CORRIGENDA.

The following corrections require to be made in the article of Dr. Matthew on "Oldhamia," in the last number of the RECORD OF SCIENCE:

Page 228, Fascicle inverted.
" 228, 5th line from bottom, read "Acetibularia" for *Acetabulifera.*
" 229, line 15, "that." for *the same.*
" 230, " 2, "Llanberis," for *Llamberis.*
" 230, " 8, "Tremadoc," for *Trimadæ.*
" 230, " 15, "Olenus Substage," for *Olen ius Substagi.*
" 230, " 21, "having," for *being.*
" 230, " 27, "Acetabularia," for *Acetabulifera.*
" 231, " 10, "form," for *forms.*

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Some Palæobotanical Aspects of the Upper Palæozoic in Nova Scotia.

By David White.

Introduction.

In a recent issue of the Transactions of the Nova Scotia Institute of Science[1] Mr. Hugh Fletcher, geologist of the Canadian Survey, presents correlations of the Upper Palæozoic formations by palæontologists in marked contradiction with stratigraphic determinations by himself and other geologists in Nova Scotia. Confident of the validity of identification on stratigraphic evidence only, he rejects the palæontological correlations, which he finds incompatible with the supposed order of succession of the strata, as well as totally erroneous as to the age of the terranes. The difference of statement involves broad questions, such as the reference of formations to one great period or another, to middle Carboniferous or middle Devonian.

1 Vol. X., 1899-1900, pp. 235-244. Geological Nomenclature in Nova Scotia.

Since the palæontological correlations that Mr. Fletcher finds so misleading are largely based on the evidence of fossil plants; and since he does me the honor to mention my opinions regarding the equivalents of several of the Upper Palæozoic formations, I herein present somewhat more definitely the palæontological evidence as seen from my own standpoint. At the same time a seeming discrepancy between one of my correlations and that of the same flora by Mr. Kidston, whom Mr. Fletcher also quotes, will be explained.

From the outset it must be borne in mind that I personally have not visited the region in question, and the views expressed regarding the ages of several of the Nova Scotia plant beds are based exclusively on palæontological evidence, interpreted in accordance with our knowledge of the fossil floras of the Appalachian province or of Europe. Reasoning from the observed vertical and horizontal distribution both of identical and of related genera and species, and especially from the stratigraphical occurrence of identical or essentially identical floras, I shall state (1) what, in my judgment, are the approximate positions of the respective plant beds as naturally indicated by the floras, and (2) the maximum of time latitude within which the floras should fall. The correlations are theoretical, and may be slightly modified by local stratigraphical conditions. Such a method is liable to error, but the errors, if the conclusions are based on ample fossil material, should fall within reasonable limits of proximity to the truth. Surely the coefficient of error should not be so great as to permit an entire geological period to intervene between its palæontologically theoretical position and its actual place.

Only those portions of the formations actually furnishing the plant material are included in this discussion. It is conceived that the time interval represented by one or more of the enormously thick subdivisions of the Nova

Scotia Carboniferous may include more than one flora, and that when such cases occur, both floras may not be referable to the same stage.

The sequence and correlations of the rocks in question as worked out by Dr. Ells and Mr. Fletcher on the stratigraphic basis is shown in the following table extracted from the correlation chart in Mr. Fletcher's paper. The correlations by Mr. Kidston and myself are also quoted from the same chart. It will be understood that in adjusting palæontological correlations to the diagrammatic classification of such a chart it is sometimes necessary to restrict them to narrower limits than the author originally intended, while at the same time the conception both of proportion and of emphasis is lost. Thus a tentative or suggested correlation that is limited in its geological range is often quoted instead of the correlation that is positive but of greater latitude. Usually no distinction is made between definite correlations, opinions as to probable age, and mere suggestions. Neither does such a chart indicate the sufficiency or meagreness of the material on which the correlation is based.

Canadian Geological Survey.	Ells & Fletcher in Nova Scotia.	R. Kidston.	David White.	
Permian.	Permian or Upper Carboniferous.	Union ?	....	Carboniferous.
Coal Measures.	Coal Measures.	Riversdale, Harrington River and Cordaite Shales (St. John Devonian).	Union ?	
Millstone Grit.	Millstone Grit.	....	Riversdale and Cordaite Shales (Devonian of St. John, N.B.)	
Carboniferous Limestone.	Carboniferous Limestone.	....	....	
Carboniferous Conglomerate.	Carboniferous Conglomerate.	Horton (Lower Carboniferous of England).	Horton (Pocono of Pennsylvania, Waverly. Newer than Kiltorcan).	

Canadian Geological Survey.	Ells & Fletcher in Nova Scotia.	R. Kidston.	David White.	
Catskill. Chemung.	Union, including rocks of MacAra Brook, Lochaber and Economy.	....	....	Devonian.
Hamilton.	Riversdale, Harrington River (4000 ft.) MacKay Head and Horton.	....	....	
Corniferous.	Basal Conglomerate.	....	....	

THE HORTON PLANT BEDS.

The Horton Bluff terrane, as recognized by Sir William Dawson (1843) and Sir Charles Lyell (1847), is referred by Dr. Ells and Mr. Fletcher to the Hamilton, it being apparently included in the Riversdale series. The Horton plant beds are characterized by a very peculiar flora containing an abundance of both *Aneimites Acadicus* and *Lepidodendron corrugatum* with its numerous decorticated phases, together with one or more higher types of *Lepidodendron* and a singular form of *Sphenopteris. Aneimites* appears to be an exclusively Carboniferous genus. The Lepidodendra are larger and more advanced, with larger bolsters than any known Devonian type. Biologically the flora is distinctly younger than any yet found in undisputed Devonian rocks, and it appears to be even more modern than the Ursa[1] flora.

Essentially the same flora is everywhere characteristic of the Pennsylvania and Virginia Pócono, with which the Horton flora was correctly correlated by Sir William Dawson as long ago as 1873. Not only is the Pocono similarly marked by an abundance of *Lepidodendron corrugatum,* but by the hardly less abundant *Aneimites,* some

[1] The Ursa stage, typical in Bear Island and Spitzbergen, is generally included within the lower limit of the Carboniferous, though by some geologists it is regarded as transitional from Devonian to Carboniferous.

of whose forms are hardly separable from the Acadian type. The Nova Scotian flora appears also to correspond to the Calciferous Sandstone series of Scotland, as has also been indicated by Mr. Kidston, who so ably elaborated the latter flora. The Horton plant terrane should, on purely palæobotanical grounds, lie below the typical Carboniferous Limestone; but I believe it should go hardly so low as the Ursa stage, or below the boundary generally accepted for the Lower Carboniferous. While granting that certain of the rocks included by the Nova Scotia geologists under the Hamilton rubric may be Hamilton in age, I do not hesitate to insist that the Horton plant beds are not earlier, at most, than the Ursa stage.

THE RIVERSDALE AND HARRINGTON RIVER PLANT BEDS.

The plant beds near Riversdale and Harrington River also are assigned to the Middle Devonian by the Nova Scotia geologists. The Riversdale plants were, in 1873, correlated by Sir William Dawson with the Millstone Grit. Although but a small quantity of plant material from these beds has come under my personal observation, even this, which includes typical representatives of *Neuropteris, Alethopteris, Annularia, Cordaites* and *Cardiocarpon*, is unequivocally Carboniferous.[1] Whether interpreted by the specimens in hand or the lists submitted by Mr. Kidston (who reached nearly the same conclusion), it is clear that the Riversdale-Harrington River plants are most closely allied to the flora of the Canadian Millstone Grit, or, more explicitly, to the plants of the Pottsville formation in the Appalachian trough. Taking into account the small amount of plant material, and the limited number of fern species, it appears unwise to insist on

1 Recently Dr. H. M. Ami, of the Geological Survey of Canada, has announced the discovery, in the Harrington River beds, of specimens of *Whittleseya*, an American genus as yet unknown below the Pottsville formation. See the Ottawa *Naturalist*, Vol. XIV., Aug., 1900.

an absolute correlation with the Pottsville, to whose flora nearly all of the species from the beds in question are common. On the other hand the plants from the Riversdale beds are practically totally different from, as well as assuredly younger than, the Horton flora.

From the palæobotanical standpoint there appears to be little room for the belief that the Riversdale-Harrington River plant beds may in any case be lower than the St. Louis, while on the other hand the plants seem strongly to indicate a level at or above the top of the Lower Carboniferous. At the present stage of our knowledge of the fossil floras these beds can not, without disregarding palæobotany, be correlated with beds below the Carboniferous Limestone (Windsor) unless it be understood that the Limestone is no older than the upper portion of the Lower Carboniferous. The Mississippian equivalents of the Carboniferous limestone (Windsor) and the time interval which it covers are not yet definitely ascertained; but, if it represents one or more stages in the lower portion of the Lower Carboniferous, my observations of the plants of the Devonian, Pocono, Mauch Chunk and Pottsville formations in the Allegheny region, and my faith in the validity of their evidence, lead me to urge that the Riversdale and Harrington River plant beds are probably above the Carboniferous Limestone, though, if the latter extends without unconformity up to the Millstone Grit, they may lie within it. They can not be Middle Devonian. If the extrusions of eruptive rock cut the Riversdale plant formation, as-is-stated by the Nova Scotia geologists, the metamorphic action is certainly Carboniferous, and it appears probable that it can not very long antedate the close of the Lower Carboniferous.

Possibly Dr. Ells and Mr. Fletcher were influenced in referring the Riversdale beds to the Middle Devonian through first correlating them with the "fern ledges" at St. John, N.B. It would be a singular incident in palæontology if the Riversdale plants, whose correlation by Sir William Dawson with the Millstone Grit is not likely to prove far from correct, were now to be pronounced Devonian on account of their palæontological identity with the fern ledges whose erroneous reference to the Devonian was earlier forced upon Sir William by the findings of the stratigraphers. The study of the plants collected at several hundred localities in the Pottsville formation along the Appalachian trough proves conclusively that the St. John flora is from nearly the same stage, while, as I have elsewhere pointed out,[1] it is probable that a portion of the section at the "fern ledges"[2] is contemporaneous with the upper portion of the Pottsville.

THE MACKAY'S HEAD PLANT BEDS.

MacKay's Head, another of the sections now placed in the Hamilton, furnished a number of the species described in 1873 by Sir William Dawson and referred by him to the Millstone Grit. Dawson's list includes alternate-ribbed species of *Calamites*, a large Carboniferous type of *Lepidodendron* identified by him as *L. aculeatum*, a fern figured as "*Odontopteris?*", and other ferns identified as *Alethopteris lonchitica* and *Sphenopteris obtusiloba.* These species, though few in number, are recognized by palæobotanists as distinctly Carboniferous. The material is hardly sufficient for a definite correlation, but it seems probable that the flora, especially the *Lepidodendron* and the *Alethopteris*, will eventually be found to lie above the Carboniferous Limestone. The small amount of published plant evidence points towards the Pottsville or Millstone Grit, to which the MacKay's Head beds were referred by Sir William Dawson.

1 20th Ann. Rept. U.S. Geol. Surv., pt. 2, 1900, pp. 913, 917.

2 Dr. G. F. Matthew suggests the reference of a portion of the St. John fern ledges to the Silurian.

Discussion of the Problem.

From the foregoing it will be seen that the reference by Mr. Fletcher and Dr. Ells of the Riversdale-Harrington River and MacKay's Head plant beds to the Hamilton would necessitate the existence of essentially Middle Carboniferous floras in the Middle Devonian. This could be admitted only on absolutely indisputable stratigraphical evidence, such as their occurrence in a continuous normal section, with abundant characteristic Middle Devonian marine fossils in close association or appropriate sequence. Evidence of this character appears to be wholly absent or quite inconclusive. It does not appear that the testimony of the animal fossils from the plant beds differs widely from that of the plants. The contradictions between the correlations by stratigraphy and those of palæozoologists[1] are perhaps less striking only because the evidence of invertebrate fossils is less abundant or is of a class of animals (*e.g.* Phyllopoda and Anthracomyæ) of somewhat uncertain stratigraphical value.

The grounds for confidence in the palæobotanical evidence are strong. The plant remains on either side of the Lower Carboniferous—*i. e.* in the Devonian and in the Upper Carboniferous—exhibit the same succession of essentially identical contemporaneous floras in New Brunswick and in other regions of Nova Scotia as well as in the United States. This presumptive evidence in favor of the contemporaneity or approximate contemporaneity of the floras of the Lower Carboniferous and Pottsville (Millstone Grit) of the United States and Europe on the one hand with the corresponding floras of the Horton and Riversdale beds of Nova Scotia on the other hand is supported by the geographical relations as well as the conditions of migration. A land stretch of no very great extent, and at times reduced to a lowland, between the Nova Scotia and

1 Dr. Ami places the Riversdale beds within the Carboniferous period, but at the base of the Lower Carboniferous. (See Trans. Nova Scotia Inst. Science, Vol. X., p. 171.)

the Appalachian basins, must have been clothed throughout by the general flora characteristic of the particular geological time; and on the occasions of the great floral changes of the earth it should, with the important aid of air and water currents, have carried migrating species so rapidly from shore to shore that the period of each successive flora would be essentially contemporaneous in either basin. In view of these relations only undeniable stratigraphic evidence can prove that the identical floras do not belong to the same great period, and that we have in Nova Scotia the unique phenomenon of a typical middle Carboniferous flora in rocks of the middle Devonian. Such an occurrence, as yet unknown elsewhere in North America or Europe, and in direct contradiction of all biopalæobotanical data, would scarcely be harder to explain for one district than would it be to account for its absence in other regions of the Northern hemisphere.

The existence of the wide gulf between the correlations by stratigraphy and those by palæontology does not admit of the conclusion that the verdict of the stratigraphers is final. With all respect for their ability and the conscientious character of their work in a field offering great difficulties of surface concealment, it is still proper to enquire of the Nova Scotia geologists if there is not a further stratigraphical explanation; whether, for instance, certain plant beds at different points may not have been wrongly correlated in carrying the stratigraphical identifications across to the type (reference) sections; or whether the Carboniferous Limestone of their sections is not much younger than is generally supposed; or whether certain of the superpositions are not possibly due to overthrust faulting.

Note of Explanation.

