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THE

# CANADIAN RECORD

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## 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 te... 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 southwest 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.

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## 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, Longue 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.)

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## 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-führende 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, Über 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, Über 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. 78.

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, Über 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 of 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. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 59,55 | 59,80 | 58,50 | 51,85 | 51,35 | — | 57,20 | 57,55 | 54,45 | 54,20 | 54,47 | 54,62 |
| $TiO_2$ | — | — | — | — | — | 39,86 | — | — | — | — | — | — |
| $Al_2O_3$ | 25,62 | 25,39 | 25,80 | 3,90 | 3,70 | — | 26,40 | 27,10 | 28,05 | 29,10 | 26,45 | 26,50 |
| $Fe_2O_3$ | 0,75 | 0,60 | 1,00 | — | — | — | 0,40 | | 0,45 | 1,10 | 1,30 | 0,76 |
| $FeO$ | — | — | — | 20,20 | 20,56 | 56,64 | — | — | — | — | 0,67 | 0,56 |
| $MnO$ | — | — | — | Spur | — | — | — | — | — | — | — | — |
| $CaO$ | 7,73 | 7,78 | 8,06 | 1,60 | 1,68 | — | 8,34 | 8,73 | 9,68 | 11,25 | 10,80 | 9,88 |
| $MgO$ | Spur | 0,11 | 0,20 | 21,91 | 22,59 | 1,44 | — | — | — | 0,15 | 0,69 | 0,74 |
| $Na_2O$ | 5,09 | 5,14 | 5,45 | — | — | — | 5,83 | 5,38 | 6.25 | [3,80] | 4,37 | 4,50 |
| $K_2O$ | 0,96 | 1,00 | 1,16 | — | — | — | 0,84 | 0,79 | 1,06 | — | 0,92 | 1,23 |
| $H_2O$ | 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 —2,67 | 2,66 —2,67 | 2,67 | 3,409 —3,417 | 3,409 —3,417 | .. | 2,68 —2,69 | | 2,69 | 2,68 —2,69 | 2,72 | 2,70 |

| | XIII. | XIV. | XV. | XVI. | XVII. | XVIII. | XIX. | XX. | XXI. | XXII. | XXIII. | XXIV. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 50,33 | 46,28 | 56,0 | 55,59 | 58,1 | 53,56 | 53,43 | 54,09 | 52,23 | 54,34 | 54,26 | 54,36 |
| $TiO_2$ | 0,07 | 0,59 | — | — | — | — | — | — | — | — | — | — |
| $Al_2O_3$ | 3,36 | 7,38 | 27,5 | 25,41 | 27,9 | 27,78 | 28,01 | 27,82 | 26,96 | 29,36 | 29,29 | 29,36 |
| $Fe_2O_3$ | 1,03 | 2,21 | 0,7 | 2.73 | | 1,15 | 0,75 | — | — | — | | |
| $FeO$ | 19,40 | 14,80 | — | — | — | — | — | 1,50 | 1,98 | 0,22 | — | — |
| $MnO$ | 0,71 | — | — | — | — | — | — | Spur | Spur | Spur | Spur | Spur |
| $CaO$ | 2,77 | 18,78 | 10,1 | 11,40 | 9,4 | 12,01 | 11,24 | 11,20 | 13,25 | 10,79 | 11,26 | 11,16 |
| $MgO$ | 21,40 | 8,91 | 0,1 | — | Spur | Spur | 0,63 | 0,05 | 0,12 | — | Spur | Spur |
| $Na_2O$ | — | — | 5,0 | 4,83 | 5,1 | 4,10 | 4,85 | 4,76 | 5,23 | 5,49 | 4,87 | 4,81 |
| $K_2O$ | — | — | 0,4 | 0,32 | — | 1,68 | 0,96 | 0,43 | 0,23 | 0,46 | 0,48 | 0,63 |
| $H_2O$ | 1,14 | 1,11 | — | — | — | — | Spur | — | — | — | 0,22 | 0,22 |
| | 100,21 | 100,06 | 99,8 | 100,23 | 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 Mount 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 particular 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 | 29.792 | .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 | 29.8997 | 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 | 48.3 | 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 | 29 921 | .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 | 70.3 | 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. | | | | BAROMETER. | | | | †Mean pressure of vapor. | ‡ 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 | 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 | .097 | .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. | 7.6 | .... | ...... | .. | 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 | 7[illegible].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 | 69.57 | 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 | 16.6 | 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 | .... | ..... | s13.16 | 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, 9191.

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  s 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.