.48		....	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	928	19	90	621	1732	4038	658	240	
Duration in hrs..	128	4	23	45	137	187	69	26	1
Mean velocity....	7.3	4.7	3.9	13.8	12.5	21.6	9.5	9.2	

Greatest mileage in one hour was 31 on the 1st and 2nd.

Greatest velocity in gusts, 36 miles per hour on the 2nd.

Resultant mileage, 5002.

Resultant direction, S. 51½° W.

Total mileage, 8336.

Thunder and lightning on 5 days, 4th, 12th, 13th 21st and 27th.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 14 years only.

The greatest heat was 86.4° on the 11th; the greatest cold was 52.8° on the 16th, giving a range of temperature of 34.6 degrees.

Warmest day was the 19th. Coldest day was the 6th. Highest barometer reading was 30.428 on the 17th. Lowest barometer was 29.603 on the 13th, giving a range of .825 inches. Maximum relative humidity was 100 on the 21st. Minimum Minimum relative humidity was 44 on the 15th.

Rain fell on 12 days.

Auroras were observed on 3 nights, 1st, 6th and 20th.

ABSTRACT FOR THE MONTH OF JULY, 1895.

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 vapor.	‡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	63.25	72.0	53.5	18.5	29.9877	30.035	29.939	.096	.3708	64.2	50.5	N.W.	13.0	2.0	4	0	89	Inap.	....	Inap.	1
2	68.78	77.2	57.8	19.4	30.1218	30.149	30.080	.069	.3422	49.2	48.3	N.	10.7	2.8	7	0	87	....	....	....	2
3	69.52	78.2	61.0	17.2	30.1138	30.189	30.024	.165	.4655	63.5	56.3	S.W.	15.5	7.5	10	5	49	....	....	....	3
4	75.02	85.3	62.2	23.1	29.9448	30.028	29.826	.202	.5785	67.7	62.7	N.	9.5	6.7	10	5	58	....	....	....	4
5	71.23	77.2	66.0	11.2	29.8820	29.934	29.806	.128	.4822	64.2	57.8	S.E.	14.2	4.8	10	0	58	....	....	....	5
6	70.13	77.5	62.0	15.5	29.7842	29.867	29.704	.163	.5475	75.0	61.3	S.E.	8.8	3.0	8	0	62	....	....	....	6
SUNDAY........7	.....	84.8	64.0	20.8	....	.....	......	....	.....	...	....	S.W.	11.0	....	....	..	75	....	....	....	7.........SUNDAY
8	78.55	87.5	69.0	18.5	29.6477	29.685	29.589	.096	.6753	71.2	67.3	S.W.	12.4	8.5	10	5	25	Inap.	....	Inap.	8
9	70.43	81.9	58.5	23.4	29.7310	29.935	29.613	.322	.5503	72.0	60.5	S.W.	18.5	5.5	10	3	59	0.02	....	0.02	9
10	59.62	67.8	51.2	10.6	30.0738	30.108	29.991	.117	.2955	58.3	44.7	N.W.	14.5	2.7	8	0	96	....	....	....	10
11	64.20	74.8	55.2	19.6	30.0810	30.152	30.029	.123	.3653	62.7	50.0	S.	14.6	3.5	10	0	89	....	....	....	11
12	64.12	73.5	54.8	18.7	29.9873	30.054	29.917	.137	.4367	73.0	55.0	S.	15.3	8.3	10	0	04	0.13	....	0.13	12
13	65.52	73.0	59.0	14.0	29.9225	29.961	29.899	.062	4427	71.2	55.5	W.	12.0	6.3	10	3	58	0.16	....	0.16	13
SUNDAY........14	.....	74.0	60.0	14.0	....	.....	......	...	.....	....	....	N.	9.2	....	......	..	53	Inap.	....	Inap.	14..........SUNDAY
15	66.58	75.0	58.2	16.8	29.9760	30.058	29.896	.162	.5003	77.8	58.7	E.	6.9	4.8	10	0	59	....	....	....	15
16	64.87	73.8	58.5	15.3	29.8620	29.884	29.845	.039	.5105	83.7	59.7	S.E.	15.5	8.3	10	0	11	0.05	....	0.05	16
17	73.25	82.0	64.0	18.0	29.7862	29.867	29.667	.200	.6102	75.2	64.0	S.W.	12.9	6.7	10	0	56	Inap.	....	Inap.	17
18	66.50	74.0	60.0	14.0	29.9838	30.084	29.846	.238	.3985	62.0	52.5	N.W.	11.8	3.3	8	0	85	....	....	...	18
19	66.33	75.0	56.2	18.8	30.1020	30.161	30.034	.127	.4338	68.0	55.0	N	5.0	7.5	10	5	46	Inap.	....	Inap.	19
20	75.72	86.0	65.0	21.0	29.9825	30.048	29.888	.160	5485	62.5	61.3	W.	9.0	6.0	10	0	76	....	....	....	20
SUNDAY........21	.....	80.6	63.4	17.2	....	......	......	....	.....	....	....	N.E.	15.2	....	...	..	59	....	....	....	21..........SUNDAY
22	73.32	82.0	65.2	16.8	29.8655	29.899	29.822	.077	.5555	67.5	61.7	S.W.	10.1	6.2	10	0	48	....	....	....	22
23	68.50	77.6	59.2	18.4	29.9835	30.052	29.950	.102	.3815	55.5	51.2	W	13.0	1.0	4	0	98	....	...	...	23
24	70.50	80.8	60.2	20.6	29.9037	29.985	29.814	.171	.4792	64.8	57.5	S.W.	12.7	3.7	10	0	81	....	....	....	24
25	64.35	68.5	61.0	7.5	29.7523	29.791	29.717	.074	.4595	76.3	56.5	S.W.	11.7	5.3	10	0	04	....	....	....	25
26	63.13	69.3	57.2	12.1	29.8363	29.879	29.767	.112	.4062	71.0	53.2	N.	7.9	8.5	10	3	40	...	....	....	26
27	59.47	64.0	56.5	7.5	29.8377	29.880	29.773	.107	.4518	89.0	56.0	S.	8.7	7.5	10	0	00	0.41	....	0.41	27
SUNDAY........28	.....	72.0	54.0	18.0	....	....	....	....	.....	....	....	W.	14.0	....	..	..	92	....	....	....	28.........SUNDAY
29	66.15	76.2	52.0	24.2	29.8117	29.908	29.707	.201	.4007	62.3	52.7	S.W.	9.9	3.8	10	0	80	....	....	...	29
30	60.35	69.2	52.0	17.2	29.5873	29.677	29.471	.206	.4332	66.7	54.2	S.W.	17.0	7.8	10	3	36	1.24	...	1.24	30
31	55.40	59.8	51.8	8.0	29.6017	29.644	29.557	.087	.3835	87.5	51.5	S.W.	22.1	9.3	10	6	00	0.37	....	0.37	31
.....Means	67.21	75.82	58.99	16.84	29.8944	29.959	29.821	.138	.4632	69.0	56.1	S. 56¼° W.	12.34	5.6	9.3	1.4	55 9	2.38		2 38	Sums ....
21 Years means for and including this month	68.75	77 24	60.62	16.62	29.8925	.....	......	.140	.4987	70.90	....	......	§13.16	5 5	..	..	¶58.8	4.00		4.00	21 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	884	383	253	1006	1031	3203	1159	1262	
Duration in hrs..	93	36	28	80	93	219	103	91	1
Mean velocity....	9.51	10.64	9.04	12.58	11.09	14 62	11.25	13.87	

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

Greatest velocity in gusts, 36 miles per hour on the 30th and 31st.

Resultant mileage, 3650.
Resultant direction, S. 56¼° W.
Total mileage, 9181.
Average mileage per hour, 12.34.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 14 years only § Ten years only.

The greatest heat was 87.5° on the 8th; the greatest cold was 51.2° on the 10th, giving a range of temperature of 36.3 degrees.

Warmest day was the 8th. Coldest day was the 31st. Highest barometer reading was 30.189 on the 3rd. Lowest barometer was 29.471 on the 30th, giving a range of .718 inches. Maximum relative humidity was 100 on the 30th. Minimum relative humidity was 38 on the 23rd.

Rain fell on 12 days.

Fog on 1 day, the 13th.

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INCLUDING THE PROCEEDINGS OF
THE NATURAL HISTORY SOCIETY OF MONTREAL,
AND REPLACING
THE CANADIAN NATURALIST.

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THE

CANADIAN RECORD

OF SCIENCE.

VOL. VI. OCTOBER, 1895. No. 8.

Contributions to Canadian Botany.

By James M. Macoun.

VIII.

Aquilegia Jonesii, Parry.

High slopes of Sheep Mountain, Waterton Lake, Rocky Mountains, Lat. 49° 05′, July 29th, 1895. (*John Macoun,* Herb. No. 10,029.) New to Canada.

Berberis nervosa, Pursh.

Not rare in deep, moist woods in Trinity Valley, between Mabel Lake and Enderby, B.C., 1895. (*Jas. McEvoy,* Herb. No. 10,133.) Not before recorded east of Yale, B.C.

Berberis aquifolium, Pursh.

In open thickets, Waterton Lake, Lat. 49° 05′, Rocky Mountains, 1895. (*John Macoun.* Herb. No. 10,267.) Eastern limit in Canada.

Papaver Pyrenaicum, L.

A single specimen collected by Dr. G. M. Dawson in the South Kootanie Pass, Rocky Mountains, 1883. Re-discovered in 1895 by Prof. John Macoun on Sheep Mountain, Waterton Lake, Rocky Mountains, alt. 7,500 feet, Lat. 49° 05′. Herb. No. 10,269. New to America.

LESQUERELLA LUDOVICIANA, Wats.

Specimens collected at Medicine Hat, Assa., by Prof. John Macoun, in 1895, (Herb. No. 10,308) are the only specimens in our herbarium that can be referred here. The pubescence of the oblanceolate radical leaves is conspicuously stellate.

LESQUERELLA LUDOVICIANA, WATS., var. ARENOSA, Wats.

Vesicaria Ludoviciana, Macoun, Cat. Can. Plants, Vol. I., p. 54, in part, and Vol. I., p. 490.

From Western Manitoba to the Saskatchewan. The reference under *L. Ludoviciana*, Wats., var. *arenosa*, Wats., Macoun Cat. Can. Plants, Vol. II., p. 305, should go with *L. arctica*, Wat.

SISYMBRIUM VIRGATUM, Nutt.

In gravel amongst bushes, Police Point, Medicine Hat, Assa. In fruit May 31st, 1894. Herb. No. 3,069; prairies, 12-Mile Lake, Wood Mountain, Assa., June 6th, 1895. Herb. No. 10,007; meadows, Sucker Creek, Cypress Lake, Assa., 1895. Herb. No. 10,006. (*John Macoun.*) New to Canada. The Canadian specimens have longer pedicels and pods and are more paniculately branched than those from the Rocky Mountains in the United States, but Dr. Robinson, who examined our specimens, has been unable to detect a single significant or constant character to separate the plants from the two regions.

ARABIS DRUMMONDII, Gray; Macoun, Cat. Can. Plants, Vol. I., p. 43, in part.

A. Lyallii, Macoun, Cat. Can. Plants, Vol. I., p. 43; and Vol. I., p. 487, in part; J. M. Macoun, Can. Rec. Science, Vol. VI., p. 145.

From the Cypress Hills, Assiniboia, west to the Gold Range in British Columbia. Our specimens are from Cypress Hills, Assa.; Sheep Mountain, Waterton Lake, Rocky Mountains; mountains north of Devil's Lake, and at Kicking Horse Lake, Rocky Mountains. (*John Macoun.*) Maple Creek, Assa.; Toad Mountain, Kootanie Lake, B.C.; Mount Queest, Shuswap Lake, B.C. (*Jas. M. Macoun.*) Rocky Mountains. (*Drummond.*)

ARABIS LYALLII, Wats.

Our specimens of this species are from West Summit of North Kootanie Pass. (*Dr. G. M. Dawson.*) Shore of Waterton Lake, Rocky Mountains; mountains north of Devil's Lake, Rocky Mountains. (*John Macoun.*) Lookout Mountain, Big Bend of Columbia River, B.C. (*Prof. Coleman.*)

VIOLA HOWELLII, Gray.

V. canina, L. var. *sylvestris,* Macoun, Cat. Can. Plants, Vol I., p. 63 in part.

V. canina, L. var. *longipes,* Macoun, Cat. Can. Plants, Vol. I., p. 493 in part.

In woods, New Westminster, B.C.; Cedar Hill, Shawnigan Lake and Nanaimo, Vancouver Island. (*John Macoun.*) Vancouver Island (*Streets,* vide Syn. Fl. North Am. Vol. I., p. 202.)

VIOLA ORBICULATA, Geyer; re-described and figured in Contr. from U.S. Herbarium, Vol. III., No. 4, p. 214.

V. sarmentosa, Macoun, Cat. Can. Plants, Vol. I., p. 493 in part.

V. sarmentosa Dougl. var. *orbiculata,* Robinson, Syn. Fl. N. Am., Vol. I., p. 199.

Western Summit of North Kootanie Pass, Rocky Mountains; Dean or Salmon River, B.C. (*Dr. G. M. Dawson*) Kicking Horse Lake, Rocky Mountains; summit of Selkirk Mountains, B.C.; Revelstoke, B.C.; mountains near Ainsworth, Kootanie Lake, B.C. (*John Macoun.*) *Viola sarmentosa* Dougl. seems in Canada to be confined to the Coast Range and Vancouver Island, all our specimens from the interior being plainly V. *orbiculata*, Geyer. The two plants have always been separated in our herbarium, though all were named *V. sarmentosa.*

ARENARIA CONGESTA, Nutt.