A seeming discrepancy between Mr. Kidston's and my own correlations of the Riversdale-Harrington River plants appears in Mr. Fletcher's table,[1] where Mr. Kidston is recorded as referring these beds to the Coal Measures, while I am quoted as correlating them with the Pottsville (Millstone Grit). This difference represents only a variation in the nomenclature of the Coal Measures in Great Britain and in America. The upper portion of the Pennsylvanian Pottsville appears, as I have elsewhere indicated,[2] to be contemporaneous with the Lower Coal Measures of Europe, while the succeeding beds in the northern Appalachian area of this country represent the Middle Coal Measures, etc., of the Old World. Accordingly my correlation of the fern beds at St. John with the upper Pottsville nearly corresponds to Mr. Kidston's correlation with the Lower Coal Measures. I do not insist that the Riversdale plants are necessarily so late as the Pottsville, though I believe they belong close to, if not in, the Pottsville stage. It is interesting to note that the conclusions reached by Mr. Kidston and myself, each independently and without the knowledge of the other, as to the age of the plant beds under discussion, are nearly identical. Not less interesting is it that our conclusions, with the exception of those relating to the St. John fern ledges, tend in general to sustain the correlations made by Sir William Dawson thirty years or more ago.

So far as I can recollect, I have never seen a fossil from the Union, or expressed an opinion as to the age of that formation, which in Mr. Fletcher's table I am credited as doubtfully referring to the Coal Measures. The terranes referred by Mr. Fletcher to this formation, which from the descriptions seems to have some features in common with the Catskill, do not appear to have yet yielded plant remains of stratigraphical value.

1 Op. cit., p. 243. See p. 3 of this paper.

2 Bull. Geol. Soc. America, Vol. XI., pp. 166, 173 ; 20th Ann. Rept. U.S. Geol. Surv., pt. 2, pp. 912, 917.

Additional Notes on the Flora of Cap-à-l'Aigle.

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

In the Record of Science, Vol. IV., No. 1, pp. 54–68, and Vol. V., No. 1, pp. 38–40, appeared lists of plants collected at Cap-à-l'Aigle, County of Charlevoix, up to that date. The work of noting the plants of that region has gone on from year to year, during the latter part of July and the first three weeks of August. The Laurentian Mountains form not only the background of the landscape but also the backbone of the Flora, if I may be allowed a free metaphor. If the rocks that face those mountains are the oldest on the earth's crust, as is generally held, then the plant-life developed on them may be regarded as also the oldest that exists in the world, since the geological evidence indicates that the north-eastern portion of the continent was the earliest to emerge from the primeval waters. On this ground a special interest attaches to the flora of the Saguenay basin and the heights of Labrador beyond. It will be observed that the district is specially fruitful in sedges, rushes, grasses and other endogenous plants. The following catalogue embraces all the additional species that I have noted up to date :

OSMUNDACEÆ R. Br.

Osmunda regalis L.—*Royal Fern.*—Loutre Marsh. July.

POLYPODIACEÆ R. Br.

Woodsia Ilvensis (L.) R. Br.—*Rusty Woodsia.*—Cap-à-l'Aigle rocks. August.

Cystopteris bulbifera (L.) Bernh.—*Bulblet Cystopteris.*—Banks of St. Lawrence. August.

Cystopteris fragilis (L.) Bernh.—*Brittle Fern.*—In many places. July.

DRYOPTERIS FRAGRANS (L.) SCHOTT.—*Fragrant Shield-fern.*—One clump found on top of a mountain. August.

PHEGOPTERIS PHEGOPTERIS (L.) UNDERW.—*Long Beech-fern.*—In high woods at Cap-à-l'Aigle.—August.

PHEGOPTERIS HEXAGONOPTERA (MICHX.) FEE.—*Broad Beech-fern.*—In same localities as the last. August.

CRYPTOGAMMA ACROSTICHOIDES R. BR.—*American Rock-brake.*—On rocks on banks of St. Lawrence. August.

PELLÆA STELLERI (S. G. GMEL.) WATT.—*Slender Cliff-brake.*—On cliffs at Pointe-à-Pic. August.

LYCOPODIACEÆ MICHX.

LYCOPODIUM SELAGO L.—*Fir Club-moss.*—In moist woods. August.

LYCOPODIUM LUCIDULUM MICHX.—*Shining Club-moss.*—In similar localities. August.

LYCOPODIUM ANNOTINUM L.—*Stiff Club-moss.*—In the same district.

LYCOPODIUM CLAVATUM L.—*Running Pine.*—Dry woods. August.

LYCOPODIUM COMPLANATUM L.—*Trailing Christmas Green.*—Also in dry woods. August.

PINACEÆ LINDL.

PINUS DIVARICATA (AIT.) LUDW.—*Labrador Pine.*—Abundant on the heights. August.

JUNIPERUS NANA WILLD.—*Low Juniper.*—In former list called *Juniperus communis.*

TAXUS MINOR (MICHX.) BRITTON.—*American Yew.*—Not rare. August.

TYPHACEÆ J. ST. HIL.

SPARGANIUM EURYCARPUM ENGELM.—*Broad-fruited Bur-reed.*—Common. August.

ALISMACEÆ D.C.

SAGITTARIA LATIFOLIA WILLD.—*Broad-leaved Arrow-head.*—Common. August.

SAGITTARIA ARIFOLIA NUTT.—*Arum-leaved Arrow-head.* Common. August.

SAGITTARIA CUNEATA SHELDON.—*Floating Arrow-head.*—Rarer. August.

SAGITTARIA GRAMINEÆ MICHX.—*Grass-leaved Arrow-head.*—Common. August.

GRAMINEÆ JUSS.

IXOPHORUS VIRIDIS (L.) NASH.—*Green Fox-tail.*—Common, August.

PHLEUM ALPINUM (L.)—*Mountain Phleum.*—On Cap-à-l'Aigle Mts. August.

CINNA LATIFOLIA (TREV.) GRISEB.—*Slender Wood Reed-grass.*—Common in high woods. August.

AGROSTIS RUPESTRIS ALLIONI.—*Rock Bent-grass.*—Port-à-Persil. August.

AGROSTIS PERENNANS (WALT.) TUCKERM.—*Thin-grass.*—Common on hills. August.

AGROSTIS HYEMALIS (WALT.) B.S.P.—*Rough Hair-grass.*—Common on dry hills. August.

CALAMAGROSTIS CANADENSIS (MICHX.) BEAUV.—*Blue-joint grass.*—In wet places. Common. August.

CALAMAGROSTIS LANGSDORFII (LINK.) TRIN.—*Langsdorf's Reed-grass.*—In less moist localities than the last. August.

AMMOPHILA ARENARIA (L.) LINK.—*Sea Sand-reed.*—Very common on sea-shore. August.

TRISETUM SUBSPICATUM (L.) BEAUV.—*Narrow False Oat.*—On rocks near Cap-à-l'Aigle wharf. Rare. August.

DANTHONIA SPICATA (L.) BEAUV.—*Common Wild-oat Grass.*—Common. July.

SPARTINA CYNOSUROIDES (L.) WILLD.—*Tall Marsh-grass.*—Moist places near the shore. August.

Catabrosa aquatica (L.) Beauv.—*Water Whorl-grass.*—Near mill on Salmon River. July.

Dactylis glomerata L.—*Orchard Grass.*—Common. July.

Poa annua L.—*Low Spear-grass.*—Common. July.

Poa compressa L.—*Wire-grass.*—Common. July.

Poa alpina L.—*Alpine Spear-grass.*—Common. August.

Poa nemoralis L.—*Wood Meadow-grass.*—In high woods. August.

Poa flava L.—*False Red-top.*—In swamps. August.

Poa debilis Torr.—*Weak Spear-grass.*—In woods. August.

Poa alsodes A. Gray.—*Grove Meadow-grass.*—In woods. August.

Panicularia Canadensis (Michx.) Kuntze.—*Rattle-snake grass.*—Marshy ground. August.

Panicularia elongata (Torr.) Kuntze.—*Long Manna-grass.*—In wet woods. August.

Panicularia nervata (Willd.) Kuntze. — *Nerved Manna-grass.*—In damp ground. August.

Panicularia Americana (Torr.) MacM.—*Reed Meadow-grass.*—Common in damp places. July.

Panicularia fluitans (L.) Kuntze.—*Floating Manna-grass.*—In wet ground. August.

Festuca rubra L.—*Red Fescue-grass.*—On the hill-tops. August.

Festuca ovina L.—*Sheep's Fescue-grass.*—In pasture fields. July.

Bromus ciliatus L.—*Fringed Brome-grass.*—In woods. August.

Bromus Kalmii A. Gray.—*Kalm's Chess.*—In woods near the St. Lawrence. August.

Bromus secalinus L.—*Chess.*—In grain fields. July.

Lolium perenne L.—*Rye-grass.*—Common. July.

Agropyron repens (L.) Beauv.—*Couch-grass.*—Common. July.

AGROPYRON VIOLACEUM (HORNEM.) VASEY.—*Purplish Wheat-grass.*—Occasionally met with. August.

HORDEUM JUBATUM L.—*Squirrel-tail Grass.*—On roadside. August.

ELYMUS ARENARIUS L.—*Downy Lyme-grass.*—On the shore. August.

CYPERACEÆ J. ST. HIL.

CYPERUS ESCULENTUS L.—*Yellow Nut-grass.*—In moist fields. August.

ELEOCHARIS PALUSTRIS (L.) R. & S.—*Creeping Spike-rush.*—In marshes. August.

ELEOCHARIS ACICULARIS (L.) R. & S.—*Needle Spike-rush.* In wet ground. July.

ELEOCHARIS ACUMINATA (MUHL.) NEES.—*Flat-stemmed Spike-rush.*—In moist places. August.

SCIRPUS LACUSTRIS L.—*Great Bulrush.*—In shallow ponds. July.

SCIRPUS FLUVIATILIS (TORR.) A. GRAY.—*River Bulrush.* —Near l'Outre River. August.

SCIRPUS ATROVIRENS MUHL.—*Dark Green Bulrush.*—Common in swamps. July.

SCIRPUS MICROCARPUS PRESL.—*Small-fruited Bulrush.*—In wet woods. August.

SCIRPUS CYPERINUS (L.) KUNTH.—*Wool-grass.*—In wet places. August.

CAREX LUPULINA MUHL.—*Hop Sedge.*—Common in swamps. July.

CAREX UTRICULATA BOOTT.—*Bottle Sedge.*—Banks of Salmon River. July.

CAREX RETRORSA SCHWEIN.—*Retrorse Sedge.*—In low ground. August.

CAREX LURIDA PARVULA (PAINE) BAILEY.—*Small Sallow Sedge.*—In springy ground. July.

CAREX HYSTRICINA MUHL.—*Porcupine Sedge.*—In low meadows. August.

CAREX PSEUDO-CYPERUS L.—*Cyperus-like Sedge.*—In bogs. August.

CAREX COMOSA BOOTT.—*Bristly Sedge.*—On border of ponds. July.

CAREX TRICHOCARPA MUHL.—*Hairy-fruited Sedge.*—In moist fields. August.

CAREX RIPARIA CURTIS.—*River-bank Sedge.*—Bank of l'Outre River. July.

CAREX HOUGHTONII TORR.—*Houghton's Sedge.*—Abundant on sandy fields. July.

CAREX FUSCA ALL.—*Brown Sedge.*—Bog near St. Lawrence. July.

CAREX STRICTA LAM.—*Tussock Sedge.*—Same places as the last. August.

CAREX HAYDENI DEWEY.—*Hayden's Sedge.*—In swamps. July.

CAREX MAGELLANICA LAM.—*Magellan Sedge.*—Marsh near St. Lawrence. August.

CAREX MARITIMA MULLER.—*Seaside Sedge.*—On banks of St. Lawrence. August.

CAREX CRINITA LAM.—*Fringed Sedge.*—Hillside swamps. July.

CAREX GRACILLIMA SCHWEIN.—*Graceful Sedge.*—In moist woods. July.

CAREX ARCTATA BOOTT.—*Drooping Wood Sedge.*—In dry woods. July.

CAREX TENUIS RUDGE.—*Slender-stalked Sedge.*—In same localities as above. July.

CAREX GRANULARIS MUHL.—*Meadow Sedge.*—In wet fields. July.

CAREX LAXIFLORA LAM.—*Loose-flowered Sedge.*—In dry woods. July.

CAREX AUREA NUTT.—*Golden-fruited Sedge.* — Near mountain springs. July.

CAREX PEDUNCULATA MUHL.—*Long-stalked Sedge.*—In dry woods. July.

Carex pedicellata (Dewey) Britton.—*Fibrous-rooted Sedge.*—In dry woods. July.

Carex Pennsylvanica Lam.—*Pennsylvania Sedge.*—On hills. July.

Carex varia Muhl.—*Emmons' Sedge.*—Common. On high ground. July.

Carex leptalea Wahl.—*Bristle-stalked Sedge.* — In bogs. July.

Carex stipata Muhl.—*Awl-fruited Sedge.*—In moist ground. July.

Carex vulpinoidea Michx.—*Fox Sedge.*—Common. July.

Carex rosea Schk.—Stellate Sedge.—In dry woods. July.

Carex tenella Schk.—*Soft-leaved Sedge.*—In bogs. July.

Carex sterilis Willd.—*Little Prickly Sedge.*—Common. July.

Carex canescens L.—*Silvery Sedge.*—Common. July.

Carex arcta Boott.—*Northern Clustered Sedge.*—In mountain swamp. Rare. July.

Carex trisperma Dewey.—*Three-fruited Sedge.*—In swamp. August.

Carex Deweyana Schwein.—*Dewey's Sedge.*—Common. July.

Carex tribuloides Wahl.—*Blunt Broom Sedge.*—Very common. August.

Carex Scoparia Schk.—*Pointed Broom Sedge.*—Very common. July.

Carex cristatella Britton.—*Crested Sedge.*—Common. August.

Carex adusta Boott.—*Browned Sedge.* — On hills. July.

Carex festucacea Willd.—*Fescue Sedge.*—In meadows. July.

ARACEÆ Neck.

ARISÆMA TRIPHYLLUM (L.) TORR.—*Indian Turnip.*—In moist woods. July.

CALLA PALUSTRIS L.—*Water Arum.*—In bogs. August.

JUNCACEÆ Vent.

JUNCUS EFFUSUS L.—*Common Rush.*—Very common. August.

JUNCUS FILIFORMIS L.—*Thread Rush.*—In marshes. July.

JUNCUS BALTICUS WILLD.—*Baltic Rush.*—Abundant by the shore. August.

JUNCUS TENUIS WILLD.—*Slender Rush.*—Very common. July.

JUNCUS ARTICULATUS L.—*Jointed Rush.*—On springy ground. August.

JUNCUS RICHARDSONIANUS SCHULT.—*Richardson's Rush.* Common. July.

JUNCUS NODOSUS L.—*Knotted Rush.*—Common. July.

JUNCUS CANADENSIS J. GAY.—*Canada Rush.*—Rare. August.

JUNCUS CANADENSIS BREVICAUDATUS ENGELM.—*Short-tailed Canada Rush.*—Common. August.

JUNCOIDES PARVIFLORUM (EHRH.) COVILLE.—*Small-flowered Wood-rush.*—In mountain woods. August.

JUNCOIDES SPICATUM (L.) KUNTZE.—*Spiked Wood-rush.* In woods on hillsides. August.

CONVALLARIACEÆ Link.

STREPTOPUS AMPLEXIFOLIUS (L.) DC.—*Clasping-leaved Twisted-stalk.*—In moist woods. July.

POLYGONATUM BIFLORUM (WALT.) ELL.—*Hairy Solomon's Seal.*—In dry woods. July.

ORCHIDACEÆ Lindl.

Cypripedium reginæ Walt.—*Showy Lady's Slipper.*—Rare. July.

Cypripedium parviflorum Salisb.—*Small Yellow Lady's Slipper.*—Rare. July.

Orchis rotundifolia Pursh.—*Small Round-leaved Orchis.*—Common. In damp woods. July.

Habenaria orbiculata (Pursh.) Torr.—*Large Round-leaved Orchis.*—In black mould in woods. July.

Habenaria Hookeriana A. Gray.—*Hooker's Orchis.*—In similar situations to the above. August.

Habenaria bracteata (Willd.) R. Br.—*Long-bracted Orchis.*—In moist woods. August.

Gyrostachys cernua (L.) Kuntze.—*Nodding Lady's Tresses.*—Common. August.

Listera convallarioides (Sw.) Torr.—*Broad-lipped Tway blade.*—In moist woods. Rare. August.

Peramium repens (L.) Salisb.—*Lesser Rattlesnake Plantain.*—In moist woods on mountain side. August.

Achroanthes unifolia (Michx.) Raf.—*Green Adder's Mouth.*—Common. July.

Leptorchis Loeselii (L.) MacM.—*Fen Orchis.*—Common. July.

Corallorhiza Corallorhiza (L.) Karst.—*Early Coral-root.*—Rare. July.

Corallorhiza multiflora Nutt.—*Large Coral-root.*—Common. August.

MYRICACEÆ Dumort.

Myrica Gale L.—*Sweet Gale.*—Near l'Outre River. July.

SALICACEÆ Lindl.

Salix alba vitellina (L.) Koch.—*Golden Osier.*—Near Cap-à-l'Aigle wharf. July.

Salix cordata Muhl.—*Heart-leaved Willow.*—Ste. Fidèle. August.

URTICACEÆ Reichenb.

Urtica urens L.—*Small Nettle.*—Common. August.

Adicea pumila (L.) Raf.—*Clearweed.*—In swampy woods. July.

SANTALACEÆ Nutt.

Comandra livida Richards.—*Northern Comandra.*—Rare. In woods near Cap-à-l'Aigle wharf. July.

POLYGONACEÆ Lindl.

Rumex acetosa L.—*Sour Dock.*—In one place by roadside. July.

Polygonum Pennsylvanicum L.—*Pennsylvania Persicaria.*—Common. August.

Polygonum cilinode Michx.—*Fringed Black Bindweed.*—Common. July.

CHENOPODIACEÆ Dumort.

Chenopodium glaucum L.—*Oak-leaved Goosefoot.*—Common. July.

Atriplex patula L.—*Spreading Orache.*—About old ruins. July.

Atriplex hastata L.—*Halberd-leaved Orache.*—Common on the shore. August.

AMARANTHACEÆ J. St. Hil.

Amaranthus retroflexus L.—*Rough Pigweed.*—Common. August.

CARYOPHYLLACEÆ Reichenb.

Alsinea graminea (L.) Britton.—*Lesser Stitchwort.*—Common. July.

CERASTIUM ALPINUM L.—*Alpine Chickweed.*—Woods near Salmon River. August.

ARENARIA GRŒNLANDICA (RETZ.) SPRENG.—*Mountain Sandwort.*—Formerly reported as *Arenaria stricta.*

RANUNCULACEÆ JUSS.

CALTHA PALUSTRIS L.—*Marsh Marigold.*— Common. Fruited in July.

ANEMONE CANADENSIS L.—*Canada Anemone.*—In one place near Cap-à-l'Aigle wharf. July.

RANUNCULUS ABORTIVUS L.—*Kidney-leaved Crowfoot.*— Fruited in July.

PAPAVERACEÆ B. JUSS.

CAPNOIDES SEMPERVIRENS (L.) BORCK.—*Pink Corydalis.* —Common on tops of rocks. August.

CRUCIFERÆ B. JUSS.

LEPIDIUM VIRGINICUM L.— *Wild Pepper-grass.*—Getting common. August.

THLASPI ARVENSE L.—*Field Penny-cress.* — Common. July.

RORIPA PALUSTRIS (L.) BESS.—*Marsh Water-cress.*—Getting common. August.

ARABIS BRACHYCARPA (T. & G.) BRITTON.—*Purple Rock-cress.*—Common. July.

CRASSULACEÆ DC.

SEDUM TELEPHIUM L.—*Live-forever.*—Along roadsides. August.

SAXIFRAGACEÆ DUMORT.

SAXIFRAGA AIZOON JACQ.—*Livelong Saxifrage.*—Rocks near Pointe-à-Pic wharf. Fruited in July.

CHRYSOPLENIUM AMERICANUM SCHWEIN.—*Golden Saxifrage.*—In swamps. July.

GROSSULARIACEÆ Dumort.

Ribes prostratum L'Her.—*Fetid Currant.*—In cold wet places. Fruited in July.

ROSACEÆ B. Juss.

Rubus chamæmorus L.—*Cloudberry.*—Peat bog. July.

Rubus occidentalis L.—*Black Raspberry.*—Fruited in July.

Potentilla littoralis Rydberg.—*Coast Cinquefoil.*—On high ground near the coast. July.

Comarum palustre L.—*Purple Marsh-locks.* — In swamps. August.

Geum rivale L.—*Purple Avens.*—In low ground. July.

Geum macrophyllum Willd.—*Large-leaved Avens.*—Rare. July.

Agrimonia Brittoniana Bicknell.—*Britton's Agrimony.*—Along roadside. August.

POMACEÆ L.

Amelanchier rotundifolia (Michx.)—*Round-leaved June Berry.*—On rocks near Cap-à-l'Aigle wharf. Fruited in July.

PAPILIONACEÆ L.

Astragalus elegans (Hook.) Britton.—*Pretty Milk Vetch.*—Hillside near Murray Bay Bridge. July.

GERANIACEÆ J. St. Hil.

Geranium Bicknellii Britton.—*Bicknell's Crane's-bill.*—On rocks near Point-à-Pic wharf. August.

EMPETRACEÆ Dumort.

Empetrum nigrum L.—*Black Crowberry.*—On rocks near Cap-à-l'Aigle wharf. Fruited in August.

ANACARDIACEÆ Lindl.

Rhus hirta (L.) Sudw.—*Staghorn Sumach.*—Formerly reported as *Rhus glabra.*

ILACACEÆ Lowe.

Ilex glabra (L.) A. Gray.—*Inkberry.*—On mountain side. July.

Ilicioides mucronata (L.) Britton.—*Wild Holly.*—Swamp on mountain top. Fruited in August.

HYPERICACEÆ Lindl.

Hypericum perforatum L.—*Common St. John's Wort.*—Rare. July.

Hypericum boreale (Britton) Bicknell.—*Northern St. John's Wort.*—In wet places. August.

ONAGRACEÆ Dumort.

Epilobium anagallidifolium Lam.—*Pimpernel Willow-herb.*—On high mountain. August.

Epilobium palustre L.—*Marsh Willow-herb.*—Formerly reported as *Epilobium coloratum.*

Epilobium lineare Muhl.—*Linear-leaved Willow-herb.*—In marshy places. August.

Onagra Oakesiana (A. Gray) Britton.—*Oakes' Evening Primrose.*—Formerly reported as *Onagra biennis.*

Kneiffia pumila (L.) Spach.—*Small Sundrops.*—In dry places. July.

UMBELLIFERÆ B. Juss.

Sanicula Marylandica L.—*Black Snake-root.*—Common. July.

PYROLACEÆ L.

Pyrola chlorantha Sw.—*Greenish-flowered Wintergreen.*—In dry woods. July.

Pyrola asarifolia Michx.—*Liver-leaf Wintergreen.*—In wet woods. July.

PYROLA MINOR L.—*Lesser Wintergreen.*—In dry woods. August.

PYROLA SECUNDA L.—*One-sided Wintergreen.*—In dry woods. July.

VACCINIACEÆ LINDL.

VACCINIUM VITIS-IDÆA L.—*Mountain Cranberry.*—Common on high rocky places. July.

MENYANTHACEÆ G. DON.

MENYANTHES TRIFOLIATA L.—*Buckbean.*—Near mouth of Murray river. Fruited in August.

SCROPHULARIACEÆ LINDL.

CHELONE GLABRA L.—*Turtle-head.*—Common in wet places. July.

VERONICA AMERICANA SCHWEIN.—*American Brooklime.*—In creeks. August.

VERONICA SCUTELLATA L.—*Marsh Speedwell.* — In swamps. August.

RUBIACEÆ B. JUSS.

GALIUM TINCTORIUM L.—*Stiff Marsh Bedstraw.*—In bogs. July.

CAPRIFOLIACÆ VENT.

VIBURNUM ACERIFOLIUM L.—*Maple-leaved Arrow-wood.*—In woods near Salmon River. Fruited in July.

VIBURNUM CASSINOIDES L.—*Withe-rod.*—In wet woods. July.

CICHORIACEÆ REICHENB.

LACTUCA CANADENSIS L.—*Wild Lettuce.*— Common. August.

LACTUCA SPICATA (LAM.) HITCH.—*Tall Blue Lettuce.*—In moist places. August.

NABALUS NANUS (BIGEL.) D.C.—*Lion'sfoot.*—Rocks near Salmon River. August.

COMPOSITÆ ADANS.

EUPATORIUM MACULATUM L.—*Spotted Joe-Pye-Weed*—In moist places. August.

SOLIDAGO HISPIDA MUHL.—*Hairy Golden-rod.*—Abundant on the dry banks of the St. Lawrence. August.

SOLIDAGO MACROPHYLLA PURSH.—*Large-leaved Golden-rod.*—On rocky sides of the mountains. August.

SOLIDAGO SEMPERVIRENS L.—*Seaside Golden-rod.*—On rocks near mouth of Salmon River. August.

SOLIDAGO RUGOSA MILL.—*Wrinkle-leaved Golden-rod.*—In dry places. August.

ASTER LINDLEYANUS T. & G.—*Lindley's Aster.*—On banks of Murray River. August.

ASTER TARDIFLORUS L.—*North-eastern Aster.*—Port-à-Persil. August.

ASTER PRENANTHOIDES MUHL.—*Crooked-stem Aster.*—Port-à-Persil. August.

ASTER NOVI-BELGII L.—*New York Aster.*—Port-à-Persil. August.

ASTER ACUMINATUS MICHX.—*Whorled Aster.*—In moist woods. July.

ERIGERON PULCHELLUS MICHX.—*Robin's Plantain.*—On dry hills. July.

ERIGERON PHILADELPHICUS L.—*Philadelphia Fleabane.*—In dry fields. July.

ERIGERON ACRIS L.—*Blue Fleabane.*—In dry woods. August.

On a New or hitherto Unrecognized Geological Formation in the Devonian System of Canada.

By H. M. Ami,
of the Geological Survey of Canada.

The paper describes an outcrop of what appears to be the base of the Old Red Sandstone of Britain and that phase of it, such as occurs in the red Cornstone of Herefordshire, England. It is met with in the red shales and sandstones of McArras Brook in Antigonish County, Nova Scotia, from which a most interesting and important fish fauna has recently been obtained, referable to a Lower Devonian horizon.

The presence of Pteraspidians, Cephalaspidians and Acanthodians, as well as Pterygotus, as determined by Mr. A. Smith Woodward and Dr. Henry Woodward, London, would seem to indicate clearly the presence of a fauna precisely similar in parts to the Hereford beds referable to the Lower Devonian or Old Red Sandstone.

The *Pteraspis* found in a calcareous matrix in the series of strata is one which Mr. Woodward refers to as very closely allied if not actually identical with *P. Crouchii.*

The horizon indicated is low down in the Devonian, not far from the summit of the Silurian. From the nature of the sediments, their composition, origin and general characters, they appear to be much more closely related to European Devonian or Old Red Sandstone strata than to the usual type of North American Devonian such as is met with in the Peninsula of Gaspé, or in Ontario and Manitoba and the United States.

The term *Knoydart* formation is assigned to this series of strata in order to be able to designate and separate it from other palæozoic formations in that portion of Eastern

Canada where the sedimentation has a wonderfully close resemblance to European types. This was long ago pointed out by Sir William Dawson, J. W. Salter and E. Billings.

The following species of fossils are provisionally recorded as characteristic of this Knoydart formation. Similar or identical species will no doubt be found sooner or later in other parts of Antigonish and other counties of Eastern Nova Scotia.

Fossil Organic Remains from Knoydart Formation, Nova Scotia.

1. Pteraspis, sp. cf. P. Crouchii.
2. Cephalaspis sp.
3. Onchus Murchisoni, Agassiz.
4. Psammosteus, sp., cf. P. Anglicus, Traquair.

Mr. Woodward writes: The McArras Brook specimens "represent the base of the lower Old Red Sandstone of Britain."

Ann. Rep. new ser. vol. 2, 1886 (1887, Montreal), p. 49P, under the head of "F. Devonian," Mr. Hugh Fletcher describes three distinct groups of Devonian strata corresponding closely with those of New Brunswick," and gives the following table of equivalencies:—

New Brunswick.	Nova Scotia.
3. Mispeck group.	3. Upper Red Slate and Sandstone group.
2. Dadoxylon Sandstone and Cordaite shale.	2. Middle Gray Sandstone and Slate group.
1. Bloomsbury Conglomerate.	1. Lower Conglomerate group.