Open prairies, Sweet Grass Hills, Alberta, just north of the International Boundary, 1895. (*John Macoun.*) Not before recorded from Canada.

CLAYTONIA MEGARRHIZA, Parry.

Additional references for this species are: summit of Saddle Mountain, Banff, Rocky Mountains; summit of Sheep Mountain, Waterton Lake, Lat. 49° 05′, Rocky Mountains, Herb. No. 10,091. (*John Macoun.*)

HYPERICUM KALMIANUM, L.; Macoun. Cat, Can. Plants, Vol. I. p. 84.

On a small rocky island in the Ottawa River, Township Clarendon, Pontiac Co., Que. In flower July 24th, 1895. (*Robt. H. Cowley.*)

NEMOPANTHES CANADENSIS, DC.

Banks of west branch of Nottaway River, N.E. Ter., 1895. (*Dr. R. Bell.*)

LUPINUS PUSILLUS, Pursh.

L. Kingii, Macoun, Cat. Can. Plants, Vol. I., 103.

Dry sand hills, five miles west of the northern elbow of the South Saskatchewan; Crane Lake, Assa., Herb. No. 4,068; Police Point, Medicine Hat, Assa., Herb. No. 4,069; South of Wood Mountain, Assa.; Many Berries Creek, Milk River, Assa., Herb. No. 10,412; Milk River, Assa., Herb. No. 10,414. (*John Macoun.*) Along the Belly River, Alberta. (*Dr. Geo. M. Dawson.*)

LUPINUS MINIMUS, Dougl.; Macoun, Cat. Can. Plants, Vol. I., p. 103.

Summit of Sheep Mountain, Waterton Lake, Lat. 49° 05′, alt. 7,500 ft., July 31st, 1895. (*John Macoun*, Herb. No. 10,413.) The only authentic Canadian record, as it is doubtful whether it was found by Douglas north of the boundary.

CICER ARIETINUM, L.

Vicia (?), Macoun, Cat. Can. Plants, Vol. I., p. 512.

In dry soil at Chinaman's Ranch, above Spence's Bridge, Thompson River, B.C., Aug. 1883. (*Jas. Fletcher.*) Introduced in wool at Wingham, Ont., 1891. (*J. A. Morton.*) A native of Bengal.

SPIRÆA BETULIFOLIA, Pall.

Peel's River, Mackenzie River Delta, July 14th, 1892. (*Miss E. Taylor.*) Specimens from Qualco Lake, B.C., collected by Dr. G. M. Dawson, are doubtfully referred here. These are the only specimens of this species in our herbarium.

SPIRÆA LUCIDA, Dougl.; Pittonia, Vol. II., p. 221.

S. betulifolia, Macoun, Cat. Can. Plants, Vol. I., p. 126, in part.

Common in thickets and on hillsides, from the Rocky Mountains westward. Our specimens are from Kootanie Pass, Rocky Mountains. (*Dr. G. M. Dawson*) Valleys of the Rocky Mountains. (*Drummond*) Waterton Lake, Lat.

49° 05′, Rocky Mountains; Bow River Pass and Kicking-Horse Lake, Rocky Mountains; Sproat and Deer Park, Columbia River, B.C.; Sicamous, B.C.; Spence's Bridge, B.C. (*John Macoun.*) Red Deer, Alberta. (*H. H. Gaetz.*)

SPIRÆA ARBUSCULA, Greene, Erythæa, Vol. III.. p. 63.

S. betulifolia, Pall., var. *rosea,* Gray; Macoun, Cat. Can. Plants, Vol. I., p. 513.

In woods and thickets at the summit of the Selkirk Range, B.C. (*John Macoun. Jas. Fletcher.*)

NEILLIA OPULIFOLIA, Wats.

Banks of West Branch of Nottaway River, N. E. Ter., 1895. (*Dr. R. Bell.*)

POTENTILLA OVINA.

P. dissecta, var. *pinnatisecta,* Macoun, Cat. Can. Plants, Vol. I., p. 517.

Low, tufted, the multicipitous ligneous caudex partly subterranean and clothed with the persistent bases of the leaves; leaves $1\frac{1}{2}$ to 4 inches long of from 4 to 7 pairs of pinnæ, these parted into 2 or 3 linear pinnæ, villous-pilose at apex and sparingly so on both surfaces. Flowering stems scarcely leafy, 4 to 6 inches high, the flowers on slender pedicels an inch or two long; achenes few, obliquely obovoid, smooth and glabrous.

High slopes of Castle Mountain, Rocky Mountains, Herb. No. 7,242; crevices of rocks at The Mound, Banff, Rocky Mountains, Herb. No. 7,235; Sheep Mountain, Waterton Lake, Lat. 49° 05′, Rocky Mountains, Herb. Nos. 10,488, 10,489. (*John Macoun.*)

Though considered a variety of *P. Plattensis* by Dr. Watson, Prof. Macoun always believed the Rocky Mountain plant to be quite distinct from that species, and more nearly related to *P. dissecta.* Later he came to the conclusion that it was a good species, and in this opinion he is sustained by Dr. Edw. L. Greene, who has examined the specimens collected on Sheep Mountain in 1895. The above preliminary description is based on his diagnosis. Prof. Macoun has seen the specimens labelled *P. Plattensis*, var. *pinnatisecta* in the Grey Herbarium, and believes them to be all referable here.

CALLITRICHE HAMULATA, Kürtz.

Dr. Morong having examined the specimens referred to this species (Macoun Cat. Can. Plants, Vol. II., p. 322,) pronounced them to be *C. verna*, L. We have no authentic Canadian specimens of *C. hamulata*.

LUDWIGIA PALUSTRIS, Ell.

Wet places, Sproat Lake, Vancouver Island, 1887. (*John Macoun.*) Not before recorded west of the Saskatchewan.

GAYOPHYTUM RAMOSISSIMUM, T. & G.

Near Dog Lake, Okanagan Valley, B.C., 1895. (*Jas. Fletcher.*) New to Canada.

SANICULA.

Following Mr. Bicknell's revision of the eastern species of this genus, our herbarium specimens have been arranged as below :—

S. MARYLANDICA, L.

From New Brunswick and Nova Scotia west to Vancouver Island.

S. GREGARIA, Bicknell, Bull. Torr. Bot. Club, Vol. XXII., p. 354.

Near Belleville, Ont. (*John Macoun*) Wingham, Ont. (*J. A. Morton.*)

S. Canadensis, L.

We have, in our herbarium, no specimens of this species as diagnosed by Mr. Bicknell, though it may be common enough throughout Eastern Canada.

S. trifoliata, Bicknell, Bull. Torr. Bot. Club, Vol. XXII., p. 360.

Casselman, Ont.; Hastings Co., Ont.; Amherstburg, Ont. (*John Macoun.*) This *Sanicula,* with conspicuously trifoliate, petioled cauline leaves, has been generally taken in Canada to be typical *S. Canadensis,* L.

Osmorrhiza brevistylis, DC.

From Prince Edward Island west to Lake Winnipeg.

Osmorrhiza longistylis, DC.

From Nova Scotia west to the Saskatchewan.

Osmorrhiza nuda, Torr.

From the Eastern slope of the Rocky Mountains west to Vancouver Island.

Osmorrhiza occidentalis, Torr.

Mountain woods at Ainsworth, Kootanie Lake, B.C., alt, 5,000 ft., 1890. (*John Macoun.*) A new station for this plant.

Cicuta Californica, Gray.

New Westminster, B.C.; Ainsworth, Kootanie Lake, B.C. (*John Macoun.*) Not before recorded from British Columbia mainland.

Carum Carui, L.

Waste places near the brick-yard at Banff, Rocky Mountains. (*John Macoun.*)

LIGUSTICUM GRAYI, C. & R.; Macoun, Cat. Can. Plants, Vol. II., p. 327.

Woods on the mountains at Ainsworth, Kootanie Lake, B.C., alt. 5,000 feet. (*John Macoun.*)

LIGUSTICUM SCOPULORUM, Gray.

Specimens collected by Prof. John Macoun, at Roger's Pass, Selkirk Mountains, B.C., in 1890, have been doubtfully referred here by Prof. Coulter. Not before recorded from Canada.

HELIANTHUS GROSSE-SERRATUS, Martens.

Along the Grand Trunk Railway, near Stamford, Ont., 1895. (*R. Cameron.*) Introduced from United States.

CLADOTHAMNUS CAMPANULATUS, Greene, Erythæa, Vol. III., p. 65.

Shrub 3 to 5 feet high, with few and stoutish ascending branches; leaves lanceolate, 1 to 3 inches long, tapering to a short petiole, which, together with the veins beneath, is more or less strigose-hirsute with red hairs; flowers solitary or in pairs or threes, from lateral buds, on pedicels ½ inch long, those setose-hispid with red hairs; sepals ovate-oblong, densely ciliate with short gland-tipped hairs; corolla light salmon colour, campanulate, the petals joined at base into a short tube; anthers opening only by a pair of large round terminal pores.

Credited to British Columbia by Dr. Greene, but all our specimens, both from Vancouver Island and the mainland, are *C. pyrolæflorus*, Bong. The new species should be looked for by collectors in British Columbia on the higher mountains of the Coast Range. We have specimens of *C. pyrolæflorus* collected at Sitka by Bongard himself.

VINCA MAJOR, Linn.

In fields near Victoria, Vancouver Island, 1893. (*John Macoun.*) Escaped from gardens.

GENTIANA PLATYPETALA, Griseb.

Mount Rapho, Bradford Inlet, Lat. 56° 13′, Long. 131° 36′, alt. 4,050 ft., July 7th, 1894. (*H. W. E. Canavan.*) Yakoun Lake, Queen Charlotte Islands, 1895. (*Dr. C. F. Newcombe.*) New to Canada.

MENYANTHES CRISTA-GALLI, Menzies.

Port Simpson, B.C., 1893. (*Jas. McEvoy.*) Shore of Yakoun Lake, Queen Charlotte Islands, 1895. (*Dr. C. F. Newcombe.*)

MYOSOTIS CÆSPITOSA, Schultz.

Cartwright, Ont., 1891. (*W. Scott.*) New to Canada.

SOLANUM NIGRUM, L., var. VILLOSUM, Mill.

A new station for this plant is New Westminster, B.C. 1895. (*A. J. Hill.*)

VERBASCUM THASPUS, L.

Waste plates, Revelstoke, B.C.; Vernon, Lake Okanagan, B.C., and Sannach Road, near Victoria, Vancouver Island. (*John Macoun.*) Not before recorded west of Ontario.

VERBASCUM BLATTARIA, L.

Waste places, Revelstoke, B.C. (*John Macoun.*) On the sea shore at Union Mines, Comox, Vancouver Island. (*Anderson.*) Not before recorded west of Ontario.

CHELONE GLABRA, Linn.

Banks of west branch of Nottaway River, N.E. Ter., 1895. (*Dr. R. Bell.*)

EUNANUS BREWERI, Greene.

Amongst grass on hillsides at Sproat, Columbia River, 1890. (*John Macoun*, Herb. No. 10,307.) New to Canada. Determined by Dr. Greene.

THYMUS CHAMÆDRYS, Fries.

Stanley Park, Vancouver, B.C., September, 1895. (*Rev. H. H. Gowen.*) *T. Serpyllum*, L., is not uncommon in Eastern America, but this species has not been before recorded from this country.

CALAMINTHA CLINOPODIUM, Benth.

New Westminster, B.C., 1895. (*A. J. Hill.*) Not recorded west of Manitoba. Probably introduced.

POGONIA OPHIOGLOSSOIDES, Ker.

In bogs, near small lakes at head of Gatineau River, Que. (*Dr. R. Bell.*)

ALLIUM GEYERI, Wats.

Gravelly banks, Botanie, west of Spence's Bridge, B.C., 1890. (*Jas. McEvoy.*) Found on Vancouver Island, but not before on mainland of British Columbia. Referred by mistake to *Allium Nevii*, Wats., in No. II. of these papers.

ALLIUM ACUMINATUM, Hook.

On gravelly banks, Botanie, west of Spence's Bridge, B.C., 1890. (*Jas. McEvoy.*) Not before recorded from mainland of British Columbia.

CAREX FESTIVA, Dew., var. GRACILIS, Olney.

Borders of coulees, Cypress Hills, Assa., 1894. (*John Macoun*, Herb. No. 7,396.) Not before recorded east of British Columbia.

Review of the Evidence for the Animal Nature of Eozoön Canadense.

By Sir William Dawson, C.M.G., LL.D., F.R.S., Etc.[1]

I. HISTORICAL AND STRATIGRAPHICAL.

The writer of these notes had hoped to have been able long ago to let the vexed questions respecting Eozoön repose in peace in so far as he was concerned, and he is now induced to offer a short summary of the evidence in the case only with the view of correcting some misapprehensions that seem to have arisen in regard to points well established, and which, independently of any question as to the nature of Eozoön, belong to the certain data of geology. These misapprehensions lead to the confounding of the structures originally discovered by Logan with things in no way related to them, and from which they had been clearly distinguished by my own original studies, and by those of Hunt, Carpenter, and Rupert Jones. New facts relating to pre-Cambrian life have also been coming to light from time to time, and many of these are connected, either directly or indirectly, with the evidence respecting Eozoön.

As early as 1858, Sir William Logan had begun to suspect that the Stromatoporoid forms collected from the great Laurentian limestones in different parts of Canada must be of organic origin, and he ventured to mention them as possibly of this nature at the meeting of the American Association in 1859, and in his General Report on the Geology of Canada in 1863. The evidence on which he relied was their occurrence only in the limestones, their similarity in form and general structure to the Stromatoporæ, or "Layer-Corals" of the Palæozoic, and the circumstance that, while the forms and structures seemed to be identical, they were mineralized by Serpent-

1 [Reprinted from the Geological Magazine, Decade IV., Vol. II., October, November, December, 1895.]

ine, Loganite, Pyroxene, and Dolomite, an indication that a similar mould had been filled by diverse minerals.

At that time the little leisure that I could spare for original work was occupied with Carboniferous and Pleistocene geology, and I had no ambition to invade the great and difficult pre-Cambrian districts of Northern Canada any further than might be necessary to my work as a teacher of geology. In the interest of that work, however, I had gone over considerable portions of the Laurentian and Huronian districts surveyed by Logan and Murray, with the aid of their maps and reports, and had satisfied myself of the great accuracy of their work, which led in my judgment to the following results :—

(1) That the upper part of the Lower Laurentian of Logan, since called the Grenville Series,[1] consisted of truly stratified metamorphic deposits, including great and extensive beds of limestone, quartzite, iron-ore, and other rocks, evidently of aqueous origin, and that the condition and crystalline and chemical characters of these rocks were not essentially different from those of the altered Palæozoic beds with which I was familiar in Nova Scotia and New England.

(2) That the Huronian, a less disturbed, less altered, and in the main evidently a clastic series, rested unconformably on the Laurentian, and was in part composed of its materials.

(3) That the "Upper Copper-bearing series" of Lake Superior, since known as Kewenian, was newer than the Huronian, but older than the oldest fossiliferous Cambrian rocks then known in Canada.

(4) That, while the Kewenian and Huronian rocks, and those designated by Logan as Upper Laurentian, indicated by the presence of igneous masses, and, in the case of the two former, by the prevalence of coarse, clastic material, littoral conditions and much volcanic disturbance, the

1 By Dr. Sterry Hunt.

still older Grenville Series was of a character more indicative of long-continued quiescence, accompanied by the accumulation of great calcareous deposits, possibly of organic origin.

These conclusions were noticed in papers contributed to local societies, in published lecture-notes, and in class-teaching, and were frequently discussed with Logan and Hunt. Accordingly, when, in 1863, at the urgent request of Logan, I undertook the microscopic examination of large series of his supposed Laurentian fossils and the containing limestones, as well as of other crystalline limestones of various ages, slices of which he had caused to be made, I was not unprepared to find the curious and beautiful structures which developed themselves in his Stromatoporoid forms, and in portions of the limestone in which they were contained, but which appeared to resemble those of Foraminifera rather than those of Corals.

The results thus attained, in 1864, were not fully published until after Logan was prepared to sustain them by detailed maps and sections of the district on the Ottawa containing Eozoön, a work extending over many years of arduous and skilful labour; and until Dr. W. B. Carpenter and Prof. Rupert Jones had studied the original specimens and others prepared for themselves, along with my notes, and camera drawings executed by the artist of the Geological Survey. Dr. Sterry Hunt had also examined chemically the serpentine and other minerals associated with the supposed fossils, and various hydrous silicates mineralizing organic remains in Silurian and other limestones, as terms of comparison. The whole was then communicated to the Geological Society of London, and appeared in the somewhat elaborate joint paper published in 1865.[1]

[1] A preliminary accoount entitled "On the occurrence of Organic Remains in the Laurentian Rocks of Canada." had, however, been communicated to the British Association at Bath, Sept. 15-21, 1864, and was subsequently published in the Geological Magazine, Vol. I, for November, 1864, pp. 225-227.

I confess that in the intervening time I have seen no good reason to induce me to doubt the essential validity of the work embodied in this paper of 1865, or to modify to any considerable extent the conclusions therein stated. On the other hand, many new and confirmatory facts have been disclosed, and after careful and, I trust, candid study of the objections raised, down to those which have recently appeared in the Dublin Transactions, I believe that they largely depend on the want of knowledge of the character of the Grenville formation, and on misapprehension as to the form and structure of Eozoön and its mode of occurrence.

It is true that in those members of the Laurentian system of Logan which are below and above the Grenville Series, later observations have not only failed to detect fossils, but have shown valid reasons adverse to the probability of their occurrence, at least in the portions of those formations hitherto open to our study.[1]

The lowest Laurentian gueiss of Logan (Trembling Mountain gneiss, Ottawa gneiss, fundamental gneiss), which occupies a vast area in Northern Canada,[2] and is the only part of the system known to many geologists, consists, so far as known, wholly of foliated or massive orthoclase gneiss, with bands of hornblendic schist (amphibolite), and of hornblendo-micaceous schist. While in some places it appears to have a truly bedded structure, especially where different varieties of gneiss, amphibolite, and biotitic schist alternate, in others its foliation is obscure, or seems to have been induced by heat and pressure. Dr. F. D. Adams, who has given much study both to its character on the large scale, and to the microscopic structure of the rocks, in his latest publication on the subject[3] characterizes it as

1 See *Geological Magazine*, June, 1895.

2 Acccording to the geological map of Northern Canada prepared by Dr. G. M. Dawson for the Geological Survey, the area of Laurantian rocks exceeds two millions of square miles. Of this, so far as is known the older or fundamental gneiss occupies by far the larger portion.

3 Journal of Geology, Vol. i, No. 4, 1893.

a complicated series of rocks of unknown origin, but comprising a considerable amount of intrusive material. He regards it as either the remains of a primitive crust penetrated by much igneous matter, or as a series of altered rocks older than the Grenville Series, and formed under different conditions. In any case it seems to want the evidences of ordinary aqueous deposition presented by the limestones, ironstones, quartzite, and schists of the Grenville Series. Similar views were advocated in my address on the "Geological History of the Atlantic," before the British Association, in 1886.[1]

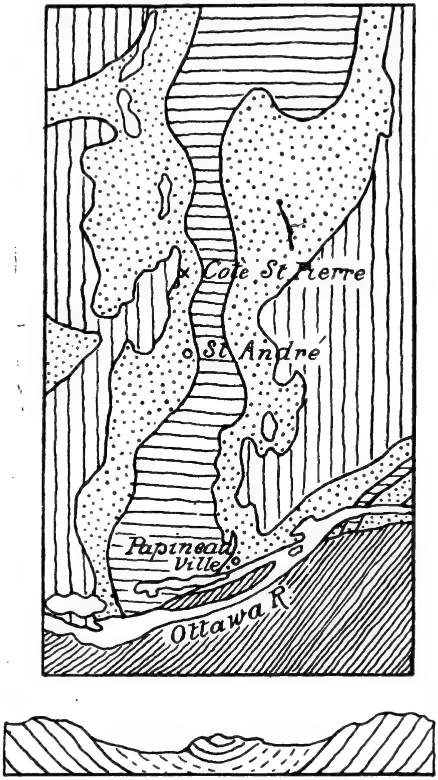


Fig. 1.—Distribution of Grenville Limestone in the district north of Papineauville, with section showing arrangement of the beds. Scale of map 7 miles to an inch. (See also Dr. Bonney's paper, *Geological Magazine*, July, 1895, p. 295.)

Dotted area: Limestone.

Horizontal lines: Upper gneiss (fourth gneiss of Logan.)

Vertical lines: Lower gneiss (third gneiss of Logan.)

Diagonal lines: Overlying Cambrian and Cambro-Silurian (Ordovician.)

The Upper Laurentian of Logan (Labradorite, Anorthosite, or Norian Series), supposed by him to overlie the

[1] See also Museum Memoir on Eozoon, pp. 2, 3. Montreal, 1888.

Grenville Series uncomformably, is now stated by Adams to consist of eruptive matter, mainly composed of triclinic or lime felspars, and to which the name Anorthosite[1] may properly be applied. These rocks, cutting the Grenville Series, and apparently in some places, interbedded with it, are not now regarded as a distinct series of beds, but as indicating local outbursts of igneous action dating about the close of the Grenville period. What aqueous rocks may have been contemporaneous with these, or may have filled the interval between the Grenville Series and the Huronian, we do not at present certainly know, though possibly some of the rocks associated with the upper part of the Laurentian, or the lower part of the Huronian in the interior, and in the eastern part of Canada, may come into this place.[2]

It is to be observed that in 1865 these facts respecting the fundamental gneiss and the Upper Laurentian of Logan, were not distinctly before our minds, though in subsequent papers I thought it best to consider the Grenville group as a distinct series under the name "Middle Laurentian." It is quite possible, however, that our referring in the first instance to the Laurentian as a whole may have led to erroneous impressions.

For the purpose of these notes, therefore, it will be best and most accurate to confine ourselves to the Grenville Series, which has been carefully explored and mapped by the officers of the Geological Survey in the country lying north of the Ottawa River, and also in some parts of the areas between that river and the St. Lawrence. In these regions Logan recognized a thickness of 17,250 feet of deposits, of which no less than 4,750 feet consisted of limestone, principally in three great bands, though with intercalated gneissose layers. The Grenville Series may

[1] Proposed by Hunt.

[2] Some of these beds are regarded by Von Hise (Jour. of Geology, Vol. i.) as a lower member of the Huronian. They may be identical in part with the "Kewatin" group of Lawson.

thus be regarded as one of the great calcareous systems, comparable with those of the Palæozoic period, which it also rivals in its association with carbonaceous and ferruginous, deposits. Though minute globular forms, probably

Fig. 2.—Arrangement of beds in valley of Calumet River—(*a*) Upper gneiss; (*b*) Limestone partly covered with soil; (*c*) Included bed of gneiss; (*d*) Lower gneiss.

organic, have been found in the Middle Limestone, that of Long Lake, Eozoön proper is confined, so far as known, to the Upper Limestone, known specially as the Grenville Band. This band and its accompaniments I have myself studied in the region north of the Ottawa, at the Augmentation of Grenville, near the Calumet, in the quarries opposite Lachute, at Côte St. Pierre, at Montebello, at Buckingham, and Templeton, as well as in some of the districts west of the Ottawa, where the same limestone is supposed to recur. Everywhere it is a large and regular bed, sometimes with even strike and dip, but at intervals thrown into violent contortions along with the enclosing beds, in the manner usually seen in disturbed strata of later age, where it is common to find portions little affected by plication alternating with strongly folded beds having the harder ones dislocated; others are merely bent or folded (Figs. 4 and 5). It presents subordinate beds of different qualities, dolomitic, serpentinous, or graphitic, and is immediately associated with thin-bedded, fine-grained gneisses, quartzite, and biotitic and hornblendic schists. In some beds it has disseminated crystals of minerals usually found in metamorphic limestones, while in others there are concretionary masses, nodules and grains of serpentine and pyroxene. Eozoön in masses occurs only in certain layers, most frequently in those which are serpentinous, but a careful examination detects in many layers, not showing perfect examples of Eozoön, small fragments or patches having its characteristic structures, or detached chamberlets or groups of these. The occurrence of these fragments I regard as an important fact, and as showing that what may be termed "Eozoön sand" enters largely into the composition of the limestone.

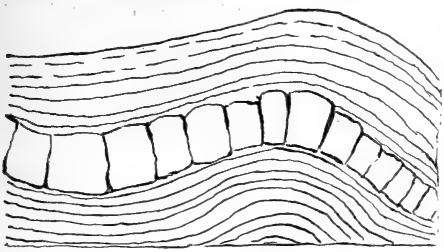


FIG. 3.

In illustration of this part of my subject, I present a rough map of the district near the Petite Nation River, in rear of Papineauville, referred to by Dr. Bonney in his valuable paper in the July No. of the Geol. Magazine, and in addition to the section given in his paper, one showing the order of succession in the valley of the Calumet, a little stream some distance to the eastward. I also give examples of the manner in which the associated gneiss, though often very regular, is along certain lines contorted, and the manner in which, in these contorted spots, the quartzite bands are cracked and broken, exactly as may be observed in the shales and sandstones of the Quebec group on the Lower St. Lawrence.

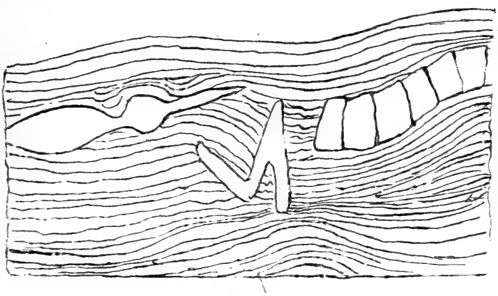


FIG. 4.

FIGS. 3 and 4.—Bent and dislocated Quartzite, in contorted schists interstratified with Grenville Limestone, near Montebello. The quartzites have been broken and displaced, while the schists have been bent and twisted. In the immediate vicinity the same beds may be seen slightly inclined and undisturbed.

I may add here that Dr. F. D. Adams has found that in certain localities the rocks of the Grenville Series become almost horizontal, though even in this case they show evidence of having been subjected to much alteration and great pressure. He has also shown, by comparison of a number of detailed analyses, that several of the gneisses of the Grenville Series have the chemical composition of Palæozoic slates, snd thus that there can be no chemical objection to regarding them as altered sediments. This I consider a very important observation; and I may refer for details to his paper in the *American Journal of Science*, 1895, p. 58.

The summary of facts above given should, I think, be sufficient to show that in the case of the Grenville limestone we have phenomena which cannot be explained by mere pressure acting on massive rocks, or by segregation of calcite from igneous rocks, or by vein structnres, or by any contact structures arising at the junction of igneous and aqueous deposits. We have, on the contrary, to deal with a formation which indicates that in the early period to which it belongs regular sedimentation was already in full operation. The more precise vital and chemical agencies which prevailed in the ocean of the Laurentian period we must notice later.

I have merely to add here that the characters assigned above to the Grenville Series have not only been fully corroborated by the recent work of Adams and Ells in Canada,[1] but also by the surveys of Kemp and Smyth in the more disturbed and elevated district of the Adirondack Mountains in New York.[2]

We have thus paved the way for the consideration of evidence of a structural and chemical character.