After giving the distribution of the above in Nova Scotia, in general, the first reference to the age of the McArras Brook strata is then given on page 49P, which reads as follows: "The Upper rocks," (*i.e.*, the Upper Red Slate and Sandstone group) "are found again near Union Railway Station, and also at McArras Brook."

On page 67P, Mr. Fletcher quotes Dr. Honeyman's views on the age of these rocks:[1] "They are certainly not Lower Helderberg, and may therefore be Devonian," and on p. 68P, the same writer quotes Sir William Dawson,[2] in which he regards them as "Pre-Carboniferous although not separated from the Silurian."

Mr. Fletcher there describes strata on McArras Brook as follows: "Good exposures are also cut by McArras Brook behind the mass of amygdaloid at the shore, consisting of red, flinty, micaceous, jointed sandstone and slate, often concretionary, interstratified with greenish thick bedded and flaggy sandstone, containing traces of carbonate of copper and iron pyrites; the brook being rocky up to the shore road. From the latter, a collection of fossils made by Mr. Weston, comprising fragments of plants and fish teeth, not certainly determinable, together with certain interesting footprints *Protichnites carbonarius*.

In his "Geology, Chemical, Physical and Stratigraphical," Sir Joseph Prestwich[3] makes the following statement regarding the "Old Red Sandstone" of Herefordshire, which enables geologists to correlate and recognize similar strata with a marked degree of proximity to certainty wherever they occur.

"The Old Red Sandstone of Herefordshire was long thought to be non-fossiliferous, a few fragmentary specimens only have been found, when in the railway cuttings near Ledbury, the Rev. W. S. Symonds (see Quart. Journ. Geol. Soc., Vol. 16, p. 193, and Vol. 17, p. 152) discovered in the lowest beds (the Ledbury shales) of that formation remains of *Pterygotus, Onchus, Pteraspis* and *Cephalaspis*,

1 Trans. Nov. Scot. Inst. Sc. Vol. 3, p. 13.
2 Acadian Geology, p. 316, line 4, and Supplement, p. 49, line 15.
3 In chap. VI., "The Devonian System: 'The Old Red Sandstone,'" p. 82.

together with large numbers of the head shields of *Auchenaspis.*"

It is impossible to read over the association of forms in the above Ledbury shales of Herefordshire without recognizing in them the fauna and horizon met with at McArras Brook in Antigonish County, Nova Scotia.

In 1843 Dr. Abraham Gesner [1] describes an "Old Red Sandstone, or Devonian group," which he recognizes above Silurian beds . . . in several parts of the Province" . . . . consisting of . . . "a bright red micaceous sandstone or conglomerate, accompanied by thin beds of red shale and marly clay, and in some places containing seams of fibrous gypsum." He adds: "Hitherto no organic remains have been found in it." He recognizes it at Advocate Harbor and on the Moose River, where it is "seen lying unconformably beneath the Coal Measures."

In his report Mr. H. Fletcher classifies these rocks of Advocate Harbor as Devonian. The "Old Red Sandstone or Devonian Group" of Gesner are therefore linked with the rocks of Union and Riversdale, "but, from the fauna and flora found in them, are referable to Carboniferous times, and from their position in the stratigraphical succession appear to belong to the Eo-Carboniferous.

In November, 1899, in a communication on a number of fossil fishes sent him by the writer from various localities in which the geological horizon and precise affinities of the species sent were doubtful, Mr. A. Smith Woodward, the eminent authority on Palæozoic fishes, gives the following notes on the specimens which he had previously submitted to Dr. R. Traquair of Edinburgh :—

"The specimens from McArras Brook are extremely interesting and represent the base of the Lower Old Red Sandstone of Britain. The Pteraspidian remains are sufficient to prove that they belong to the genus *Pteraspis.*

1 Proc. Geol. Soc. London, Vol. 4, part 1, No. 95, p. 187, 1843.

Both dorsal and ventral shields are so much like those of *P. Crouchi* that if these Nova Scotian fossils had been found in West England we should have referred them to the latter species. Perhaps the rostral plate may prove to distinguish your form when it is completely known. One piece of dorsal shield, in counterpart, shows the impressions of the supposed branchial pouches on one side.

"The pointed fragments may be Cephalaspidian cornua, but are uncertain.

"There is the typical *Onchus Murchisoni, Ag.*

"Most interesting is one small fragment of *Psammosteus*, with ornament identical with that of *P. anglicus.* (See Traquair, Ann. Mag. Nat. Hist., Ser. 7, Vol. 11, 1898, p. 67, pl. i., figs. 1, 2.) In this fossil the chambers of the middle layer are larger than in our unique plate.

"On the whole, I should place the McArras Brook beds on the same horizon as the Lower Old Red Cornstones of the Hereford District of England, above the passage beds."

In order to give a comprehensive view of the succession of strata in this Knoydart formation, the following section, carefully measured and prepared by Mr. Hugh Fletcher, of the Geological Survey of Canada, in the year 1897, is here given :—

"From the mass of trap near the mouth of McAra Brook the following is the section in ascending order :

Amygdaloidal trap, probably Lower Carboniforous as described in Report P. for 1886.

		ft.	in.
	Measures concealed. On the left bank of the brook trap is in the cliff, while on the right bank there are indications of red stratified Devonian rocks..............	30	0
1.	Red, argillaceous shale, more or less slaty, with coherent underclay full of rootlets. Dip 230°/32° (Magnetic)..............	3	0
2.	Red, argillaceous slaty rock, not well seen..	4	9

		ft.	in.
3.	Red, broken, argillaceous shale, with greenish and gray blotches	6	0
4.	Red shale, nearly all concealed	6	0
5.	Red, very coherent, concretionary, calcareous rock at the mouth of a little brook from the eastward	1	6
6.	Red, argillaceous shale	7	6
7.	More coherent, flaggy rocks, which may be called sandstone	1	0
8.	Red, argillaceous shale	8	0
9.	Red, coherent, somewhat sandy flags, in two layers	3	0
10.	Red, argillaceous shale, in part blotched with green	46	0
11.	Greenish and reddish, coherent micaceous sandstone and flags, with fossils. (No. 1)	4	0
12.	Red, argillaceous shale, with coherent layers	22	0
13.	Red, somewhat coherent, massive argillaceous rock	6	0
14.	Red, coherent flags, containing fish remains	11	6
15.	Red, argillaceous shale	5	0
16.	Greenish, calcareous flags, from which Dr. Ami collected many fossil fish remains in 1897. The upper part contains broken carbonized plants, seeds, etc. (No. 2)	2	0
17.	Red and green, somewhat massive, mottled, calcareous rocks, with nodular, rounded and oval spots and fish remains. Dip 230°/25° on fine long faces	7	0
18.	Red, argillaceous shale, with layers of more coherent, concretionary flags	5	0
19.	Red, micaceous flags	1	6
20.	Red, somewhat crumbly, argillaceous shale, forming fine ledges in the brook	2	0
21.	Red, argillaceous shale, with layers of fine, more coherent flags	14	6

	ft.	in.
22. Greenish, flinty, argillaceous and siliceous flags, micaceous, and sometimes spotted with red, containing much carbonaceous matter, and cut by veins of quartz. (No. 3)	3	0
23. Greenish, coherent, massive, fine sandstone, in two layers......................	4	0
24. Red and greenish mottled shale, in regular layers, more massive towards the top, for the most part red..................	8	0
25. Reddish, coherent flags and argillaceous shale	32	0
26. Red, crumbly, argillaceous shale, not well seen...............................	11	0
27. Red, crumbly, argillaceous shale, with harder bands, not well seen.................	10	9
28. Red, argillaceous shale, with flaggy layers..	17	6
29. Red, argillaceous shale, not well seen......	25	0
30. Red, coherent, thick bedded sandstone, in two layers, at a small waterfall.........	6	0
31. Red, coherent, argillaceous shale, with green layers and blotches..................	5	0
32. Measures not well seen, but evidently chiefly red..............................	6	0
33. Greenish, argillaceous shale, at the mouth of a little brook from the westward. (No. 4.) From this, the seeds and plants[1] were obtained by Dr. Ami in 1896. One coarse, rusty layer is full of pyrites and plant remains.....................	2	6
34. Measures concealed, probably greenish shales cut by quartz veins and containing plants	3	0
35. Greenish quartzite or fine sandstone, over which the little brook from the westward falls into the main stream at water level	3	0

1 From a microscopic examination recently made of the peculiar objects in question, referred to in No. 33 of the section as "seeds and plants," the writer is of the opinion that there is no evidence of the presence of such organisms.

		ft.	in.
36.	Grey and greenish and red coherent, argillaceous rock in three layers..	3	0
37.	Red, argillaceous shale, with coherent layers. The top comes to the foot of the falls in a gorge from which Mr. Weston is supposed to have obtained his fish remains. (No. 5)	12	0
38.	Red, coherent, argillaceous shale, forming a little fall..........................	15	0
39.	Red, coherent shales, forming a higher fall..	14	0
40.	Red, argillaceous shale, containing greenish blotches, harder layers and small nodules. To the water level of the lower side of the culvert at the shore road..........	31	0
41.	Red, argillaceous rock, with green layers and blotches, in cliffs at the road, dipping 235°/32°	30	0
42.	Red and green mottled, argillaceous shale, principally red.....................	15	0
43.	More coherent, red, siliceous and argillaceous rock, with a few fish remains..........	10	0
44.	Greenish and mottled lenticular limestone, from which Dr. Ami obtained the fish remains, *Pteraspis*, etc., first sent to Dr. Woodward (No. 6).................	0	6
45.	Red, argillaceous and siliceous rock, with green bands and blotches..............	30	0
46.	Reddish, altered rock, at the level of the road under the schoolhouse, not well seen....	20	0
47.	Greenish, argillaceous flags and shales (No. 7)	4	0
48.	Red, argillaceous shale..................	3	0
49.	Red and greenish sandstone, in two layers..	4	0
50.	Red, argillaceous shales, with layers of more coherent rock, some of which contain rootlets............................	17	0
51.	Measures concealed.....................	13	6

		ft.	in.
52.	Bright red, soft, argillaceous shale. To the first bridge where the brook crosses to the eastward........................	4	0
53.	Red, argillaceous shale, with a few more coherent layers........................	31	0
54.	Greenish, somewhat massive, argillaceous and arenaceous rock (No. 8). At the second bridge where the brook runs to the westward, the dip now changes to 80°, and this layer is concealed for some distance, but again appears to return to the road further south. Assuming that this is the case, the section is continued beyond as follows :—		
55.	Red, argillaceous shale, with coherent layers	18	0
56.	Greenish and dark gray crumbly argillaceous rock..........................	3	0
57.	Greenish and gray argillaceous rock, the upper part greatly altered.............	4	0
58.	Trap................................	4	0
59.	Red, argillaceous shale, greatly altered.....	6	0
60.	Measures concealed. Dip 250°/23°. To a little brook from the eastward.........	5	0
61.	Red, argillaceous shale, and thin flags in which fish remains were found (No. 9)...	14	0
62.	Red, argillaceous shale and flags..........	43	0
63.	Trap, thickness undefined ; perhaps.......	120	0
	This trap begins about 550 yards above the main road. In the brook west of the road there is a green, flinty shale, which yielded no fossils.		
	Total thickness of the stratified rocks in the section...........................		

NOTE.

This section is only approximate. It represents only a small portion of measures apparently as thick as at Union, seen also in Knoydart Brook and other streams of the vicinity. It is not supposed that either the base or the summit of the series is here given."

The above series of strata (exclusive of the "trap") constitute part of the succession to which the term *Knoydart* formation is applied, in order to separate it from the various members of the Silurian system to the east of and in close relation to the Devonian series. The local divisions of the Silurian fall naturally (and provisionally) into four formations, in descending order as follows:—

THE STONEHOUSE FORMATION.

THE MOYDART FORMATION.

THE MCADAM FORMATION.

THE ARISAIG FORMATION (LIMITED).

For a definition of these formations by the writer, *see* the January number of the Supplement (No. 1307) to *The Scientific American*, New York City, p. 20949, in Dr. E. O. Honey's article on the Albany Meeting of the Geological Society of America and the discussion of the papers read.

An Hour's Botanizing on the Mountain Side.

By John Dearness.

On the 8th and 9th November, 1898, the Ontario Entomological Society, at the invitation of the Montreal Branch, held its annual meeting in the Royal city, the date being the twenty-fifth anniversary of the foundation of the Branch just named. On the morning of the 9th, the mountain side afforded an advantageous position to watch the sun rise. The weather was delightful, the air comparatively clear, and not too cool to be pleasant,—a dry, clear, bracing morning.

If there were any insects on the wing, they were not conspicuous enough to divert attention from the rich fungal flora in the humid rearward slopes of the wooded terraces. The bareness of the trees and shrubs rendered the cryptogamic forms more noticeable.

On the right of the path entering under the inclined railway there were a few dilapidated shrubs, including bladder-nut (*Staphylea trifolia*). On some of the stems of these shrubs, in a brush heap and on dead erect branches, there was a vigorous growth of three or four species of fungus. One of them is related to the black-knot of the plum (*Otthia* or *Plowrightia morbosa*) at least so far as a similar method of fruiting establishes relationship among these forms. Whether the fungus on *Staphylea* like that on plum has a parasitic stage I cannot say, but in the stage of complete maturity both develop a stromatic layer which becomes thickly covered with fruit-balls, technically called perithecia. Each little shining, papillate globe contains a large number of sacs standing among infertile branches called paraphyses. Each sac or ascus contains eight semi-transparent, centrally constricted spores. The species on *Staphylea* is illustrated in Plate 41 of Ellis and

Everhart's Pyrenomycetes, from material collected near London, Ont.

A still more interesting species obtained on the same host is a *Fenestella*, probably *F. princeps.* It was not, at the time of collection, mature enough to be sure of the species. It, too, is a pyrenomycete; microscopically less attractive than *Otthia*, but when sectioned and prepared for study under the microscope much more beautiful. For study and identification freehand sections of these forms are easily made and are quite satisfactory, if mounted in water or dilute glycerine.

Another imperfect but interesting form, found on the same host, proved a new species. It was described and figured in the current volume of *Proceedings of the Canadian Institute*, under the name *Haplosporella Staphylina.* The perithecia are grouped in small round stromata with their apices projecting. The relatively large brownish spores appear sessile on the hymenial lining of the perithecia.