To be Continued.

1 *American Journal of Geology*, 1893, No. 4. Also Reports Geol. Surv. of Canada.
2 Bulletin Geol. Soc. of America, March, 1895.

THE CHEMICAL COMPOSITION OF ANDRADITE FROM TWO LOCALITIES IN ONTARIO.

BY B. J. HARRINGTON, B.A., PH.D., MCGILL COLLEGE.

(Presented to the Meeting of the Royal Society of Canada, May 17th, 1895).

1. LUTTERWORTH.

The specimens examined were collected by Dr. F. D. Adams at the "Paxton Iron Mine," in the township of Lutterworth, Ontario.[1] The magnetite at this locality is associated with a number of other minerals, including garnet, pyroxene, and hornblende. The ore body is also cut by reticulating veins holding quartz, calcite, orthoclase, pyroxene, scapolite, allanite, etc. The garnet is black in colour, and looks exceedingly like ordinary black tourmaline. It is mostly massive, but also found in crystals, which are rhombic dodecahedrons with their edges generally truncated by the tetragonal tris-octahedron (∞ O, 2 O 2). Carefully selected material was found to have a specific gravity of 3.813 at 17°C., and gave on analysis the following percentage compositions:—

Silica	35.68
Alumina	5.88
Ferric oxide	23.70
Ferrous oxide	3.65
Manganous oxide	0.81
Lime	29.64
Magnesia	0.35
Loss on ignition	.28
	99.99

The mineral was specially examined for titanium, but no trace found.

1 See Report of the Geological Survey of Canada, Vol. VI., 1891-92-93, Part J, by Dr. Adams,

The atomic and quantivalent ratios deducible from the above figures are as follows :—

	Atomic.		Quantivalent.		
Si	595 × 4 =	2380	2380	2380	 1
Al	112 × 3 =	336	1224	2424	 1
Fe^{III}	296 × 3 =	888			
Fe^{II}	51 × 2 =	102	1200		
Mn	11 × 2 =	22			
Ca	529 × 2 =	1058			
Mg	9 × 2 =	18			

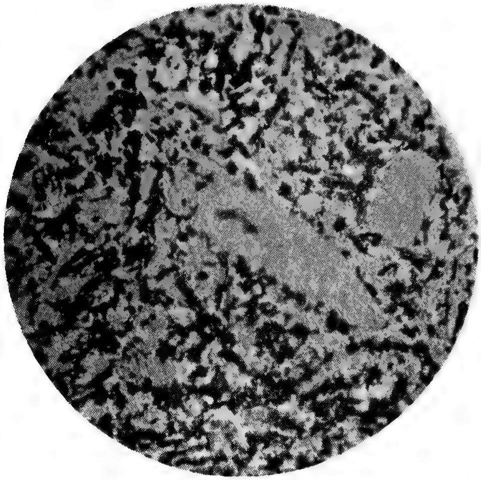
This shows that the mineral is a unisilicate, and it agrees well with the garnet formula $\overset{II}{R}_3 \overset{III}{R}_2 Si_3 O_{12}$, R being chiefly calcium and R chiefly ferric iron. Being, therefore, a lime-iron garnet, it should be referred to the sub-species *Andradite.*

2. Dungannon.

Among the minerals in the Nepheline Syenite of Dungannon, Ontario,[1] is a brown garnet, sometimes showing crystalline form, but occurring for the most part in small irregular grains. After careful separation by means of dense liquids, the grains were found to have a specific gravity of 3.739 and the following percentage composition :—

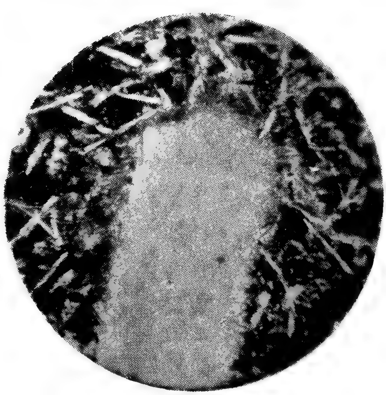
Silica	36.604
Titanium dioxide	1.078
Alumina	9.771
Ferric oxide	15.996
Ferrous oxide	3.852
Manganous oxide	1.301
Lime	29.306
Magnesia	1.384
Water	.285
	99.577

1 See papers on this rock and some of the minerals which it contains, by Dr. Adams and the writer, in the American Journal of Science, Vol. XLVIII., July, 1894.



No. 1.

No. 2 (*a*).



No. 2 (*b*).

MICRO-PHOTOGRAPHS OF DYKES.

The atomic and quantivalent ratios deducible from the above analysis are as follows:—

Si	610 × 4 =	2440	2492	2492	 1
Ti	13 × 4 =	52			
Al	192 × 3 =	576	1176	2434	 1
Fe^{III}	200 × 3 =	600			
Fe^{II}	53 × 2 =	106	1258		
Mn	18 × 2 =	36			
Ca	523 × 2 =	1046			
Mg	35 × 2 =	70			

Evidently the mineral belongs to the sub-species *Andradite*

Some Dykes Cutting the Laurentian System in the Counties of Frontenac, Leeds, and Lanark, Ont.

By W. G. Miller and R. W. Brock, Kingston, Ont.

[With Plate III.]

During a canoe trip which the writers took last September in connection with a party in field geology from the Kingston School of Mining, a large number of dykes cutting the Laurentian series were examined. In the district traversed, the county of Frontenac and adjoining eastern counties, the dykes show a considerable variety in mineralogical composition. It is proposed, in the present paper, to give a short description of a few of the more basic representatives of these.

The larger masses of more coarsely crystalline igneous rocks throughout the district belong to the granite and gabbro families. The characters of the more typical granites in the south-western part of the district seem worthy of notice. The quartz in these generally forms about one-fourth of the mass of the rock, and possesses a blue colour; the feldspar consists of microperthite, orthoclase, microcline, albite, and probably anorthoclase; while the ferro-magnesian constituents, which are usually so much decomposed that their true characters are not determinable even in specimens obtained from a considerable distance beneath the surface of the ground, are to a large extent grouped in such a way that a face of the rock shows numerous dark patches, often two inches or more in diameter. In some of the most acid of these granites, there are basic segregations which consist of lime-soda feldspar, together with small amounts of pyroxene. The granite dyke rocks, in many cases, are very coarse-grained, and consist of microcline and other alkali feldspars, quartz, and a light-coloured mica which occurs in varying amounts.

Many of the schistose rocks of the district, with the exception of the crystalline limestones, are in all probability of eruptive origin; but very little work has so far been done on them.

The scapolite rocks are among the most interesting representatives of the schistose group. While it is likely that some of these have been produced by the alteration of gabbros, there are others in which such evidence of their origin has not been obtained. The writers have examined specimens, taken in some cases from a considerable distance beneath the surface of the ground, which consisted of the two essential minerals, scapolite and pyroxene. Some grains of the latter constituent were seen to be quite fresh, while others, especially in those specimens from near the surface, were more or less changed to hornblende. In the rock referred to, no plagioclase was noticed.

Another rock of a very striking character, when examined microscopically, consists of the minerals microperthite and pyroxene, together with small amounts of orthoclase, lime-soda feldspar, and a finely-striated plagioclase which is probably anorthoclase. The microperthite is present in much greater quantity than the other constituents. The rock is undoubtedly of eruptive origin, and occurs in the district adjacent to the locality in which the mineral perthite was first discovered.[1]

Thin sections of the scapolite-pyroxene and microperthite-pyroxene rocks referred to have a general resemblance to each other when examined under the microscope in ordinary transmitted light. The pyroxene has about the same form and green colour, occurs in about the same proportion, and is set in a colourless matrix in each. In polarized light, however, the resemblance ends, the scapolite possessing very much brighter colours than the feldspar.

Masses of gabbro and norite are found at a number of localities throughout the district traversed. These coarse-grained rocks possess the same general characters as those of their class which have been described from other parts of Canada. In most of the masses a considerable differentiation is shown; in one part they may show the characters of a normal gabbro while in others they are true norites; and again, in certain portions of the mass free silica may be present. The gabbro-norite mass which crosses the railroad a short distance north of the village of Parham is interesting on account of the comparatively large size of the inclusions which occur in both the diallage and hypersthene. This rock appears to offer a good opportunity for the determination of the characters of these materials which, except in size, are similar in appearance to those commonly found in these minerals. Prof. Judd, the late Prof. G. H. Williams, and others, have examined such inclusions in rocks from different parts of the world. In some rocks they have been held to be of secondary origin, while in others it is claimed they are original constituents. Their chemical composition is said to be different in different cases.

Dykes of the basic rocks occur in great numbers

1 This rock seems to resemble one referred to by Prof. K. de Kroustchoff, of St Petersburg, Bulletin Soc. Franc. de Min., IX., 1886. Tschermak's Min., u Pet. Mitth. 1887.

throughout these counties. They do not cut the strata of Cambrian and Silurian age, which are found at a number of places overlying the Laurentian, nor are any surface flows known to occur, although, from the characters of one set of very fine-grained porphyrite dykes which will be described, it seems not unlikely that such flows have taken place over the Laurentian series, but the material of which they were composed has been removed by the excessive denudation to which these rocks have been subjected since pre-Cambrian times.

The late Mr. H. G. Vennor mentions a dyke, composed of "a fine-grained, black, glittering dolorite, weathering greyish-white," discovered by him near the banks of the Rideau canal, in the township of North Burgess, and states that "in width it varies from four to one hundred feet."[1] Series of specimens were taken from this dyke, and when examined in thin sections under the microscope the rock is seen to consist of lime-soda feldspar and a secondary ferro-magnesian mineral, together with small amounts of brown mica, hornblende, and quartz. The plagioclase occurs in more than one generation, so that the rock is a porphyrite. The larger phenocrysts of this mineral, whose length rarely exceeds 2·5 mm., occur sparingly, and are of earlier formation than any of the other essential constituents of the rock. The most important ferro-magnesian constituent is a uralitized pyroxene which occurs in irregular grains, enclosed, to some extent, in crystals of the second generation of plagioclase. Individuals of this latter mineral, whose average length is under 0·35 mm., have, like the older phenocrysts, the "dusted" appearance commonly seen in the feldspar of gabbros. Some of the inclusions are air cavities. Filling up the interstices between the two generations of crystals mentioned are grains of quartz and feldspar, some of which is probably orthoclase. A considerable

1 Report of Progress, Geological Survey of Canada, 1872-3.

proportion of these minerals forms an intergrowth of micropegmatite. The most important accessory minerals are magnetite and apatite. The latter occurs in needle-like forms, and, curiously enough, is most abundant in the minerals filling the interstitial spaces. The rock at the contact, and in the centre of the wider parts of the dyke, is seen to vary considerably, specimens from the centre being somewhat coarser grained and more acid. The latter point is illustrated by the more abundant occurrence of quartz and hornblende, and by the shorter and broader form of the feldspar, which commonly shows twinning according to both the albite and pericline laws. Phenocrysts of plagioclase of the first generation are also less abundant near the centre of the dyke. A specimen of the rock, taken some distance from the contact, was found to contain 52·96 per cent. of silica. Thin sections of the rock taken from a number of dykes in the township of Bedford were found to be similar in character to those taken from the North Burgess dykes. These rocks, from both townships, appear to belong to the gabbro family, the more acid representatives of which frequently contain 53 per cent. of silica. We believe that they should be described as quartziferous gabbro porphyrites. The following table will show the relation they hold to other gabbro and diorite dyke rocks which have been described from other countries:—

	Gabbro.	Diorite.
Dyke Rocks	Gabbro aplite. (Beerbachite).[1]	Diorite aplite. (Malchite).[2]
	Gabbro porphyrite. (————)	Diorite porphyrite. (Orbite).[1]
	Gabbro lamprophyre. (Odinite)[1]	Diorite lamprophyre. (1. Kersantite). (2. Camptonite).

1 Dr. C. Chelius: Notizbl. Ver. Erdk. Darmstadt, IV., Folge, 1891 u. 1892.

2 Prof. A. Ossan: Mitth. grossh. bad. Geol., Landesanst, II.. 380.

A number of dykes which occur near the west bank of the Rideau canal, in the vicinity of Seeley's Bay, were examined. One of the smaller of these, which cuts the graphite-holding crystalline limestone near a narrows in the canal, has a width of four feet, and sends off branches into the surrounding rock. It is dark in colour, very fine-grained, and possesses a highly perfect columnar structure, developed in a direction at right angles to its walls. The rock has a specific gravity of 2·92, and on analysis was found to have the following chemical composition :—

SiO_2 46.51, TiO_2 2.90, Al_2O_3 12.33, Fe_2O 11.14, Fe_2O_3 3.87, CaO 9.37, MgO 6.48, Na_2O 3.67, K_2O 1.18, H_2O+CO_2 2.47, S ·16. Traces of copper and barium were observed. Manganese and nickel are both present.

The rock fuses readily. About twelve ounces of it were finely pulverized, placed in a covered graphite crucible, and fused for some hours in a coal furnace. It was then allowed to cool. On breaking the crucible the fused mass was found to have separated into two parts—a highly perfect, clear, slightly amythistine glass, and a "button" containing most of the metallic matter. The latter rested on the bottom of the crucible, and was easily detached from the glass. It had a diameter of about 2·5 cm. and a thickness of about 1 cm., and weighed about one and one-quarter ounces.

In hand specimens many minute crystals are seen scattered through the rock. Examined microscopically, in thin sections, the groundmass is found to be very fine-grained, and, in the denser portions, microlitic. Abundant phenocrysts of plagioclase and pyroxene are present. These minerals are also constituents of the groundmass, which contains, in addition, much magnetite. The larger individuals of plagioclase of the groundmass, Fig. 2 (*b*), are in needle or lath-like forms, having an average length of about 0·05 mm., but there are innumerable smaller and less regular ones. The magnetite occurs in octahedrons, irregular grains, and in skeleton crystals or dendritic forms. A number of octahedrons are often seen joined together into strings, having branches at right angles. The porphyritic plagioclase, Fig. 2 (*a*), usually has the lath-shape and an average length of less than 1 mm. Phenocrysts of this mineral are more abundant than those of pyroxene, with which they are often intergrown—the pyroxene being the older, and having served as a point of attachment for the feldspar when it began to crystallize. The porphyritic crystals of monoclinic pyroxene are light-brown to colourless, and frequently have a somewhat elongated form, with rough edges. Some of the largest are 1·8 mm. in length. An irregular parting perpendicular to the longest axis of the crystal is present. Rhombic pyroxene occurs sparingly in some of the sections. Its phenocrysts are smaller than those of the monoclinic, and generally have a somewhat regular octagonal outline. Patches or irregular grains of chloritic material are present in all of the thin sections examined.

Thin sections were examined from some larger dykes in the same vicinity. These were found to possess the general characters of the rocks just described. Pyroxene, however, was not observed among the phenocrysts, and olivine appeared to be absent. A flow structure is often seen in the sections from the narrow dyke. This structure is illustrated by the arrangement of the feldspar phenocrysts and the constituents of the groundmass around the earlier-formed individuals. This dyke rock, which may be classed as a porphyrite, appears to resemble the members of the effusive group more closely than it does those of the plutonic. Effusive masses, however, are not known to overlie the Laurentian in any part of the district.

DESCRIPTION OF FIGURES.—PLATE III.

No. 1.—Gabbro porphyrite from North Burgess. The thin section was photographed in ordinary transmitted light, a number two objective being used in the microscope. Two large phenocrysts of plagioclase are shown. The feldspar of the second generation is also shown in white. The minerals filling the interstitial spaces do not come out distinctly.

No 2 (*a*).—Dyke rock (porphyrite) near Seeley's bay, Rideau canal. Photographed under the same conditions as No. 1. A number of phenocrysts of plagioclase and one or two of pyroxene are shown. The feldspar in the groundmass is also brought out.

No. 2 (*b*).—This is a portion of No. 2 (*a*) more highly magnified, a number seven objective being used. The white central portion represents an end of a plagioclase phenocryst. The feldspar of the groundmass is also shown.

The writers are indebted to their friend Mr. William Lawson, B.A.Sc., for the photo-micrographs from which these figures are taken.

GEOLOGICAL DEPARTMENT.
SCHOOL OF MINING.

ON THE FERNS IN THE VICINITY OF MONTREAL.

By HAROLD B. CUSHING, B.A.

Montreal has been spoken of by more than one writer as a very favorable locality for collecting plants. However this may be with regard to plants in general, the remark is certainly true of the ferns, principally on account of the situation of the city at the foot of Mount Royal. In the comparatively small area comprised by the mountain, we have rich damp woods, rocky hillsides, swamps and shaded cliffs, in fact, all the most favorable conditions for the growth of the various species of ferns. Thus, out of at most forty-five varieties which include Montreal within the limits of their distribution, no less than thirty-two have been found within an area of about one square mile. My purpose in writing this paper is to collect the past records of Montreal ferns, describe as far as possible the present distribution of the various species in this vicinity, and contrast it with what can be learned from the records of their distribution in the past.

Ferns have always received their due share of attention by botanists. While the rest of the Cryptogams and many of the orders of Phanerogams are persistently neglected, except by specialists, the ferns form part of every herbarium and are included in all manuals of flowering plants. As a result of this, we find, on referring to past records of Montreal plants, that we have a fairly complete record of ferns from 1821, when the Holmes Herbarium was made, to the present time. The more important of these records are as follows ;—

Catalogue of the Holmes' Herbarium ; Canadian Naturalist, April, 1859.

List of Canadian Plants, by Dr. Maclagan ; Annals of the Kingston Botanical Society.

Synopsis of Canadian Ferns, by Dr. Geo. Lawson ; Canadian Naturalist, August, 1864.

Notes on Canadian Ferns, by John B. Goode ; Canadian Naturalist, Vol. IX., p. 49.

Canadian Filicineæ, by Macoun and Burgess ; Transactions of the Royal Society of Canada, Vol. II.

Catalogue of Canadian Plants, Part V., by John Macoun.

Flora of Montreal Island, by Dr. Robt. Campbell ; Canadian Record of Science, Vol. V., No. 4.

A few species have also been recorded from Montreal by McCord, St. Cyr, Provancher, Parsons, and others.

I have made a careful comparison between these various records, and have for three years past carefully examined the present distribution of Montreal ferns, to observe how far their distribution corresponded to the past records. I hoped by these means to be able to trace the influence of civilization in exterminating species through the clearing of land and draining of wet places. The change in the flora should be especially evident in the case of the ferns on account of their peculiar habitat, and, moreover, of no other group of plants have we such a complete local record. The chief result of my investigation, however, is a realization of the difficulty of exterminating species even in a limited locality. Thus, out of the thirty-two varieties recorded, I have been able to discover twenty-nine still occurring, though several of these were spoken of thirty years ago as on the point of disappearing. Doubtless this persistent survival of species, which have become rare, is partly due to the mountain having been preserved as a park, though great changes have been made in it. The following instances will serve to illustrate what I have stated :—

Pellæa gracilis is only recorded from Montreal by Dr. Holmes in 1822. In view of the very complete character of several of the above records, the absence of any mention of it since that time is sufficient proof of its rarity. However, it still occurs sparingly on the mountain side.

Asplenium angustifolium is recorded by McCord and Goode as occurring on the smaller mountain with *Aspidium Goldianum*, and a colony of this fern is still found there, though *A. Goldianum* has probably become extinct.

Aspidium acrostichoides is recorded by Goode in 1879 as occurring back of Sir Hugh Allan's and behind the cemeteries, but becoming scarce. It is still found, however, in sufficient abundance in both localities.

Dicksonia pilosiuscula is only recorded by Maclagan, and is found behind the cemeteries.

There are only three species which I have been so far unable to discover, but which may possibly still occur. These are *Aspidium Goldianum*, *Camptosorus rhizophyllus* and *Botrychium ternatum*.

Aspidium Goldianum, Hooker, is of especial interest, as Montreal is the locality where it was first discovered, in 1818, by Mr. Goldie, after whom it was named by Sir William Hooker. Since then it has been recorded by Maclagan, McCord and Goode, though Mr. Goode writes, in 1879, that he has not found it for some years. I have been unable to discover it in the locality described by these writers.

Camptosorus rhizophyllus, Link, is represented in the Holmes Herbarium by a specimen from St. Helen's Island. It is recorded from l'Abord-à-Plouffe and St. Helen's Island by McCord, and from Montreal Mountain by Provancher. It probably does not now occur on the mountain or on St. Helen's Island.

Botrychium ternatum, Swz., var. *lunarioides*, has also been recorded by McCord and Goode, and a specimen, marked "Montreal, 1861," is in the McGill Herbarium, but I have not succeeded in finding the fern in this vicinity.

In the following list I have chiefly given the distribution of the various species on the mountain, as that is the locality to which I have devoted most attention. The mountain consists of three separate hills, divided by Côte des Neiges road and the cemeteries. For convenience of description I have referred to these as Mount Royal and the North and West Mountains.

Polypodium vulgare, Linn.—Polypody—Rather common, especially abundant on the north-east slope of Mount Royal, growing on loose rocks.

Adiantum pedatum, Linn.—Maidenhair.—Common in many places, in rich woods and on wooded hillsides.

Pteris aquilina, Linn.—Common Brake.—Common everywhere in thickets and open places, especially in sandy soil.

Pellæa gracilis, Hook.—Cliff Brake.—Crevices in the cliffs of volcanic rock on the north-east face of Mount Royal, rare.

Asplenium Trichomanes, Linn.—" A few plants were found on the north slope of mountain, growing in the crevices of a huge detached rock in a very secluded and precipitous spot," Goode, 1879. About a dozen rather weak and stunted plants still grow in this situation.

Asplenium angustifolium, Michx.—A small colony of these ferns grows in the rich damp woods near the gate of Mount Royal Cemetery. " Nun's Island," Parsons.

Asplenium thelypteroides, Michx.—Rich woods and hill-sides, round the base of Mount Royal, and on the north mountain.

Asplenium Filix-fœmina, Bernh.—Spleenwort.—Very common and variable, growing in low grounds and in woods.

Camptosorus rhizophyllus, Link. — Walking-Leaf.— " Montreal Mountain," Provancher. " Dry rocks at l'Abord-à-Plouffe, Isle Jesus, not common," McCord. " St. Helen's Island," Sheppard. I have been unable to find it either on St. Helen's Island or on Mount Royal.

Phegopteris polypodioides, Fée.—Beech Fern.—Damp woods, at the north-east base of Mount Royal, and between the cemeteries.

Phegopteris Dryopteris, Fée.—Oak Fern.—Rocky woods and hillsides, north-east base of Mount Royal, and on the north and west mountains.

Aspidium Thelypteris, Swartz.—Wet places, base of Mount Royal, between the cemeteries, and on the west mountain.

Aspidium Noveboracense, Swartz.—Wet places, rather common, especially in the mountain swamps.

Aspidium spinulosum, Swartz.—Wood Fern.—In mountain swamps, between the cemeteries, and on the west mountain, not common.

Aspidium spinulosum, Swz., var. *intermedium*, D.C.E.—Woods and shaded hillsides, in drier places than the last, found in several localities on all three mountains, but nowhere common.

Aspidium cristatum, Swartz.—Shield Fern.—Swamp between the cemeteries and in mountain swamps, not common.

Aspidium cristatum, Swz., var. *Clintonianum*, D.C.E.—In the same localities as the last, distinguished chiefly by its size and the position of the sori.

Aspidium Goldianum, Hook.—Recorded from Montreal Mountain, by Goldie, Maclagan, McCord and Goode, and from Nun's Island, by Parsons. I have been unable to find it on the mountain.

Aspidium marginale, Swartz.—Shield Fern.—Rocky hillsides, common in many places.

Aspidium acrostichoides, Swartz.—Christmas Fern.—Not common, on the rocky hillside above Ravenscrag, and on the north mountain. The form known as var. *incisum* is recorded by McCord in 1861.

Cystopteris bulbifera, Bernh.—Bladder Fern.—Common on the east slope of Mount Royal, and on the north and west mountains.

Cystopteris fragilis, Bernh.—In crevices of shaded cliffs, rather common in various places on all three mountains.

Onoclea sensibilis, Linn.—Sensitive Fern.—Common in swampy places. The occasional form known as var. *obtusilobata* occurs in the mountain swamps.

Onoclea Struthiopteris, Hoffm.—Ostrich Fern.—Common in the swamp near the Riding Ring, Mount Royal; occurs also in the mountain swamps.

Woodsia Ilvensis, R. Br.—Woodsia.—Common all along the exposed cliffs on the face of Mount Royal.

Dicksonia pilosiuscula, Willd. — Dicksonia.—A few plants were found growing in open places on the north mountain.

Osmunda regalis, Linn.—Flowering Fern.—Abundant in mountain swamps and west of the Riding Ring.

Osmunda Claytoniana, Linn.—Osmunda.—Rather common in swampy places.

Osmunda cinnamomea, Linn.—Cinnamon Fern.—Common in swampy places. The occasional state, called var. *frondosa*, occurs in the mountain swamps.

Botrychium simplex, Hitchcock.—On a grassy hillside at the north-east base of Mount Royal, rare.

Botrychium ternatum, Swartz, var. *lunarioides.*—"Dry open spot, on top of mountain, back of the Redpath property," Goode, 1879, also recorded by McCord. I have been unable to find this station.

Botrychium Virginianum, Swartz.—Moonwort.—Rich woods, rather common in various places.

Gold and Silver Ores of the Slocan, B.C.

By J. C. Gwillim, B.A.Sc.

One of the most striking physical features of the interior of British Columbia is caused by the great system of lakes and rivers which almost surrounds the Selkirks within their Canadian limits.

These waterways form long north and south depressions and are connected by low transverse passes, which drain to the east and west.

This region is, therefore, fairly accessible to the explorer or prospector. The geology has not as yet been fully worked out, but enough has been learned to show it to be a region of intrusive and of uplifted rocks of undetermined age.

The western portion of this watershed is largely of a granitic nature, but there are several large areas of metamorphic rocks, such as quartzites, schists and calcareous slates. The eastern portion is mainly composed of slates and schists.

Up to the present time the most richly mineralized belt appears to lie along the summits of this watershed. Yet the whole region is well stocked with economic minerals and offers to the mineralogist a rich and varied field for study.

The existence of the chief galena silver districts appear to be determined to a great extent by the large areas of impure limestones and calcareous slates. Such districts are the Slocan and Lardeau. Of this mineral, so abundant and valuable, there are three principal varieties, and these have come to be recognized as bearing certain relations to one another in their silver bearing capacity. *Cubical*, well crystallized galena, is by far the most common; it forms the backbone of the silver mining industry and assays, in the Slocan district, from 50 oz. to 200 oz. in silver. Here it occurs in fairly massive impure limestones and slates. Galena differing in no way in appearance, coming from Lower Kootenay Lake or the Lardeau country, carries far less silver. The same is true of the great galena bodies of East Kootenay.

This variety forms the largest ore bodies; it seems to be the mother mineral of the chief fissure veins. Calcite crystals and chalcopyrite are sometimes intimately mixed with it, as in the great "Slocan Star" mine.

Steel galena is of a granular texture, with some resemblance to broken iron. It occurs in patches through the cubical variety, but is seldom found in large bodies. Assays made upon this usually show it to carry a higher percentage of silver than the preceding.