Another sphæreloid ascomycete on the twigs, I have not yet identified. It is not very far from Prof. Peck's *Metasphæria* on the same host. Besides the foregoing, all on bladder-nut, two or three cosmopolitan species were observed but not recorded.

The more conspicuous hypoxylons and valseæ were found in variety and in fine fruiting condition, on decaying birch, hawthorn and sumach, a few rods nearer the ascent. Coriaceous hymenomycetes—stereum, dædalea and other polyporei were in fair profusion, but the season was too far advanced to find any of the fleshy species except, *Collybia velutipes,* the gregarious velvet-footed collybe which is usually given a place in lists of edible toadstools. Its favorite situation is on partially decayed elm, but it grows on other kinds of wood.

THE CANADIAN MARINE BIOLOGICAL STATION.

By F. SLATER JACKSON, M.D.

The history of Acadian Zoology may be said to date from the time of Champlain, for Lescarbot's "Histoire de la nouvelle France," published in 1609, contains accounts of the more common Mollusca of that region. In Champlain's own work, "Les Voyages du Sieur de Champlain," published a few years later (viz., in 1613) mention is made of the various shell-fish which appear to have been employed by him for food. Similarly Denys' "Description Géographique et Historique des costes de l'Amerique Septentrionale" and his "Histoire Naturelle," published in 1672, contain in addition, references to many forms apparently overlooked by previous observers: thus he mentions the Razor-fish (Ensatella Americana) and various Cephalopoda, of which latter his accounts are singularly interesting and accurate. These observations, however interesting historically, contain little of scientific value. It was not until 1852 that a systematic scientific study of the marine organisms of Acadia was commenced. In this year Stimpson spent three months in investigating the Invertebrata of Grand Manan, and his results, published two years later, constitute the first important contribution to our knowledge of this subject. In 1870 Gould's "Invertebrata of Massachusetts" (which first appeared in 1841) was rëedited, and made to include many species common to that State and to New Brunswick and Nova Scotia.

The Reports of the United States Fish Commission also contain much valuable information relative to the species inhabiting the Bay of Fundy, particularly in the vicinity of Eastport, Me., and Grand Manan. More recently the entire subject has been carefully reviewed and studied by Prof. Ganong, of Harvard, whose name is associated with the Zoology of Nova Scotia and New Brunswick as that of Dr. G. F. Matthew is with the Geology and Palæontology of that region. To us in 1899 was offered the opportunity of corroborating and extending the observations of these writers, for in that year the Canadian Government granted an appropriation of $7000 for the erection, equipment and maintenance of a Marine Biological Station, largely through the influence of Sir Louis Davies, Minister of Marine and Fisheries.

The objects of such an institution may be considered under two aspects, Scientific and Economic. From a Scientific point of view may be mentioned :—

(1) The collection and identification of the various organisms indigenous to the region.

(2) The study of their abundance, food, habits, mode of propagation, and the circumstances favorable or inimical to their life and propagation.

(3) Their parasites.

(4) Their variation under natural and artificial conditions.

(5) Their development and life history.

(6) The depth and temperature of the water inhabited by the various forms.

(7) The investigation of such forms and phases of organic life as cannot be satisfactorily preserved for subsequent study.

The Economic aspect presents itself under such headings as the following :—

(1) The investigation of such organisms as are of commercial value; more especially the fishes and edible Mollusca.

(2) Problems concerning their natural and artificial propagation.

(3) The study of the food, habits and development of Fishes, and their relative abundance under varying conditions.

(4) A consideration of organisms injurious to timber.

To meet these objects and to facilitate the elucidation of these problems the present Laboratory was built and equipped.

The Laboratory itself (the construction of which was commenced in June, 1899) is a one-storey building, well lighted from above and from the sides. In the centre is a large room where ten or twelve investigators may comfortably work. It is provided with tables and shelves, basins, fresh and salt water, etc.

At either end are two smaller rooms for the use of the Director, storage of glassware and reagents, and for the tanks supplying the fresh and salt water. These last are replenished by means of pumps, of which there are two, one operated by hand, the other by hot air. While the present equipment of the Laboratory leaves much to be desired, much has already been done in this direction. A boat, dredges, tow-nets, etc., have been provided, and the Laboratory contains, in addition, the nucleus of a reference library of no small value, including a complete set of the "Challenger" Reports, a gift from the British Government.

The Laboratory was designed as a floating station, and with this object a barge has been constructed, upon which it may be placed and towed from one locality to another.

Its present situation has been well chosen, viz., St. Andrews, N.B., on the shore of Passamaquoddy Bay.

In speaking of Passamaquoddy Bay Prof. Ganong says:

"Lying in the south-western corner of Charlotte County, with a length of fifteen and a breadth of seven miles, it receives the waters of four rivers and many smaller streams, and is filled by the tide twice each day through four narrow channels. The degree of hardness of the surrounding rocks is favorable to the existence of a great variety of life; for they consist largely of soft, easily eroded conglomerates and sandstones, which are carried away by the strong tides and deposited among the islands, forming pebble, sand, and mud bottoms, while numerous trap dykes afford rugged reefs and ledges."

Under these favorable conditions the investigator seeks the desired information by all means in his power. Collecting at low tide the numerous littoral forms so abundant in the tide-pools, under the rocks, and in the mud and sand exposed by the receding water, securing by means of the tow-net the smaller drifting and swimming organisms —the plankton and nekton—on or near the surface, dredging at various depths the more stationary and inaccessible forms, examining the haul of the fisherman, and the contents of the fishes' stomachs—such are the more important methods of ascertaining the habitat and mode of life of the organisms, and of securing material for future identification and investigation.

With regard to the fauna of this region, a correct conception may perhaps best be gained by a comparison with that of Vineyard Sound and the vicinity of Cape Cod, so thoroughly worked out by Gould and by Verrill and Smith.

It may be said in general that the New Brunswick fauna is less rich and more Arctic and Boreal in character, being intermediate in these respects between those of the Massachusetts Coast and the Gulf of St. Lawrence.

This is obviously due to the lower temperature of the water and the diminished influence of the Gulf Stream, to which the waters of Vineyard Sound owe not only their increased temperature but also many of their characteristic types—more especially numerous pelagic animals, which are directly transported by its currents.

Other factors, as noted by Dr. Stimpson, are the great depth of the water on the Maine and New Brunswick coasts, and the thick fogs so prevalent in this region. He states that " the surface temperature of the sea is 15°—20° lower than in Massachusetts Bay at the same time," which latter, according to Verrill, varies in August from 66° to 72° F.

Stimpson further says :—

"It is interesting to notice a great similarity of the Fauna of this region and that of Greenland, as described by O. Fabricius and others. The correspondence is very great, especially among the Tunicata and Echinodermata, of which the species are nearly the same."

Another interesting point of comparison is that between the existing Acadian Fauna and that of the Canadian Pleistocene period. Many of the Invertebrata (particularly the Mollusca) are common to both, and the Capelin (*Mallotus Villosus*) described by Cox as "never ranging further south than the shores of New Brunswick" occurs, as is well known, in the clay concretions of the Pleistocene at Green's Creek, near Ottawa.

While it is not my intention to enumerate a list of the species collected in this vicinity, a brief reference to some of the commoner and more important forms may be of interest.

Of Cœlenterata may be mentioned various Hydroids, of which *Plumularia* and *Sertularia* are the most common. The large "Jelly-fish" (*Aurelia Flavidula*) is abundant, and another closely related form (*Ptychogena Lactea*)—conspicuous by the prominent white cross on its disc—is occasionally found. The common Sea-anemone (*Metridium Marginatum*) is frequently met with, but of Ctenophores, such as *Idyia* and *Pleurobrachia*, so abundant at Halifax, I saw but few.

The class of animals popularly grouped together as "Worms" is well represented. Conspicuous among these are the large Carnivorous sea-worms of the genus *Nereis*, observed at low tide, partially extruded from their holes.

On turning over the stones at low tide, almost every one is seen to harbor various Nemerteans—those interesting organisms with eversible proboscis and supposed Vertebrate affinities, and a multitude of other interesting forms may be obtained by digging in the mud and sand.

The Echinodermata are well represented. Prof. Ganong, in his paper on "The Echinodermata of New Brunswick," mentions twenty-eight species. The common Star-fish (*Asterias Vulgaris*), the Sea Urchin (*Strongylocentrotus Drobachiensis*), the "Sand-Dollar" (*Echinarachnius Parma*), the Sea-Cucumber (*Cucumaria Frondosa*), together with several Brittle-stars, and the delicate and transparent *Synapta*, are among the more common.

Of Crustacea the most abundant and conspicuous are the Barnacles (*Balanus Balanoides*), which are so numerous along the littoral zone as to give the rocks in many places a marked white appearance.

Crabs and lobsters, although not very abundant, are met with, and little Amphipod Crustacea of the genus *Gammarus* are found in swarms in the tide pools and in the shallow water. In many places beautiful Isopoda are found swimming on the surface, and the Hermit-crab (*Bernhardus Pubescens*) is frequently seen occupying the shells of whelks and other Gastropods.

A list of even the more common Mollusca would, I fear, prove tedious, but Prof. Ganong's delightful little book on "The Economic Mollusca of Acadia" will be read with pleasure by all interested in the subject. Among Lamellibranchs clams of the genus *Mya*, Mussels (*Mytilus*) and Horse-mussels (*Modiola*) are abundant; the former buried in the sand with nothing but the siphons visible, and the latter attached to the rocks by means of their byssus, or forming large beds, where the star-fish congregate to feed upon them. The Scallop (*Pecten Islandicus*) is also found in fair quantity, and by means of the dredge numerous and interesting forms are to be obtained.

Another Lamellibranch of economic as well as of scientific interest is the Teredo, or ship-worm, so injurious to timber.

Of Gastropoda, whelks (*Buccinum*) and Limpets (*Acmæa*), together with the so-called round-whelks (*Lunatia*) and the widely distributed *Littorina*, are among the forms more commonly met with.

Squid, of the genera *Loliago* and *Ommastrephes*, are frequently taken in the nets of the fisherman, and occasionally found along the shore.

A consideration of the fish and fisheries of this region, while of the highest scientific and economic interest, cannot be entered into here.

Since the publication in 1852 of Perley's Report of the Fisheries of New Brunswick, and of the "Descriptive Catalogue of the Fishes of Nova Scotia" by J. F. Knight (1866) much has been done upon this important subject, and the annual Report of the Commissioner of Fisheries contains much interesting and important information.

The good work done by the United States Fish Commission is a sufficient indication that money and energy expended on the scientific investigation of economic problems produce far-reaching and satisfactory results.

During the past summer investigations were undertaken at the Biological Station by a number of workers, representing the various Canadian Universities. Among them were:

The Director, Prof. Prince, Commissioner of Fisheries; Prof. Macallum, Prof. MacBride, Prof. Fowler, Dr. Knight; Dr. Stafford, Miss Ganong and Dr. Scott.

Among the problems which received the attention of these workers were: the anatomy, variation and parasites of fishes, the question of water contamination as affecting the fisheries, the chemistry and physiology of some Medusæ, together with observations on the flora of the vicinity.

That the scientific and industrial communities of Canada will profit by the establishment of the Marine Biological Station is beyond doubt, and we trust that another summer will see us well advanced in the pleasant and profitable work of investigation.

McGill Zoological Laboratory,
Jan. 10th, 1901.

A HORNBLENDE LAMPROPHYRE DYKE AT RICHMOND, P.Q.

By JOHN A. DRESSER, M.A.

A trap dyke of considerable interest was lately discovered by Mr. G. H. Pierce, C.E., in the lower Trenton limestones on the southern outskirts of the town of Richmond, P.Q. It can be seen near the highways a few yards south of the residence of Mr. Mills Wilcocks, having been brought to view somewhat recently by the erosive action of a small stream in the bed, or bank, of which it can be traced for some twenty rods.

It has a width of about three feet, and stands nearly vertically, running in a southeast-northwesterly course at an angle of 30° to 40° with the strike of the enclosing sedimentary rock. This, which is a dark, nearly black, graphitic limestone, belonging to what is known as the Farnham Black Slates (Ann. Rept. Geol. Survey of Canada, 1894, Part J, Dr. R. W. Ells) is not altered in any noteworthy manner at the contact; and while it has been folded and contorted to a remarkable degree, being within the folded belt of the Appalachian mountain system, the dyke shows no evidence of having been subjected to the same disturbing agencies. It has thus apparently been intruded not only later than the deposition of the lower Trenton sediments but after they had passed through the crumpling, folding and tilting which has given them their present altered character and position.

The dyke is a fine-grained holocrystalline rock, having a dark iron-gray color and weathering readily on exposure to a rusty brown. It is quite strongly magnetic, fragments as large as grains of rice adhering readily to a pocket horse-shoe magnet.

By the aid of the microscope the constituents of the rock are seen to be as follows:

I. Essential.—1. Primary—Hornblende.
Feldspar.
2. Secondary—Calcite.
Chlorite.
Serpentine (?)

II. Accessory.—1. Primary—{Magnetite.
Apatite.
2. Secondary—Leucoxene.

Hornblende is in very distinct idiomorphic crystals, often having a slender columnar form, and is the most prominent constituent of the rock. It is brown in color and pleochroic with $\mathfrak{b}$ nearly $= \mathfrak{c}$, the scheme of absorption being $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$. $\mathfrak{c}$ and $\mathfrak{b}$ = dark brown, and $\mathfrak{a}$, yellowish brown. The greatest angle of extinction that was measured, $c \wedge \mathfrak{c}, = 17°$. A number of smaller crystals are also present, but it is not definitely ascertained whether they represent a separate generation, *i.e.*, that they crystallized at a different period of the solidification of the rock from the larger hornblendes, or not.

Feldspar appears usually in lath-shaped or slender sections, which are generally unstriated by the polysynthetic twinning of plagioclase, though many are twinned once. Some extinguish nearly or quite parallel to the longer axes, others at angles as high as 80°. The feldspars often show an approach to a radial arrangement, and are less distinctly idiomorphic as well as less abundant than the hornblende.

Calcite, either alone or more frequently associated with other secondary minerals, forms numerous irregular masses in which crystals of feldspar are sometimes imbedded. After hornblende and feldspar it is the most abundant constituent. While presumably of secondary origin, no remnants of any mineral from which it has probably been derived have been found in it.

A greenish substance, nearly or quite isotropic, which is associated with calcite in places, and commonly forms pseudomorphs after hornblende, is regarded as chlorite. In association with calcite it occasionally shows aggregate polarization and sometimes has a more serpentine-like appearance, where it probably consists in part of that mineral.

The iron ore is in black angular grains, which have a metallic lustre and are all thought to be primary. Its general characters are those of magnetite, some of the larger grains containing cores of leucoxene, thus indicating its titaniferous nature.

Needles of apatite penetrate both feldspar and hornblende.

The rock thus belongs to the dark-colored trap dykes, or lamprophyres, and agrees most closely with the characters of Camptonite, of which it is a fairly typical specimen.

The known occurrences of Camptonite in eastern North America include Montreal and the shores of Lake Memphremagog in Canada, as well as several localities in the states of New Hampshire and Vermont, southern Maine and eastern New York.[1] The nearest of these, that at Lake Memphremagog, is about fifty miles south of the present occurrence.

Camptonite is commonly, though not invariably,[2] an accompaniment of highly alkaline rocks, such as nepheline syenites, no occurrence of which is known, however, nearer than Brome and Yamaska mountains, some fifty miles to the westward. From the presence of such dykes

1 "The Trap Dykes of the Lake Champlain Region," by J. F. Kemp and V. F. Marsters. Bull. U.S.G.S., No. 107. "Camptonites and other Intrusives at Lake Memphremagog," by V. F. Marsters. *Amer. Geologist*, July, 1895.

2 "Geology of the Castle Mountain Mining District." Weed and Pirsson. Bulletin U.S. Geol. Survey, No. 139, p. 111. The authors here cite Brögger's opinion, deduced from the study of the basic rocks of Gran, Norway (Q. J. G. Soc. London, Feb., 1894), that Camptonite is "not necessarily indicative of the presence of a definite type of granular plutonic rock as formerly supposed."

along the shores of Lake Champlain Prof. Kemp has pointed out the probable occurrence of an area of nepheline syenite in that region, which has not yet, however, been discovered, though amongst the many igneous rocks of these localities even a series of such a character may yet be found perhaps running along the western border of the Appalachian folding.

The other rocks of igneous origin in this vicinity are the well-known serpentines of the Eastern Townships, three miles to the south, which contain irruptive masses of hornblende granite, and are bordered on the south by a volcanic agglomerate, the matrix of which is an altered porphyrite. Both the first and second of these have been fully described by Dr. F. D. Adams.[1] Of the former, Dr. Adams says, "the alteration to serpentine was found to be complete, with the exception of a few irregular-shaped remnants which occur in one of them. . . . They are probably bastite or some allied mineral derived from the alteration of a rhombic pyroxene, which was a constituent of the rock from which the serpentine was derived."

The hornblende granite is described as "composed essentially of quartz, orthoclase, plagioclase and hornblende, with a little titanic iron ore. The hornblende, as is usual in granites, seldom has a good crystalline form. It is light green in color, strongly pleochroic, shows in many places the characteristic cleavage and often occurs twinned. It sometimes contains little pleochroic 'hofe' surrounding minute doubly refracting crystals. Its angle of extinction, as is often the case with the hornblende in granites, is large. The greatest angle measured was 24°, and this was in a section in the zone of the orthopinacoid and clinopinacoid, nearly but not quite coinciding with the latter plane. Many of these hornblende grains assume a fibrous form at their edge, but this is especially the case at the extremi-

1 "Notes on the Microscopic Structure of some Rocks of the Quebec Group," by F. D. Adams. Rep. Geol. Surv. Can., 1880-1-2, part A.

ties of the elongated patches in which it often occurs. The rock is no longer fresh. The feldspar, of which a very considerable portion is plagioclase, is a good deal decomposed, and the hornblende is altered in a very peculiar and hitherto unobserved manner. . . ."

It is a very frequent associate of the serpentines throughout the Eastern Townships, and is commonly believed by miners to be a necessary condition of the occurrence of the better class of asbestos deposits. It is enclosed in the serpentine, and from this fact, as well as its finer crystallization near the contact, is presumably intrusive through it, although the actual contact is generally concealed.

The porphyrite consists of a fine feldspathic base, containing phenocrysts of plagioclase and a few large individuals of epidote and chlorite, possibly representing primary hornblende. It, too, is considerably decomposed, and it contains veins and secondary aggregates of quartz, chlorite and epidote. No quartz, that is certainly primary, could be distinguished. The relations of this rock are not so easily determined as the last, yet are tolerably certain. It appears to have reached about the same degree of decomposition as the granite, but has suffered less dynamic metamorphism, and although the difference in the susceptibility of various rocks to metamorphic agencies prevents this fact from furnishing a safe clue to their relative ages, yet it cannot be entirely overlooked. The porphyrite also contains fragments of Cambrian slate which probably elsewhere overlies the serpentine, but this fact, again, is not yet clearly established. But a block, apparently of the same agglomerate which is found in Lot 13, Range XIII. of the township of Cleveland, nearly two miles north of the serpentine belt, contains fragments which are macroscopically indistinguishable from the hornblende granite just described. This evidence, which appears conclusive, is substantiated by the fact that the course of local glaciation has here been such as to convey a large number of serpentine boulders, whose character is unmistakable, for a distance of three or four miles north of the occurrence of that rock.[1] Accordingly the porphyrite may be regarded as the latest intrusion along the serpentine belt.

At a distance of a mile and a half north of the locality of the lamprophyre dyke described above, there is an interbedded sheet of amygdaloidal trap rock,[2] probably diabase. This is also highly altered in character, and, like the other rocks that have been mentioned, is apparently much older than the dyke. Whether it has any genetic connection either with the dyke or the igneous rocks to the south of it, it is impossible at present to say. The following order of age can, however, be ascertained for the other rocks of igneous origin:

1. The parent rock of the serpentine.
2. Hornblende granite, intrusive through the serpentine.
3. Porphyrite, which was intruded generally along the southern contact of the serpentine with the sedimentary slates, and with the fragments thus included forms an agglomerate.
4. The Camptonite dyke, which is much later in age, and, being a common associate of rocks of a different character, is only doubtfully connected with the others in origin.

1 Dr. R. W. Ells. Ann. Rept. Geol. Survey of Canada, 1894, p. 86 J.

2 *Ottawa Naturalist*, Jan., 1901.

Was Mount Royal an Active Volcano?

By J. S. Buchan, K.C.

Mount Royal is commonly described as the root or remnant of an old volcano, which has been worn down through long ages by the action of the elements, and its peak shorn by ice fields carried over it during the great subsidence of the Glacial Period, until it was reduced to its present comparatively small proportions.

Doubtless many have pictured in their own minds the Mountain in all its glory, in the far distant time when the struggling forces burst through the barriers which restrained them, and seem to see again a great mountain peak piercing the sky, with volumes of smoke and clouds of ashes thrown out and scattered over the surrounding country, while rivers of lava ran down its almost perpendicular sides. It may even be supposed that some have contemplated this picture with a sigh of regret, when they think what a magnificent advertisement the Volcano would be for Montreal, provided, of course, it was removed to a safe distance from the City.

Be that as it may, the question as to what was the height and magnitude of Mount Royal when it had reached its greatest proportions, and the conditions which then prevailed, possesses an intense interest, which the difficulties in the way of its solution only tend to increase.

At the outset, it must be admitted that the records containing the story of the Mountain have for the most part been swept away, and any conclusions based on those which remain are largely conjectural. It will, however, also be admitted that any attempt, however humble, to bring together the facts which bear on the subject, and to state such conclusions as may appear to flow from them, may have some value, even although it falls far short of meetiag the whole question.

In approaching the subject, there is great difficulty in arriving at a just appreciation of the conditions which prevailed in that immensely distant age before the mountain arose from the depths below. If we attempt to reason from the conditions of the present, we will find but little to assist, and much to mislead, and it is only when all the facts relating to the different conditions which have prevailed, and the changes and vicissitudes through which the earth has passed are brought together, and their relation to and bearing on each other are given due weight, that any correct idea of these things can be formed, and the possible history of the mountain in some measure understood.

Mount Royal is an intruded mass of trap, which has been forced upward through an opening or fracture in the lower Silurian strata by which the whole country in the neighborhood of Montreal was overlaid.

The first point to be noticed is that the limestone strata being pierced by the trap, it necessarily follows that the eruption must have occurred after it was laid down. This affords a means of approximately fixing the period at which the eruption occurred, or, at least, of knowing it could not have occurred until after a certain period had elapsed.

On the other hand, as we shall see, it must have taken place before the time of the Lower Helderberg group, which is the highest member of the Upper Silurian formation.

At various places, almost to the top of the mountain, fragments of the Lower Silurian strata are found, apparently in place, where they have been protected from erosion by the harder trap rock.

From this it would appear that the overlying strata have, to a great extent, been removed by denudation, that the general surface of the country is now much lower than it was at some former period, and its relation to the height of the mountain very different from what it is at present.

Since the earth became cooled and hardened, there has been a constant succession of changes in the position and location of the materials which formed its surface.

These have been disintegrated by the effect of the atmosphere, rain, frost, and other influences, and redistributed by the action of water, forming in this way beds and banks which eventually hardened into rocks, which enclose and preserve the various forms of life existing at the time they were deposited, the total mean thickness of the accessible part of these fossiliferous rocks in Europe being estimated by Geikie at 75,000 feet or about 14 miles, while single beds of limestone over 1,000 feet in thickness are described by Logan as occurring in the Laurentians, and the total thickness of the latter formation has been placed at 30,000 feet, or over 5½ miles.

Bearing in mind the tremendous scale on which these operations of nature have been carried on, the fact will be easily realized that there might have been a thickness of several hundred feet of strata above that of the present level, and that it might even have stood much higher than the summit of the mountain as it appears to-day.

The facts which have so far been ascertained would seem to justify the opinion that this was the case. Logan estimates the thickness of the Trenton with the Black River and Birdseye formations at Montreal at 650 or 700 feet, and the Chazy at 150 feet, while the total thickness of the Hudson River formation, the highest member of the Lower Silurian, is placed at 2,000 feet, of which the Utica formation would amount to about 300 feet, although in places the thickness of the latter was much greater, a boring at Laprairie showing a depth of over 1,000 feet.

It is needless to say that no absolutely certain measurements of the highest level of the Silurian strata can be based on these estimates, but they at least show the possibility of its being much higher than the 744 feet above the level of the St. Lawrence, which is the present highest point of the mountain.

There is, however, corroborative evidence in the nature of the trap of Mount Royal itself, and in this respect the same rule is found to apply, to some extent at least, to the other intrusive masses belonging to the same series, namely, Yamaska, Rougemont, Belœil, Montarville and Rigaud. The structure of the mass in all these cases is highly compact, and crystalline, which would indicate that they were ejected and consolidated under great pressure. Some of them reach a height of more than 1,000 feet above the plain, and their summits appear equally solid and crystalline with their bases. Reasoning from these facts, it would appear that the level of the Lower Silurian strata must in all probability have reached a point far above the present summit of Mount Royal.

If this assumption is correct, there would be at the close of the period in which the Hudson River formation, including the Utica and Trenton, was laid down, a great plain, with few inequalities, and covered with solid rock, extending from the Laurentian to the Adirondack Mountains.

An interesting question arises here as to the date or distance of time when the eruption took place. Any estimate which may be made of this date must of necessity be largely a mere deduction from certain supposed premises, both of which may be altogether mistaken. Various attempts, however, for the most part widely divergent, have been made to fix the date, some of which have been placed at over 100,000,000 years. Among others, Lord Kelvin, better known as Sir William Thomson, whose opinion is perhaps of as much value as that of any one, has estimated the whole duration of the earth at 20,000,000 years.

Of this he apportions 5,000,000 for the Azoic or Archæan, the same period to the Eozoic, and 6,000,000 to the Palæozoic, including the carboniferous or coal period.

If the Hudson River formation was completed about the middle of this period of 6,000,000 years, which other circumstances would render probable, it would place the eruption as having occurred about 7,000,000 years ago, but, as already stated, this, as well as any other date which might be named, is altogether conjectural, and may be very far from the fact.

What were the conditions under which the various formations up to the Hudson River were deposited? Probably a shallow sea, with a slow but quiet and continuous subsidence of the land, followed at the end of this period by a contrary movement, which was continued until it stood at possibly a higher level than at present.

As a possible consequence of this movement of elevation, the great fracture or line of disturbance, which, according to Sir William Logan, has been traced for a distance of 180 miles, from the Hills of Brome and Shefford to the Lac des Chats, on the Ottawa River, and which is marked by the Mountains of Brome, Shefford, Yamaska, Rougemont, Belœil, Montarville, Mount Royal and Rigaud, while Mount Johnson or Monnoir, situated to the south of Belœil, apparently belongs to the same series, although out of the range of those first mentioned.

Along the line of this fracture or disturbance, at various places where the overlying strata had been weakened or forced apart, liquid or viscid matter was forced upwards until the cavity in the strata was completely filled, in some places, as in the quarry on Côte des Neiges Hill, tilting up and curving the limestone strata and leaving it lying at an angle against the intruded mass. Where the fracture reached the surface, the lava, if the eruption was without violence, would flow out over the surrounding country, forming sheets or floors, as in the Indian Deccan, where an extent of country estimated at 200,000 square miles is covered with nearly horizontal sheets of lava to a depth of 4,000 or 5,000 feet. If accompanied by explosions or great force, the molten matter, with ashes and stones, would be thrown out, and a cone built up out of the ejected materials.

If, on the contrary, the fracture did not extend to the surface, the molten matter would be forced upwards as into a mould, where it would be cooled and consolidated into a mass, the shape of the cavity which contained it. If, then, in course of time, the overlying crust under which it cooled should be removed, the intrusive mass, being harder than the surrounding rock, would remain and stand out as a hill or " Boss " of trap.

There is reason for the opinion that Mount Royal belongs to the latter class. Had the ordinary volcanic phenomena been present, the resulting cone or sheets of lava might have protected the softer limestone strata from erosion, as is the case at various points on the mountain where the limestone was overlaid by the trap, and thus preserved the mountain from it, to some extent at least; but the strongest reason for this opinion is found in the fact that the trap of which the mountain is composed presents, as already noticed, the compact and highly crystalline structure, which it could scarcely have shown had it not been consolidated under great pressure.