Wavy galena is of much the same texture as steel galena, but is more lustrous and is foliated, giving it a somewhat laminated appearance. The value of this variety often exceeds that of the others mentioned. The relative values of these varieties, together with the fact that locality bears such a strong relation to their silver value, may go to show that the silver itself exists outside of a chemical combination with this mineral. Silver is found throughout the whole range, pervading all formations and associated with so many different minerals that the question of the form in which it is present becomes interesting.

Tetrahedrite, or "gray copper," is widely represented, and much sought after. It is usually of a dark grey color with a faint iridescence and a texture like steel galena. Specimens of this carry from 200 oz. to 800 oz. of silver. It occurs associated with galena, zinc blende and calcite, giving, upon decomposition, very beautiful ores of azurite and malachite. Silver has entered into many curious relations where the absence of galena has caused its association with some other mineral. One case occurs near Slocan Lake, where little bunches of native arsenic have been found containing 1,000 oz. to the ton.

In one of the principal producing mines, the "Alamo," upon Silver Mountain, it is found with antimony, giving a very rich ore. This is known as "antimonial silver." The mineral is very dark grey, sometimes faintly streaked, and occurs as small patches included in a matrix of cubical galena.

Silver is found in combination, as Sylvanite in one mine near Slocan Lake, as "Ruby silver" in several places and as native silver filaments and silver sulphides all about the limits of the Slocan area of limestones, in granite.

These latter constitute the dry ores of the district, and are rarely found in the main galena limestone belt.

Argentite is usually associated with iron pyrites in a coarsely crystallized gangue of quartz. Often this mineral is well crystallized, but in most cases it occurs chiefly as a fine black dust or stain. The veins, having a comb-like structure, easily open to decomposing agencies,

Usually a paying quantity of gold is associated with the argentite ores. Some of the veins are banded. A notable example occurs at the "Exchange" mine, near Slocan City. Here there is first a band of opaque milky quartz some inches in thickness. Next to this comes an inch band of iron pyrites (always well crystallized) mixed with silver sulphide dust. An inch from this, in a clearer quartz, there occurs a distinct broken lamina of native silver. This arrangement is repeated four times. The pyritous band assays 270 oz. in silver. There are no pyrites with the native silver band. It would be interesting to find what relations exist between the pyrites and silver sulphide and if the silver exists as a sulphide below the line of decomposition.

As regards gold, there is little evidence of its occurrence in a free state. It does occur so in a few places along the east side of Slocan Lake, in a quartz gangue, but even here the ore body carries so much pyrites that it would cause it to become unfit for free-milling. Usually the gold is intimately associated with pyritous matter, such as arsenical iron, chalcopyrite and pyrrhotite, as in the Trail Creek country. One of the deposits carrying gold in a free state also carries it in combination as sylvanite, but this is rare.

Very little gold is found in the galena mines. What is produced seems to be derived from the pyritous matter contained therein.

The Trail Creek gold ores are a mixture of chalcopyrite and pyrrhotite, greatly resembling the Sudbury nickel ores. They carry from half an ounce to five ounces of gold. Assayers of this ore have come to the conclusion that there is a direct proportion between the amount of chalcopyrite present and the gold contained. Some such relation as exists between the copper and nickel in certain nickel ores.

As this region becomes more developed, there will, doubtless, be found many rare and interesting mineral combinations. It is but four years since it was a wilderness, in which some stray prospectors found the first galena lode.

Book Notices.

Ein Prä-Kambrisches Fossil, Palëntologische Notizen, von Carl Wiman.—Bull. Geol. Inst., Upsala, No. 3, Vol. II., 1894.

The above author, in this paper, offers a contribution toward the explanation of an enigmatical fossil found in the pre-Cambrian rocks of the Island of Visingsö, in Lake Wetter, in Sweden.

The terrain which these rocks form is said to underlie unconformably the Cambrian-Silurian[1] terrain, and is therefore clearly older than the Olenellus Zone. It consists of a conglomerate, with yellow sandstone at the base ; then 40-50 metres in thickness of red and green slate and sandstone ; then 250 metres of slates—greyish-green below and white above, where there are layers and seams of argillaceous limestone.

In the white slates appear small, round, black disks of 1 to 2 millimetres diameter. These fossils have caused considerable speculation among Swedish geologists. (In 1879) A. G. Nathorst mentioned them, and thought they were of organic origin. (In 1880) G. Linnarsson also spoke of them as objects of organic origin, but of very uncertain nature. (In 1885) G. Holm described them as being similar to a small flattened Brachiopod, such as a Discina. (In 1886) Nathorst referred to the fossil again, and says it reminded him of a small Estheria, although the agreement was far from being decided.

Herr C. Wiman submitted these objects to various tests with Shultze's masceration fluid and other preparations, and from their resistance to reagents concluded that the shell was chiefly Chitine, as in the graptolites. He found that the object was originally globular, but had been flattened in the shale, and that it was perforated with minute holes, for the passage of pseudopoda, and had some larger openings. However, he thinks that the affinities of these fossils (which are obscured by clay clinging to the surface) are still so uncertain as to make it inadvisable to give them a name.

[1] This is not the Cambro-Silurian of English authors.

Though their affiliations are obscure, the concensus of such high Swedish authorities as those above cited, that the objects are organic, is valuable, as making known a type of pre-Cambrian animal not hitherto recognized.

The formation, or terrain, in which these fossils are found is described as pre-Cambrian, but nevertheless Palæozoic; hence it would appear to hold the same relation to the Cambrian of Sweden that the Etchuninian series does to that of Canada.

A plate, with figures and section of the fossil accompanies the article. G. F. M.

MINERALS, AND HOW TO STUDY THEM: A BOOK FOR BEGINNERS IN MINERALOGY. — By Edward Salisbury Dana, Yale University, New Haven. John Wiley and Sons, New York, 1895, pp. 380.

This little book is a most welcome addition to the rather scanty literature of elementary mineralogy, and will, we hope, be widely read not only by "the young people of both sexes," but by many of larger growth. Books on "popular science" multiply apace, but while many of them are popular, few are scientific. In Dr. Dana's new volume, however, we have an example of a work which is thoroughly scientific, and which, we think, is sure to prove popular. The author himself tells us in the preface that "the attempt has been made to present the whole subject in a clear, simple, and so far as possible a readable form, without too much detail, and at the same time without cheapening the science." The attempt has been successful.

As an example of the style in which the book is written, we give the following extract from the introductory chapter:—

"And here it is important to realize how little we can know by actual contact and direct observation about this earth, though we live upon it. It is possible, indeed, to measure its size and shape, to find out its density as a whole, to study its surface features and the changes which they have undergone; but of the materials of which it is made we can know little beyond those which form the surface upon which we walk. The miner digs down a little distance, and the artesian-well borer goes down still deeper, and we may have a chance to examine the specimens that their work brings up; or perhaps we can go down with the miner and see them in place. But the deepest mines descend to less than three-quarters of a mile; and though this seems deep to one who is let down a shaft in a bucket, it is but a little way compared with the whole distance to the earth's centre, which would require a journey of nearly four thousand miles. Even the deepest artesian-well borings hardly go down to the depth of one mile.

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"Thus the mineralogist is limited to the study of the little part of the crust of the earth which he can reach with his hammer; and he cannot extend his collection much beyond this, unless indeed he takes in some of those rare visitors from outer space—called *meteorites*—which once in a while tumble down to the earth, usually with a bright light and loud explosion."

Chapter VIII., on the Determination of Minerals, gives some useful advice, a little of which may be reproduced here :—

"Confidence and hasty judgment," Dr. Dana tells us, "belong to those who have little experience and a scanty knowledge of the difficulties of the subject.

"But, on the other hand, to recognize most of the minerals which are likely to be collected on a mineralogical excursion, or to be obtained by exchange with other collectors, is generally easy even for the beginner, if he goes at the subject in the right way.

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"The best way, then, for one with a specimen of an unknown mineral in hand, is to think of the common species first, and afterwards of others which may suggest themselves, running over in mind, or by reference to the book, the characters observed and those of the species to which it is provisionally referred, but with care not to decide too hastily, but to give each character full weight. Do not give the name *albite* to a specimen of *barite*, either the tabular glassy crystals or the white massive granular kind, because both species are often white and also resemble each other in form, and overlook the fact that it is much too heavy as well as too soft. Do not give the name *beryl* to a crystal of *apatite* because it is a green hexagonal prism, and overlook the fact that it is quite too hard. Finally, do not hesitate to confess ignorance—that the experienced mineralogist is ever ready to do ; and it is this fact that enables him from time to time to identify some rare and interesting species, and perhaps occasionally one new to science."

The chapters on the physical and chemical characters of minerals are clear and to the point, and the descriptions of species, while necessarily restricted, bring out well the essential characters of the minerals.

The book has an attractive cover, is well printed, and admirably illustrated. B. J. Harrington.

Life and Rock : A Collection of Zoological and Geological Essays.—By R. Lydekker, B.A. Cantab., F.Z.S. (Knowledge Series). London, 1894.

"Life and Rock," comprises a series of essays relating to zoological and geological subjects, more especially to the former. Some of the chapters deal with the natural history of certain animals ; others treat of the interesting problems of evolution and development in a popular style, aimed to reach those lovers of nature who are repelled by the technical phraseology of scientific treatises.

The first few pages are devoted to the elephant, cousin of the extinct mastodon, and differing from it chiefly in the structure of the teeth. "The first and most obvious peculiarity in regard to its dentition is to be found in the tusks, which correspond to one of the pairs of upper teeth in man, and also to the single pair of such teeth in the Rodents (rats, hares, etc.) Moreover, these teeth, like the incisors of the Rodents, grow continuously through the life of the animal, owing to the circumstance that the pulp cavity at their base always remains open and has a permanent connection with the soft structures of the gum. In our own teeth, on the contrary, the pulp cavity closes at a certain period, after which there is a total cessation of growth."

A rude shock to our common ideas of elephantine nature is afforded by the extinct elephants of Malta, which show us that gigantic size is not a necessary concomitant of the group, and that when the area in which a species dwelt was small the size of the species itself was proportionately reduced. These little Maltese elephants were very closely allied to the living African species, but whereas "Jumbo" attained eleven feet in height, and wild specimens of the African elephant may be still larger, the smallest of the Maltese species was scarcely taller than a donkey. So small, indeed, are the bones and teeth of this species, exhibited in the National History Museum, that it is sometimes difficult to convince people that they really belong to elephants at all.

As regards their distribution, elephants and mastodons formerly roamed over the whole world, with the exception of Australia; true elephants ranging over the whole Northern Hemisphere, while mastodons extended as far south in the New World as the confines of Patagonia. It is in the north-east of India, Burma, and the Islands of the Malayan region that the fossil elephants connecting the living species with the mastodons are alone found; and it is thus probable that from these regions the true elephants migrated westward into Europe and Africa, while the mammoth, in later times, crossed from Asia into Alaska by way of Behring Strait. That the mammoth, which ranged from the Arctic regions to the Alps and Pyrenees, was a contemporary of the primeval hunters of Europe, is now a well-established fact; but it appears that throughout the Old World mastodons had utterly died out before the advent of man. In the New World, however, the continuity between the old and the new fauna was more fully sustained, the Missouri mastodon having survived well into the human period, so that we have in this survival a good instance of the vast changes that have taken place in the fauna of the globe within what we may metaphorically call the memory of man.

In organized nature, two factors are in constant opposition; one being adherence to a particular type of structure—the other, adaptation to a particular mode of life. The resultant of these two forces is usually found to be, that animals living similar modes of existence become similar in external appearance, and may be distinguished only by their internal anatomy. A striking example of this is the mole, which has taken to a burrowing existence. Moles, be they insectivorous, rodent, or marsupial, have assumed a character adapted to their subterraneous existence. A coat of spines lends resemblance to other members of the same class of animals. Thus the author shows that though certain animals may resemble one another very closely in external appearance, as the burrowing animals, or may possess certain peculiar structural features, as tusks, they may not be internally related, and the similarities of form and structure must therefore have been independently acquired, and not inherited from a common ancestor. These so-called accidental resemblances indicate what may be termed parallel development, or, to be brief, "parallelism." This parallelism is exemplified in respect to teeth and dentition, and to the elongation of the limbs. The resemblances between Unintatheres and Protoceras are clearly due to parallel development.

Cestaceans next claim attention. Existing Cestaceans are divisible into the two groups—Whalebone Whales and Toothed Whales; differing, as the name implies, in the presence or absence of true teeth. Whether these two groups have been derived from a common ancestral stock, or have had a totally independent origin, is as yet undecided. The discovery in Patagonia of certain toothed whales that have nasal bones nearly as well developed as is the case in whalebone whales, removes one of the difficulties in regarding the latter as descended from the former. Be that as it may, they are extremely ancient, and have undergone parallel development. That the whalebone whale has been developed from an ancestor provided with a full series of functional teeth is proved by the fact that their young, in an early stage of development, are provided with teeth germs, which are absorbed by the gum prior to birth. As might be expected, closely associated with the function of rumination is the complexity of the molar teeth, known as selenodont structure. True ruminants, or chewers of the cud, possess hoofs, a cannon bone in both limbs, and no upper front teeth.

The tallest of all quadrupeds owes its towering stature to the lengthening of two of the bones of the leg and of the vertebræ of the neck. In delegating to the giraffe the position it should take among mammals, especial notice must be taken of its three bony horns, covered with skin, and which are quite unlike those of any other ruminant. Were it not for certain bodily peculiarities, the "ship of the desert" might find in the giraffe a formidable rival as a beast of burden, since the latter is better adapted to life in desert places, and can live much longer without water. Though in the Pliocene period the giraffe roamed over Southern Europe and Asia, at the present day it is confined to Eastern and Central Africa; and unless care be taken this unique animal will soon suffer extermination—shot by the relentless hunter solely for the paltry sums brought by the skins.

"There is one point to be mentioned in connection with the adaptation of the giraffe to its surroundings, before passing on, and this relates to its coloration. When seen within the enclosures of a menagerie—where, by the way, its pallid hue gives but a faint idea of the deep chestnut tinge of the dark blotches on the coat of the wild male—the dappled hide of a giraffe appears conspicuous in the extreme. We are told, however, that among the tall kameel-dhorn trees, or giraffe mimosas, on which they almost exclusively feed, giraffes are the most inconspicuous of all animals; their mottled coats harmonizing so exactly with the weather-beaten stems and with the splashes of light and shade thrown on the ground by the sun shining through the leaves, that at a comparatively short distance even the Bushman or Kaffr is frequently at a total loss to distinguish trees from giraffes or giraffes from trees."

Previous to the discovery by Cuvier, in 1818, that the minute jaws found in the Stonesfield slate of the lower Jurassic were those of a mammal, mammals were supposed to have been unknown before the Tertiary period. It has been concluded that these jaws are those of a marsupial—the lowest of all living mammals. Some of the Jurassic mammals of Dorsetshire and North America may be more nearly allied to insectivores. There seems to be a likelihood that some of the Jurassic mammals were actually the link connecting marsupials with insectivores.

The distinction between crocodiles and alligators is not a well known one. In the lower jaw of crocodiles there are invariably fifteen teeth; the teeth of the two jaws interlock when the mouth is closed; when the jaws are in opposition, the first tooth on each side of the lower jaw is received into a pit in the palate of the skull, while the fourth lower tooth bites into a notch in the side of the skull, and is distinctly visible externally in the living animal. The alligator, on the other hand, has never less than seventeen lower teeth; the upper teeth bite on the outside of the lower without interlocking. The first and fourth lower teeth are received into pits in the skull, and are invisible when the mouth is closed. Modern crocodiles show advance in organization over those of the Jurassic period, in the backward placing of the internal nostrils, and in the ball-and-socket vertebræ. Change in mode of life has wrought a transference of body armour from the under surface to the back of the creature.

The fins and tails of fishes are of two types—the fringe-like and the fan-like. The former is the older type, and has gradually become modified into the latter as best adapted for speed in locomotion. A representative of the fringe-like type is the Australian lung-fish, allied to Ceratodus, the name applied to certain teeth found in the Trias of Europe. The lung-fish is the oldest type of vertebrate now living.

The term "living fossil" is applied to types which, though more or less abundant at the present day, are of extreme antiquity, or to such as were abundant in past epochs, but are now represented by few forms. The most remarkable instance of this persistence of type is the brachiopod—Lingula, which ranges from the Cambrian—the base of the Palaeozoic, to the present day. Other examples are the crinoids or stone lilies, the lung-fish above cited, and the water chervotain of Africa. Our world is fast being impoverished of many forms of animal life. Though this is due largely to the demon of destructiveness, inherent in human nature, other causes are at work. The introduction of other animals by human agency has led in some cases to final extinction. Occasionally it is a catastrophe of nature. As an instance, may be cited the submergence of the breeding place of the Great Auk. The African elephant, the walrus of the polar regions and the New Zealand tuatera are in urgent need of protection if they are to be preserved. Animals often endeavor to protect themselves from their foes by simulating some object—animate or inanimate—that the foe may be deceived thereby. This is especially true of the order of Insecta.

"As old as the plains" would, in many instances, be a more truthful simile than the current saying, "as old as the hills," The higher a mountain range, the shorter we know is the time it has been subjected to the denuding agencies of nature, and, therefore, the younger it is. Nummulites are exceedingly interesting to those who study the genesis and growth of mountain ranges, for the reason that they occur in large numbers only in the Eocene period. Therefore when we find limestones, rich in nummulites, as is the case in the Alps, Pyrennees, Carpathians, Caucasus and Himalayas, we must conclude that elevation in these cases must have taken place at a time subsequent to the Eocene period.

Three great lessons, Mr. Lydekker informs us, may also be learned from the chalk. First, that there is a certain Chalk or Cretaceous style or Facico. Though the rock of this age be chalk, limestone, sandstone or slate, the Facico, or style of its fossils, will be the same, with certain limitations the whole world over. Secondly, from the researches carried on during the voyage of the "Challenger," the old view that chalk was an abyssal deposit was entirely dissipated. All the stratified rocks, therefore, with which we are acquainted have been laid down in comparatively shallow water. This leads to the general acceptance of the grand doctrine of the permanence of continents and water basins. The study of the European chalk, in the third place, has proved the former existence of two great seas, in which Cretaceous rocks were laid down, the northern one being a "mare clausum," cut off from the Atlantic, and in which was deposited the white chalk, while the southern one, in which the great limestones of Southern Europe were laid down, connected the Atlantic and Indian oceans. It is almost certain that at this period there was land connection between India and Southern Africa by way of Madagascar. This will account for the remarkable similarity in many of the animals inhabiting these countries.

The purity and thickness of the chalk deposit are hard to explain. It has been suggested by an eminent geologist that in addition to its partially organic origin it may have been formed as a chemical precipitate of carbonate of lime. The origin of flints in the chalk has been a subject of great interest. It is believed that they were originally an integral portion of the rock itself, which was then a slightly silicated limestone, and that the silica has separated out by segregation, a sponge spicule or an echinoid shell being the nucleus around which the segregating process has taken place.

The conciseness and clearness with which this book is written is worthy of notice. A large amount of information is presented in a small bulk (220 pp,). The illustrations are excellent, while here and there the humor of the writer enlivens the discussion of dry facts.

ROSALIND WATSON.

INDEX.

ABSTRACT FOR THE MONTH OF AUGUST, 1895.

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 vapor.	‡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	59.38	64.9	53.0	11.9	29.7065	29.778	29.659	.119	.4048	80.3	53.0	W.	18.5	6.8	10	2	47	....	....	....	1
2	61.52	68.0	55.2	12.8	29.8470	29.869	29.796	.073	.4592	84.5	56.3	S.W.	14 9	5.3	10	0	60	Inap.	....	Inap.	2
3	63.17	68 2	57.0	11.2	29.8567	29.910	29.803	.107	.4628	80.2	56.7	S.	14.5	9.8	10	9	04	Inap.	....	Inap.	3
SUNDAY.......4	.....	76.4	61.0	15 4	....	.....	......	...	....		....	S.	11 5	....	.	..	42	0.30	....	0.30	4.........SUNDAY
5	68.97	77.2	59.5	17.7	29.8298	29.916	29.715	.201	5503	78.5	61.7	S.W.	8.9	5.0	10	0	72	....	....	....	5
6	70.85	81.2	61.8	19.4	29.8642	29.946	29.760	.186	.5787	78.3	63.0	S.W.	13.1	5.0	10	0	56	0.32	....	0.68	6
7	67.80	75.2	65.3	9 9	29.6872	29.722	29.589	.133	.6007	88.5	64.2	S.	17.1	7.0	10	3	24	0 68	....	0 02	7
8	67.02	75.3	63.0	12.3	29.8018	29.885	29.722	.163	.5088	77.7	59.5	S.W.	22.1	6.0	10	1	40	0.02		0.02	8
9	69.43	80 0	60 2	19.8	29.9332	29 976	29.906	.070	.4648	66.8	57.0	N.W.	18.3	1.2	4	0	95	....	....	....	9
10	71.35	80.5	62 9	17.6	29.8770	29.944	29 825	.119	.4667	61.2	56.8	W.	9.1	2.8	5	0	98	....	....	....	10
SUNDAY...... 11	.....	78.8	61.5	17.3	....	....	.	.	.....	...	....	N.	8 4		......		22	0.34	....	0.34	11..........SUNDAY
12	67.97	78.0	63 7	14.3	29.7123	29.754	29 667	.087	.6345	93 0	65.8	S.	6.5	8 8	10	6	35	0.71	....	0.71	12
13	68.42	76.8	62 2	14.6	29.8515	29.956	29.764	.192	.5318	77.7	60.8	W.	10 6	5.5	10	2	69	Inap.	....	Inap.	13
14	69 15	76.0	62 2	13.8	29.9620	30.010	29.933	.077	.4658	66.0	57 0	N.	8.5	6.3	9	1	79	....	....	....	14
15	69.07	78 0	62.0	16.0	29.9768	30.027	29.927	099	.5210	73.5	59.8	S.W.	14 7	5.2	10	0	52	0 08	....	0.08	15
16	69.22	79.3	60.0	19.3	30.0607	30.118	30.024	.094	.4323	61 3	55 0	N.	7.6	0.5	3	0	99	..	...	.	16
17	70.05	81 8	58 0	23.8	29.7768	29.965	29 624	.341	.5913	79 8	63.5	S.	15 7	3 3	10	0	93	1.08	...	1.08	17
SUNDAY...... 18	.....	77.0	59.6	17 4	......	.....	......	...	....	...	...	S.W.	18.1	....		..	69	1.24	....	1 24	18..........SUNDAY
19	61.38	70.5	56.1	14.4	29.7598	29.867	29.686	.181	.4097	76.3	53.2	W	18.1	1 8	5	0	96	Inap.	....	Inap.	19
20	57.75	65.8	52.0	13.8	29.8717	29.914	29.838	.076	.3550	74.3	49.2	W.	11 5	3 3	10	0	64	0.02	....	0.02	20
21	54.92	60.8	50.5	10.3	29.9318	30.126	29.784	.342	.3220	75 5	46.7	N.W.	22 5	5 5	10	0	73	0.32	....	0.32	21
22	57.50	65.2	47.7	17.5	30.1415	30.242	30.040	.202	.3620	76.5	50.0	S.W.	11 8	4 7	10	0	69	Inap.	....	Inap.	22
23	64.67	71.5	56.8	14 7	29.8692	29.888	29.836	.052	.5330	87.0	60 3	S.W.	21.4	10 0	10	10	00	0 22	...	0.02	23
24	64.33	66.2	62.8	3.4	29.7258	29.818	29 614	.204	.5852	97.2	63.3	S.	10.8	10 0	10	10	00	1.43	....	1 43	24
SUNDAY......25	.....	72.2	61.2	11.0	....	... .	......	....	...	....	....	N.W.	14.5	....		..	92	....	....	....	25..........SUNDAY
26	67.97	76.2	60.0	16.2	29.9532	29.995	29.892	.104	5405	79 0	60.8	W.	15.2	7.0	9	0	56	Inap.	....	Inap.	26
27	71.55	82 2	61.9	20.3	29 8878	29.979	29.794	.18,	.5800	76.3	63 2	S.W.	13 0	1.8	5	0	67	Inap.	....	Inap.	27
28	67.60	73.5	62.8	10.7	29.8443	29.902	29.780	.122	.4785	71.5	57.5	W.	10 6	7.7	10	2	09	0.02	....	0.02	28
29	65.10	72 2	59.9	12.3	29.8437	29 9 2	29.808	.113	.4558	71.3	56.2	N.	6.7	6.8	10	4	43	0.06	.	0 06	29
30	67.97	76.5	60.8	15.7	30.0017	30.049	29 965	.084	.5020	74.0	59 0	S.W.	10.9	1.7	5	0	94	..	...	....	30
31	63.57	77.5	54.2	23.3	29.8014	29.927	29 636	291	4742	79 5	57.0	S.	18.5	5.5	10	0	08	0.08	....	0.08	31
....Means	65.84	74.29	59 19	15 10	29.8658	29.9404	29 7921	.1482	.4916	77.25	58.02	S. 54° W.	15.69	5 3	8.7	2 0	57 7	6.92		6.92	Sums ....
21 Years means for and including this month	66 71	75 03	58.70	16.39	29.9384	....	....	.134	.4810	73.0	....	......	§12.82	..	..	..	¶54.7	3.59	....	....	21 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	522	36	72	197	2505	5531	2305	1012	
Duration in hrs..	61	5	12	15	192	224	177	57	1
Mean velocity....	8.56	7.20	6 00	13.13	13 05	15 76	13.02	17.75	

Greatest mileage in one hour was 33 on the 21st.
Greatest velocity in gusts, 36 miles per hour on the 21st.

Resultant mileage, 6,900.
Resultant direction, S. 54° W.
Total mileage, 10,180.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 14 years only § Ten years only.

The greatest heat was 82.2° on the 27th; the greatest cold was 47.7° on the 22nd, giving a range of temperature of 34.5 degrees.

Warmest day was the 10th. Coldest day was the 21st. Highest barometer reading was 30.242 on the 22nd. Lowest barometer was 29.589 on the 7th, giving a range of .653 inches. Maximum relative humidity was 100 on the 12th and 24th. Minimum relative humidity was 45 on the 16th.

Rain fell on 23 days.

Auroras were observed on 2 nights, the 9th and 10th.

Solar halo on 22nd.

Thunder and lightning on 7 days, the 6th, 7th, 11th, 12th, 13th, 17th and 18th.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1895.