Assuming this view to be correct, the eruption or ejection of the trap which now constitutes the mountain might have been accompanied by no external phenomena, unless it were by earthquakes of a more or less violent character, according to the nature of the disturbances, which were probably of frequent occurrence, since the principal mass of the mountain is composed of two distinct and different materials ejected at different periods, while a succession of trap dykes and floors extending for great distances from the mountain, and, in the case of the dykes, frequently cutting each other, show that the activity was successive and long continued, although proceeding far below the surface of the country.

But while the mountain was thus being formed in the depths beneath, a different process was going on at the surface. The comparatively soft sedimentary rock was being dissolved and eroded by the action of the elements, until in course of time the limestone had been removed to nearly its present level, and the great mass of lava, being hard enough to resist the action which dissolved the limestone, stood out as a mountain possibly of much greater height than at present.

This process of denudation must have continued for a long period to have removed the great thickness of strata which probably existed, and it might possibly have begun about the middle of the period of 6,000,000 years already referred to.

Following this erosion came a subsidence of the land, during which the conglomerate of the Lower Helderberg group was laid down, of which St. Helen's Island and Round Island, with the exception of a few scattered outlying patches, present the only examples in the neighborhood of Montreal.

This formation, according to Logan, "Geology of Canada," pp. 669, 358, rests unconformably on the Lower Silurian strata, and is cut by dykes of dolorite, which show that the volcanic activity had not ceased even at that period. This formation found on St. Helen's and Round Islands presents a most difficult question for solution. The conglomerate is composed of fragments, sometimes rounded, but for the most part angular, of Laurentian gneiss, white sandstone, Trenton limestone, black and red shales, and red sandstone, besides fragments of igneous rocks, the whole cemented together by a paste of gray dolomite, covering the island, and rising into a hill, the greatest height of which is about 125 feet above the river.

How such a mass of different materials became collected together, whether it is in the nature of a Moraine formation or fragments carried by fields of ice from different localities and deposited in an eddy of the glacial sea of some possible Silurian Ice Age, is a question of the greatest difficulty, and perhaps somewhat beyond the scope of the present enquiry; but as it is the opinion of some observers that the dolomite paste which binds the conglomerate together contains volcanic ash, if this view is correct, it is not impossible that there may have been at this point something more of volcanic activity than on the mountain itself, which, at the time the conglomerate was deposited, was, as the land subsided, a small island, then completely covered with water, and afterwards, doubtless during the Pleistocene period, worn down to its present height by the great icefields floating on the surface of the glacial ocean. Then, as the elevation of the land continued, at the close of this period it would again become an island, its cliffs broken and worn by the waves, which piled up beaches of pebble and shingle around its sides until at length the land arose above the water, and the mountain stood out, presenting much the same appearance as it does at the present time.

Such in outline is the possible history of Mount Royal, if this view is well founded; but while the weight of evidence appears to support it, the fact must always remain that, with our limited information, the opposite view, which holds that the mountain has at some period been an active volcano, may be the true one.

There may, however, be in the former opinion something reassuring to timid citizens, who are perhaps disturbed by the ancient prophecy which declared that the old volcano would yet awaken from its sleep and destroy the city, since, if it never has been an active volcano, there should be less probability of its becoming one in the future.

ADDENDA AND CORRIGENDUM TO "PROGRESS OF GEOLOGICAL WORK IN CANADA DURING 1899."[1]

By H. M. AMI, M.A., D.Sc., F.G.S.,
(Of the Geological Survey of Canada, Ottawa).

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PALÆONTOLOGICAL NOTE.

"ON CYPHORNIS, AN EXTINCT GENUS OF BIRDS." By E. D. COPE. *Journal Academy Natural Sciences*, Philadelphia, Vol. IX., pp. 449-452, Pl. XXI., figs. 11-16 ; 1894.

Among the recent additions to our knowledge of the extinct vertebrata of Canada, Prof. E. D. Cope contributes an interesting article in the *Journal of the Academy of Natural Sciences*, Philadelphia. The paper is based on a specimen collected by Dr. George M. Dawson from the Tertiary shales of the west coast of Vancouver Island, and belongs to the Geological Survey of Canada. The bone was sent by Capt. Jacques, of Victoria, B.C., to Dr. G. M. Dawson, and was obtained at Carmanagh Point, Vancouver Island. The specimen is carefully described by Prof. Cope on pages 449 *et seq.*, and consists of the "superior part of a tarsometatarse" belonging to a new genus of bird. It was a singular but rather fortunate occurrence that this portion of the skeleton was preserved, inasmuch as the "tarsometatarse is perhaps the most characteristic part of the skeleton of a bird." Prof. Cope finds that this extinct species of birds, which used to inhabit our western coast in Tertiary times, and to which he has given the generic designation of *Cyphornis*, bears greater resemblance to the Steganopodes or Pelicans than to any other family. "The anterior aspect of the bone," Cope says (*loc. sit.*, p. 451), "is almost exactly like that of *Pelecanus*," but the "posterior aspect resembles that of none of the order, in the absence of the tendinous grooves." When compared with Cretaceous birds, Cope finds but *one* "point of resemblance," and that to the extinct form *Hesperornis*, in "the ridge-like elevation of the anterior part of the external tibial facet, which is in both genera connected with the intercondylar tuberosity." The affinities of this bird, Prof. Cope holds, are more clearly with the "*Steganopodes*," but they have combined with these certain affinities to "more primitive birds with a simple hypotarsal structure." CYPHORNIS MAGNUS, Cope, is the name ascribed to this extinct bird from Canada, which inhabited our western shores in Tertiary times. "As regards its habits, it may be said that the pneumatic character of its foot bone renders it improbable that it depended on this member for habitual locomotion on land. In all the birds of terrestrial habit which I have examined, and of which I can give information, the tarsometatarse is either filled with cancellous tissue, dense or open, or the walls of the shaft are thick, as in the Emeu. The presumed affinity with the Steganopodes indicates natatory habits and probable capacity for flight. Should this power have been developed in *Cyphornis magnus*, it will have been much the largest bird of flight thus far known." On plate XX. of this *livraison* Cope figures six views of the tarsometatarse in question, and in the text expresses the hope that new and additional material will be forthcoming from which to describe more fully the present imperfectly known but interesting species.

Regarding the precise geological horizon to which to refer the species, Prof. Cope writes :—"The characters of *Cyphornis* indicate that the bed from which it was obtained is not older than Eocene nor later than Oligocene."

H. M. AMI.

Book Notices.

The increasing interest taken in the study of Astronomy has induced the proprietors of *Knowledge* to issue an annual for students and workers in that science specially devoted to their requirements. It is entitled "Knowledge Diary and Scientific Handbook, 1901," and will contain, amongst other things, useful tables, original articles, calendar of scientific events, and a blank diary portion.

Botany: An Elementary Text-Book, by L. H. Bailey. 12mo. Half leather. 500 illustrations. Pages xiv + 355. The MacMillan Company. New York. Price $1.10.

The amount of literature relating to the study of plants which has appeared during the last five years is truly astonishing. For a quarter of a century or more Gray's Lessons with plants was the standard, in fact the dominant class-room botany. About the time his "New Manual" was published in 1887, other books presenting the study of botany in quite a different manner appeared. Since that time, each year has marked divergences of opinion among botanists regarding teaching methods.

Gray's Lessons did not take up the subject from the present-day view point of botanical science. It is a question with many whether the botanical science standpoint is best for the pupil—the average pupil. There are many text-books for the student of botany. The admirable works of Coulter, Barnes, Atkinson and Ganong are written for the college student. There are few text-books for the pupil. In the present-day botany, individuals of the plant kingdom illustrating its lowest and simplest forms are studied first. More complete forms are examined in natural order and regular sequence. This is the logical; it is the scientific method, the one approved by those versed in pedagogy.

Bailey's botany "is made for the pupil"—so its author announces. "There are four general subjects in the book: The nature of the plant itself; the relation of the plant to its surroundings; histological studies; determination of the kinds of plants." The author's position on the teaching of botany in the secondary school has no doubt been much influenced by his intimate association with the nature study movement in New York, which in itself has been a great training school. It is as follows: "In the secondary schools, botany should be taught for the purpose of bringing the pupil closer to the things with which he lives, of widening his horizon, of intensifying his hold on life. It should begin with familiar plant forms and phenomena. It should be related to the experiences of the daily life. It should not be taught for the purpose of making the pupil a specialist; that effort should be retained for the few who develop a taste for special knowledge. It is often said that the high-school pupil should begin the study of botany with the lowest and simplest forms of life. This is wrong. The microscope is not an introduction to nature. It is said that the physiology of plants can be best understood by beginning with the lower forms. This may be true ; but technical plant physiology is not a subject for the beginner. Other subjects are more important. . . Good botanical teaching for the young is replete with human interest. It is connected with the common associations. . . When beginning to teach plants, think more of the pupil than of botany. The pupil's mind and sympathies are to be expanded: the science of botany is not to be extended. The teacher who thinks first of his subject teaches science ; he who thinks first of his pupil teaches nature-study. . . The old way of teaching botany was to teach the forms and the names of plants. It is now proposed that only function be taught. But one cannot study function intelligently without some knowledge of plant forms and names. He must know the language of the subject. The study of form and function should go together. Correlate what a plant is with what it does. What is this plant? What is its office, or how did it come to be? It were a pity to teach phyllotaxy without teaching light-relation: it were an equal pity to teach light-relation without teaching phyllotaxy."

Of the book itself there is little need to speak. The subject-matter is excellently edited ; the illustrations are elaborately profuse—perhaps unnecessarily so—mostly half-tones ; the paper and binding are of the best. It is an exceedingly attractive volume ; not a dull page between its handsome covers.

We shall watch the success of this book, which in a measure is a reversion to former botanical teaching ideals, with a great deal of interest. There is unquestionably a tendency on the part of the advanced teacher of botany to cater to the specialist in scientific botany rather than the student who wishes to study plants. I think this book has a distinct mission and will find a large constituency awaiting it.

JOHN CRAIG.

Ithaca, N.Y.

ABSTRACT FOR THE MONTH OF JULY, 1900.

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 relative humidity.	a WIND. General direction.	Mean velocity in miles per hour	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	57.19	66.7	48.8	17.9	29.93	30.04	29.76	.28	74	W.	27.0	76	....	....	....	1 ....SUNDAY
2	63.22	72.9	51.0	21.9	30.10	30.14	30.02	.12	74	S W.	14 6	93	...	....	....	2
3	61.27	64.7	52.8	11.9	29.89	30.11	29.70	.41	92	S.E.	13.7	00	0.42	....	0.42	3
4	69.87	78.5	63.5	15.9	29.91	29.99	29.78	.21	79	W.	13.5	63	....	....	....	4
5	62.55	68.6	56.3	12.3	30.02	30.09	29.94	.15	76	W.	9.3	21	....	....	....	5
6	60.45	62.4	58.2	4.2	29.83	29.94	29.73	.21	96	E.	7.4	00	0.39	...	0.39	6
7	73.65	87.0	57.2	29.8	29.60	29.73	29.52	.21	74	S.W.	17.6	80	0.11	....	0.11	7
SUNDAY........ 8	69.96	78.7	65.3	13.4	29.41	29 52	29.34	.18	94	S.W.	19.6	25	0.77	....	0.77	8..........SUNDAY
9	62.07	66.4	60 7	5.7	29.53	29.61	29.39	.22	91	S.W.	18.2	04	0.03	....	0.03	9
10	65.40	72.8	59.5	13.3	29.79	29.92	29.61	.31	75	S.W.	18.0	74	....	....	....	10
11	65.66	74 8	59.9	14.9	29.93	30.01	29.84	.17	86	S.	15.0	21	0.86	....	0.86	11
12	60.18	71 3	60.8	10.5	29.84	29.90	29.80	.10	70	S.W.	18.4	54	0.00	....	0.00	12
13	65.80	74.8	61.2	13.6	29.75	29 81	29.71	.10	83	S.W.	16.5	41	0.03	.. .	0.03	13
14	69.19	80.0	60.0	20.0	29.85	29.89	29.78	.11	60	W.	16.7	84	0.05	....	0.05	14
SUNDAY....... 15	71.87	80.3	66.0	14.3	29.86	29.89	29.83	.06	78	S.W.	18.0	59	...	....	....	15......... .SUNDAY
16	73.27	78.5	69.2	9.3	29.84	29.88	29.80	.08	91	S.W.	16.4	18	1.00	....	1.00	16
17	68.67	75.4	65.7	9.7	29.82	29.84	29.81	.03	94	N.	15 7	32	1.76	....	1.76	17
18	70.74	75.5	66.4	9.1	29.83	29.94	29.76	.18	73	S.W.	21.4	68	0 00	....	0.00	18
19	71.05	79.6	62.5	17.1	29.96	29 99	29.92	.07	67	W.	15.0	99	....	....	....	19
20	69.44	80.0	59.5	20.5	29.93	29.99	29.86	.13	79	S.	9.6	37	0.07	....	0.07	20
21	71.62	81.0	66.0	15.0	29.89	30.06	29.81	.25	80	S.W.	18.4	42	0.00	....	0.00	21
SUNDAY........22	71 82	80.7	60.0	20.7	30.12	30.16	30.06	.10	69	S.W.	13.4	98	....	....	....	22 ....SUNDAY
23	73.20	81.3	63.4	18.9	30.05	30.09	29.99	.10	70	S W.	16.6	96	....	....	....	23
24	72.77	80.2	67.8	12.4	29.91	29.99	29 82	.17	80	S.W.	14.8	25	0.20	...	0.20	24
25	67.15	70.6	64.8	5.8	29.77	29.83	29.72	.11	93	N.W.	5.9	00	1.34	....	1.34	25
26	66.98	74.1	59.2	14.9	29.90	29.96	29.82	.14	68	N.W.	9.8	90	....	....	....	26
27	65.53	72.9	58.4	14.5	30.04	30.08	29.96	.12	65	W.	11.7	95	....	....	....	27
28	68.84	77.0	59.2	17.8	30.05	30.09	30.02	07	73	S.W.	18.0	90	....	....	....	28
SUNDAY....... 29	73 29	84.4	60.0	24.4	29.94	30.03	29.84	.19	72	S.	11.2	91	0 06	....	0.06	29..........SUNDAY
30	68.41	73.8	62.3	11.5	29.87	29.92	29.84	.08	86	S.	14.3	05	0.25	....	0.25	30
31	69 53	79.0	60.1	18.9	29.82	29 90	29.75	.15	77	S.W.	15.0	46	0.07	....	0.07	31
Means......	67.76	75.64	60.83	14.81	29.870	29.946	29 791	.155	78.7	W. 39.7° S.	15 19	52.4	7.41	....	7.41	...............Sums.
26 Years means for and including this month	68.84	77.31	60.76	16.55	29.897	......	......	.142	71.84	....	§ 13 06	¶59.21	4.252	....	4.252	26 Years means for and including this month.

a ANALYSIS OF WIND RECORD.