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 vapor.	‡Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS Mean.	Max.	Min.	Per cent. of possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted	DAY.
SUNDAY.........1	.....	61.5	48.0	13.5	....	.....	......	....	.....	....	....	W.	15.5	....	....	..	77	....	....	....	1..........SUNDAY
2	57.47	65.0	50.0	15.0	29.9302	30.017	29.860	.157	.3292	71.3	47.3	S.W.	13.0	2.2	6	0	86	....	....	....	2
3	65.33	76.5	52.2	24.3	29.8457	29.900	29.803	.097	.4530	73.3	55.8	S.W.	17.9	1.8	10	0	90	....	....	....	3
4	71.65	82 8	59.2	23.6	29.8642	29.908	29.840	.068	.5833	74.8	63.0	S.	14 0	4.3	10	0	90	....	....	....	4
5	72.07	79.9	64.8	15.1	30.0263	30.101	29.944	.157	.6188	78.8	64.8	S.W.	15.1	9.0	10	6	47	....	....	....	5
6	70.43	80.0	61.5	18.5	30.1125	30.171	30.042	.129	5562	76.0	62.0	N.E.	6.5	3.7	7	0	82	....	....	....	6
7	69.98	78.8	62.2	16.6	29.9797	30.054	29.909	.145	.5582	76.3	62 0	S.	11 3	7.5	10	6	42	0.04	....	0.04	7
SUNDAY........ 8	.....	71.2	55.5	15.7	....	......	......	....	.....	....	....	S.W.	13.0	....	....	..	90	....	....	....	8..........SUNDAY
9	60.02	69.8	52.6	17.2	30.1193	30.185	30.056	.129	.4400	83.2	54.7	S.W.	16.7	4.3	10	0	29	Inap.	....	Inap.	9
10	64.17	72.2	56.0	16.2	30.1350	30.229	30.015	.214	.4883	81.7	58.3	S.	10.4	2.3	10	0	83	....	....	....	10
11	69.12	77.0	61.5	15.5	29.8388	29.953	29 716	.237	6597	92.5	66.8	S.W.	13.7	8.0	10	2	49	1.69	....	1 69	11
12	64.10	71.8	54.5	17.3	29.7353	29.827	29.663	.164	.5322	86.5	59.5	N.	12.9	8.8	10	3	00	0.02	....	0.02	12
13	51.57	59.8	43.8	16.0	29.9722	30.156	29.844	.312	.2390	63.8	38.8	N.W.	17.4	2.3	8	0	96	....	....	....	13
14	46.78	53.4	39.5	13.9	30.1960	30.301	30.077	.224	.2282	71.5	37.8	N.	13 0	3.7	9	0	64	...	....	....	14
SUNDAY........15	.....	56.6	39.0	17.6	....	......	......	....	.....	....	....	N.	9.2	....	......	..	96	....	....	....	15..........SUNDAY
16	53.20	57.2	47.3	9 9	29.9553	30.113	29.827	.286	.3597	88.3	49.7	S.	15.0	7.2	10	0	00	0.03	....	0.03	16
17	56.60	65.8	46.5	19.3	29.8460	29.890	29.815	.075	.2963	63 3	43.7	N.W.	19.6	1.7	9	0	83	....	....	...	17
18	49.05	55.3	42.0	13.3	29.7793	29.889	29.703	.186	.2285	65.5	37.7	E	5.0	7.3	10	0	12	....	....	....	18
19	56.20	63.0	46.0	17 0	29.9395	29.968	29.880	.088	.3372	74.3	47.8	S.W.	10.0	6.2	10	0	52	....	....	....	19
20	63.60	73.0	55.8	17.2	29.9925	30.033	29.935	.098	.5212	88.5	60.0	S.E.	9.1	5.7	10	0	53	0.02	....	0.02	20
21	76.48	84 0	62.0	22.0	29.9512	29.963	29.932	.031	.6875	75.7	68.0	S.W.	23.5	1.5	5	0	92	....	....	....	21
SUNDAY........22	.....	84.8	69.0	15 8	....	......	......	...	.....		....	S.W.	21.0	...	....	..	92	....	....	....	22..........SUNDAY
23	71.88	86.3	56.3	30.0	29.8732	30.040	29.753	.287	5753	73.2	62.5	S.W.	26 0	2.0	7	0	70	....	....	....	23
24	55.05	61.0	49.0	12.0	30.1242	30.172	30.092	.080	.2972	69.7	44.7	S.	15 2	1.0	3	0	96	....	....	....	24
25	56.62	65.3	45.5	19.8	30.0538	30.149	29.886	.263	.3293	71.8	47.2	S.	12.0	4.0	8	0	78	....	....	....	25
26	62.78	71.2	55.8	15.4	29.6568	29 757	29.587	.170	.4688	81.3	56.7	S.W.	20.3	6.5	10	0	24	0.25	....	0.25	26
27	53.28	61.3	44.0	17.3	29.9238	30.143	29.730	.413	.2905	70 8	43.8	W.	16.8	5.0	10	0	78	Inap.	....	Inap.	27
28	44.40	49.3	36.5	12.8	30.2278	30.313	30.126	.187	.1893	64.8	33.2	N.E.	10.7	2.7	10	0	96	....	....	....	28
SUNDAY........29	.....	58.1	42.8	15.3	......	......	......	....	.....	....	....	S.E.	15.6	....	..		00	0.79	....	0.79	29..........SUNDAY
30	45.77	54.3	40.9	13.4	29.6903	29.755	29.645	.110	.2613	85.2	41.2	S.W.	*16.2	9 2	10	5	50	0.56	....	0.56	30
....Means	60.30	68.21	51 32	16.88	29.9508	30.0395	29.8672	.1723	.42113	76.08	52.28	......	14.52	4.7	8.9	.88	63 4	3 40	...	3.40	Sums ....
21 Years means for and including this month......	58.60	66.72	50.83	15 88	30.0149	.....	......	17 9	.3834	75.47	....	......	s12.72	5.5	..	..	¶54.1	3.14	....	....	21 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	921	263	215	500	2125	4686	1066	685	
Duration in hrs..	84	31	32	44	144	258	86	40	1
Mean velocity....	11.0	8.5	6.7	11.4	14.8	18.2	12.4	17.1	

Greatest mileage in one hour was 40 on the 23rd.

Greatest velocity in gusts, 60 miles per hour on the 23rd.

Resultant mileage, 5,876.
Resultant direction, S. 44¾° W.
Total mileage, 10,461.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 14 years only s Ten years only.

The greatest heat was 86.3° on the 23rd; the greatest cold was 36.5° on the 28th, giving a range of temperature of 49.8 degrees.

Warmest day was the 22nd. Coldest day was the 28th. Highest barometer reading was 30.313 on the 28th. Lowest barometer was 29.587 on the 26th, giving a range of 0.726 inches. Maximum relative humidity was 100 on the 11th, 26th and 29th. Minimum relative humidity was 41 on the 17th.

Rain fell on 10 days.

Auroras were observed on 2 nights, the 14th and 16th.

Lunar halo on 6th.

Lunar corona on the 7th.

ABSTRACT FOR THE MONTH OF OCTOBER, 1895.

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 vapor.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	WIND. Mean velocity in miles per hour	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.
1	42.57	47.4	36.2	11.2	29.9315	30.050	29.670	.380	.2188	80.7	36.5	S.W.	25.1	7.2	10	0	44	0.07	....	0.07	1
2	53.17	60.2	40.2	20.0	30.0152	30 040	29.992	.048	.3207	78.8	46.5	S.	19.5	5.3	10	0	53	0.00	....	0.00	2
3	50.53	57.8	44.3	13.5	30.2153	30.315	30.081	.234	.2772	75.5	41.2	N.	13.7	4.5	10	0	65	....	....	....	3
4	47.67	55 5	39.4	16.1	30.2545	30.348	30.148	.200	.2617	79.2	41.2	N.	8.0	0.0	0	0	97	....	....	....	4
5	48.10	54.8	39.8	15.0	30 0143	30.121	29.393	.228	.2723	81.2	42.3	N.	7.7	2.7	10	0	62	....	....	....	5
SUNDAY.......6	.....	61.1	40.4	20.7	....	......	......	....	.....	...	....	S.W.	12.0	....	....	..	91	....	....	....	6..........SUNDAY
7	52.47	57.8	43.3	14.5	29.5857	29.683	29.475	.208	.3188	80.3	46.5	S.	10.1	7.3	10	0	21	0.00	....	0.00	7
8	45.08	53.5	38.0	15.5	29.6602	29.830	29.539	.291	.2027	66.5	34.3	S.W.	24.1	9.5	10	8	29	....	....	....	8
9	37.93	43.8	32.2	11.6	30.0662	30.197	29.906	.291	.1570	69.0	28.5	W.	16.7	7.0	10	0	14	....	....	....	9
10	37 52	44.6	33.5	11.1	30.2963	30.351	30.246	.105	.1527	69 0	27.8	W.	9 7	4.5	10	0	89	....	....	....	10
11	47.30	56.6	34.0	22.6	30.0695	30.191	29.973	.218	.2180	67.7	36 5	S.	18.3	5.3	10	0	85	0.00	....	0 00	11
12	48.67	54.2	46.0	8.2	29.9570	30.003	29.905	.098	.3285	95.7	47.2	E	10.7	10.0	10	10	00	0.24	....	0.24	12
SUNDAY.... .. 13	.....	58.0	45.0	13.0	....	......	......	....	.....	....	....	N.	13.2	....	......	..	30	....	....	....	13..........SUNDAY
14	45.25	56.7	38.0	18.7	29.9738	30.170	29.741	.428	.1933	63.5	33.0	N.W.	18.4	4.8	10	0	79	....	....	....	14
15	37.52	42.3	34.2	8.1	30.1183	30.179	30.046	.133	.1598	71.2	28.7	N.	5.2	7.0	10	4	00	....	....	on 16th	15
16	41.98	48.0	34.1	13.9	29.7495	30.009	29.465	.544	.2225	83.8	37.2	S.E.	15.2	9.8	10	9	00	0.07	....		16
17	39.22	45.6	29.7	15.9	29.6943	29.933	29 544	.389	.1797	73.0	31 2	N.W.	24.7	8.0	10	4	58	0.00	....	0.00	17
18	32.50	40.4	24.0	16.4	30.0390	30.179	29.809	.370	.1517	80 2	27.2	W.	19.6	1.8	10	0	85	....	....	....	18
19	47.40	58.2	34.6	23.6	29.5885	29.695	29.462	.233	.2302	69.7	37.7	S.	25.4	4.8	8	0	39	0.00	....	0.00	19
SUNDAY.. 20	.....	37.7	28.5	9.2	....	......	......	...	.....	..	....	S.W.	14 9	....	....	..	99	....	0.00	0 00	20..........SUNDAY
21	31.60	36 6	25.8	10 8	30.0070	30.093	29.857	.236	1457	83.2	26.8	S.	9.8	6.2	10	0	74	....	0.80	0 07	21
22	42.62	51.2	28.4	22.8	29 8680	30.072	29.717	.355	.1810	66.0	31.5	S.	18.8	9.3	10	6	27	0.06	....	0.06	22
23	36.17	40.5	31.6	8.9	30.0603	30 136	29 951	.185	.1390	65.3	25.5	W.	14.5	5.3	10	1	37	0.01	....	0.01	23
24	37.30	43.4	29.5	13.9	30.0003	30.094	29.860	.234	.1712	77.5	30.5	S.	14.8	8.0	10	3	70	....	....	....	24
25	37.37	40.6	27.6	19.0	29.7218	29.951	29.553	.398	.1698	75 5	30.2	S.	22 2	7.8	10	1	08	0.00	....	0.00	25
26	32.18	41.7	23.8	17.9	29.8978	30.008	29 702	.306	.1373	73.5	24.8	S.E.	7.1	7 0	10	0	07	...	....	....	26
SUNDAY.. 27	.....	58.6	33.8	24.8	.....	......	......	....	.....	....	....	S.	12.6	....	...	.	07	0.00	....	0.00	27..........SUNDAY
28	44.10	49.2	35.5	13.7	29.7433	29.902	29.569	.333	.1838	63.0	31.8	S.	27.5	8.3	10	5	20	0.06	....	0.06	28
29	32.47	39.3	29.8	9.5	30.1405	30.263	30 029	.234	.1285	70.0	23.8	S.W.	12.3	6.3	10	0	19	....	....	....	29
30	30.05	34.9	25 4	9.5	30.4797	30.571	30.347	.224	.1238	74.8	22.8	W.	10.7	5 0	10	0	35	....	....	....	30
31	34.27	42.2	24.1	18.1	30.3443	30.517	30.066	.451	.1343	70.8	24.5	S.	16.0	8.3	10	0	02	0.13	....	0.13	31
....Means	41.22	48.98	33 89	15.09	29.9812	30.1074	29.8350	.2724	.19926	74.24	33.21	S. 25½ W.	15.43	6.33	9.56	1.89	43.4	0.64	0.80	0.71	Sums ....
21 Years means for and including this month......	45.35	52.40	38.63	13 78	29.9951	.....	......	.2140	.2433	76.49	....	......	§13.82	6.44	..	..	¶40.4	3.09	1.31	3.22	21 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	793		266	647	4108	2967	1732	976	
Duration in hrs..	90		24	52	260	136	119	57	6
Mean velocity....	8.81		11.08	12.44	15.80	21.82	14.55	17.12	

Greatest mileage in one hour was 48 on the 28th.

Greatest velocity in gusts, 60 miles per hour on the 28th.

Resultant mileage, 5,719.
Resultant direction, S. 25½° W.
Total mileage, 11,489.
Average velocity 15.54 m. p. h.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 14 years only. § Ten years only.

The greatest heat was 61.1° on the 6th; the greatest cold was 23.8° on the 26th, giving a range of temperature of 37.3 degrees.

Warmest day was the 2nd. Coldest day was the 30th. Highest barometer reading was 30.571 on the 30th. Lowest barometer was 29.462 on the 19th, giving a range of 1.109 inches. Maximum relative humidity was 100 on the 5th, 12th and 31st. Minimum relative humidity was 43 on the 31st.

Rain fell on 14 days.

Snow fell on 2 days, 20th and 21st.

Rain or snow fell on 16 days.

Auroras were observed on 1 night, the 14th.

Lunar halo on 1 night, 10th.

Hail storm on the 17th.

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