Direction......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	301	148	110	535	1743	5139	2943	380	
Duration in hrs..	27	17	15	43	136	290	183	33	
Mean velocity....	11.1	8.7	7.3	12.4	12.8	17.7	16.1	11.5	

Greatest mileage in one hour was 32 from the southwest on the 18th.

Greatest velocity in gusts was 52 miles per hour on the 11th from the southwest.

Resultant mileage, 8320.
Resultant direction, W. 39.7° S.
Total mileage, 11,298.
Average velocity—, 15.19 miles per hour.

a Wind velocity on the 2nd, 3rd, 13th, 16th, 17th and 19th, reduced from City Hall Anemometer.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15, and 20 hours.

¶ 19 years only. § 14 years only.

The greatest heat was 87.0 on the 7th; the greatest cold was 48.8 on the 1st, giving a range of temperature of 38.2 degrees.

Warmest day was the 7th. Coldest day was the 1st. Highest barometer reading was 30.16 on the 22nd. Lowest barometer was 29.34 on the 8th, giving range of .82 inches.

Minimum relative humidity observed was 43 on the 14th.

Rain fell on 19 days.

Fog on 2 days.

Thunderstorms on 5 days—the 8th, 11th, 24th 25th and 29th.

ABSTRACT FOR THE MONTH OF AUGUST, 1900.

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

DAY	THERMOMETER.				*BAROMETER.				‡Mean relative humidity.	⁂ WIND.		Per cent. 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 per hour					
1	62.75	69.2	55.0	14.2	30.01	30.04	29.85	.19	70	N.W.	11.2	92	0.00	....	0.00	1
2	61.31	75.5	55.0	20.5	29.94	30.04	29.87	.17	81	S.W.	14.6	53	0.42	....	0.42	2
3	56.90	63.5	50 0	13.5	30.10	30.20	29.93	.27	76	W.	10.9	13	....	....	....	3
4	62.48	70.4	53.9	16.5	30.25	30.29	30.20	.09	75	N.W.	6.9	76	....	....	....	4
SUNDAY.... 5	66.01	78.0	53.7	24.3	30.16	30.25	30.04	.21	85	S.	10.7	38	0.04	....	0.04	5 ......SUNDAY
6	69.63	79.4	63.9	15.5	30.04	30.07	29.98	.09	91	N.	6.0	00	0.60	....	0.60	6
7	65 75	67.9	63.9	4.0	30.08	30.12	30.05	.07	94	N.	7.9	23	0.34	....	0.34	7
8	73.06	81 0	66.0	15.0	29 93	30.05	29.84	21	92	S.W.	9.9	15	0.75	....	0.75	8
9	77.58	85.5	72.0	13.5	29.93	29 97	29.88	.09	81	W.	12.6	86	....	....	....	9
10	75.40	82.0	69.8	12.2	29.81	29.91	29.74	.17	89	W.	15.0	26	0.45	....	0.45	10
11	74.67	83.7	59.2	24.5	29.74	29.91	29.70	.21	82	W.	20.3	53	0.12	....	0.12	11
SUNDAY........12	59.32	66.8	49.5	17.3	30.04	30.08	29.91	.17	60	N.W.	12.7	83	....	....	....	12..........SUNDAY
13	59.62	68.2	53.0	15.2	30.01	30 07	29.94	.13	86	N.E.	13.0	39	0.29	....	0.29	13
14	60.58	66.5	56.4	10.1	29.97	30.00	29.93	.07	88	S.E.	7.0	00	0.01	....	0.01	14
15	69.28	79.1	60.0	19.1	29.96	29.98	29 93	.05	80	S.	12.6	79	00.3	....	0.03	15
16	73.22	82.3	65.9	16.4	29.89	29.93	29.84	.09	73	S.W.	13.2	64	....	....	....	16
17	69.27	76.0	63.7	12.3	30 01	30.05	29.91	.14	55	W.	14 1	89	....	....	....	17
18	66.43	76.5	58.1	18.4	30.03	30.06	29.98	.08	75	N.W.	8.9	59	0.02	....	0.02	18
SUNDAY........19	61.74	69.7	54.0	15.7	30.10	30.12	30.04	.08	70	N.W.	9.8	79	....	....	....	19..........SUNDAY
20	61.32	67.0	53.0	14.0	30.06	30.11	30.01	.10	75	N.	11.0	71	....	....	....	20
21	59.60	68.3	49.7	18.6	29.98	30.04	29.91	.13	71	N.	8.6	88	....	....	....	21
22	65.75	74.0	60.2	13.8	29.93	29.97	29.90	.07	81	W.	9.8	54	0.07	....	0.07	22
23	65.06	74.0	55.9	18.1	29.98	30.03	29.93	.10	73	S.E.	8.1	81	....	....	....	23
24	71.26	80.4	61.7	18.7	29.86	29.93	29.82	.11	79	S.E.	12.7	58	....	...	....	24
25	76.85	86.1	68.9	17.2	29.91	29.96	29.85	.11	75	S.	13.0	64	....	....	....	25
SUNDAY........26	79.32	87.9	73.0	14.9	29.93	29.97	29.90	.07	71	S.W.	16.1	87	....	....	....	26..........SUNDAY
27	78.05	84.4	72.5	11.9	29.94	30.00	29.89	.11	64	W.	10.0	80	....	....	....	27
28	70.60	79.5	62.7	16.8	29.97	30.00	29.93	.07	72	N.	7.5	86	....	....	....	28
29	73 28	84.6	61.5	23.1	29.95	29.99	29.92	.07	69	S.	11.1	84	....	....	....	29
30	70.72	78.8	65.0	13.8	30.06	30.13	29.94	.19	66	N.W.	9.2	87	....	....	....	30
31	65.37	71.8	60.1	11.7	30.22	30.28	30.13	.15	69	N.	10.0	73	....	....	....	31
Means............	67.81	76.06	60.23	15.83	29.993	30.050	29 925	.125	76.4	West.	11.10	60.4	3.14	....	1.14	..............Sums.
26 Years means for and including this month	66.76	75.07	58.82	16.25	29.940	....	......	.133	* 73.40	....	§ 12.29	¶58.26	3.50	....	3.50	26 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	1205	422	307	457	1449	786	2458	1177	
Duration in hrs..	123	53	37	39	135	61	187	109	
Mean velocity....	9.8	7.9	8.3	11.7	10.7	12.9	13.2	10.7	

Greatest mileage in one hour was 31 from the west on the 11th.

Greatest velocity in gusts was 32 miles per hour from the west on the 11th.

Resultant mileage, 2,924.

Resultant direction, West.

Total mileage, 8,261.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15, and 20 hours.

¶ 19 years only. § 14 years only.

The greatest heat was 87.9 on the 26th; the greatest cold was 49.5 on the 12th, giving a range of temperature of 38.4 degrees.

Warmest day was the 26th. Coldest day was the 3rd. Highest barometer reading was 30.29 on the 3rd. Lowest barometer was 29.70 on the 11th, giving range of .59 inches.

Minimum relative humidity observed was 46 on the 17th.

Rain fell on 13 days.

Lunar halo on the 12th.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1900.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	64.77	75.0	54.0	21.0	30.31	30.37	30.26	.11	71	E.	9.4	89	...	....	....	1
SUNDAY...... 2	72.09	83.9	58.5	25.4	30.17	30.27	30.03	.24	77	S.E.	13.6	87	....	....	....	2..........SUNDAY
3	75.51	89.0	68.5	20.5	29.95	30.03	29.87	.16	71	S.	20.4	79	0.01	....	0.01	3
4	70.26	76.7	63.0	13.7	30.15	30.20	29.96	.24	78	S.W.	11.7	91	....	....	....	4
5	70.25	78.0	62.5	15.5	30.08	30.20	29.92	.28	87	S.W.	15.7	73	....	....	....	5
6	69.92	82.0	63.0	19.0	29.79	29.92	29.71	.21	93	S.W.	19.7	43	0.41	...	0.41	6
7	56.18	62.1	48.3	13.8	30.15	30.22	29.92	.30	79	N.W.	11.6	96	....	...	....	7
8	59 77	70.0	47.5	22.5	30.12	30.21	30.05	.16	85	S.W.	11.7	50	....	....	....	8
SUNDAY........ 9	62.94	68.1	59.0	9.1	30.12	30.18	30.06	.12	81	N.	12.4	78	....	....	....	9..........SUNDAY
10	55.26	62.2	48.6	13.6	30.20	30.26	30.15	.11	89	N.	6.7	17	0.00	....	0.00	10
11	54.46	56.3	51.8	4.5	29.86	30.15	29.54	.61	99	N.E.	7.1	00	0.31	....	0.31	11
12	60.74	68.1	54.0	14.1	29.42	29.80	29.05	.75	91	W.	25.0	10	0.47	....	0.47	12
13	54.65	59.2	51.5	7.7	29.87	29.93	29.80	.13	91	S.	11.4	32	....	...	....	13
14	58.83	66.1	53.7	12.4	29.99	30.16	29.85	.31	82	W.	18.3	94	....	....	....	14
15	53.36	59.3	46.1	13.2	30.13	30.25	29.94	.31	86	N.	10.2	88	...	....	....	15
SUNDAY........16	57.63	61.5	52.9	8.6	29.70	29.94	29.58	.36	98	E.	15.7	00	0.68	....	0.68	16..........SUNDAY
17	57.26	62.5	51.4	11.1	29.69	29.77	29.59	.18	94	W.	18.5	14	0.07	....	0.07	17
18	51.73	57.9	46.1	11.8	30.03	30.23	29.77	.46	85	N.W.	17.4	96	....	....	....	18
19	49.31	57.8	39.8	18.0	30.29	30.37	30.23	.14	88	S.E.	7.1	87	....	....	....	19
20	52.95	57.8	46.1	11.7	30.07	30.25	29.97	.28	95	S.E.	17.3	co	0.17	....	0.17	20
21	60.52	68.0	55.9	12.1	29.88	29.97	29.83	.14	95	S.E.	11.0	40	0.09	....	0.09	21
22	57.30	64.6	54.2	10.4	29.88	29.90	29.87	.03	91	W.	11.9	39	0.18	....	0.18	22
SUNDAY........23	58.08	63.5	53.6	9.9	29.91	29.95	29.88	.07	91	N.W.	9.0	38	....	....	....	23..........SUNDAY
24	62.11	71.2	54.1	17.1	30.09	30.21	29.95	.26	81	N.W.	14.0	88	....	...	....	24
25	57.70	66.2	49.1	17.1	30.24	30.30	30.20	.10	87	N.E.	10.5	54	....	....	....	25
26	67.73	76.7	58.3	18.4	30.07	30.20	29.95	.25	91	S.E.	12.3	61	....	....	....	26
27	63.91	72.9	54.5	18.4	30.04	30.16	29.92	.24	93	N.E.	10.5	06	....	....	....	27
28	53.43	58.7	48.4	10.3	30.25	30.30	30.16	.14	87	N.	13.2	73	....	....		28
29	54.86	61.2	46.0	15.2	30.02	30.25	29.89	.36	96	S.E.	11.1	00	1.23	....	1.23	29
UNDAY........30	54.65	58.7	50.5	8.2	30.16	30.26	29.95	.31	91	W.	4.3	00	....	....	....	30..........SUNDAY
Means............	59.94	67.17	53.03	14.14	30.021	30.140	29.895	.245	87.4	W. 35 .4° S.	12 97	51.0	3.62	....	3.62	..............Sums.
26 Years means for and including this month	58.46	66.50	50.78	15.72	30.015	....	......	.184	76.19	....	§ 12.88	¶53.57	3.27	....	3.27	26 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	1227	160	757	1626	1015	1579	1636	1335	
Duration in hrs..	135	22	72	118	65	97	120	89	
Mean velocity....	9.1	7.3	10.5	13.8	15.6	16.3	13.6	15.0	

Greatest mileage in one hour was 43 from the west on the 12th.

Greatest velocity in gusts was 48 miles per hour from the west, at 3.30 p.m. on the 3rd, and 11.40 a.m. on the 12th.

Resultant mileage, 2460.

Resultant direction, W. 35 .4° S.

Total mileage, 9,335.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15, and 20 hours.

¶ 19 years only. § 14 years only.

The greatest heat was 89.0 on the 3rd; the greatest cold was 46.0 on the 29th, giving a range of temperature of 43.0 degrees.

Warmest day was the 3rd. Coldest day was the 19th. Highest barometer reading was 30.37 on the 1st and 19th. Lowest barometer was 29.05 on the 12th, giving range of 1.32 inches.

Minimum relative humidity observed was 57 on the 1st.

Rain fell on 11 days.

Lunar halos on the 10th and 11th.

Fog on 3 days.

Thunder on the 3rd, 6th and 16th.

ABSTRACT FOR THE MONTH OF OCTOBER, 1900.

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

DAY	THERMOMETER. † Mean.	THERMOMETER. Max.	THERMOMETER. Min.	THERMOMETER. Range.	*BAROMETER. † Mean.	*BAROMETER. Max.	*BAROMETER. Min.	*BAROMETER. Range.	‡Mean relative humidity.	WIND. General direction.	WIND. Mean velocity in miles per hour	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	54.67	63.3	46.5	16.8	30.38	30.43	30.26	.17	93	W.	4.3	66	....	....	....	1
2	59.72	69.6	51.0	18.6	30.44	30.49	30.40	.09	90	S.W.	11.1	69	....	....	....	2
3	63.25	71.0	57.5	13.5	30.31	30.40	30.24	.16	92	S.	11.9	29	....	....	....	3
4	66.50	75.7	58.3	17.4	30.12	30.24	30.02	.22	90	S.W.	15.3	33	0.00	....	0.00	4
5	59.92	75.0	48.9	26.1	30.00	30.08	29.94	.14	97	S.W.	14.8	38	0.02	....	0.02	5
6	51.92	55.0	47.7	7.3	30.16	30.19	30.08	.11	95	W.	14.9	00	0.02	...	0.02	6
SUNDAY...... 7	63.05	71.0	52.1	18.9	30.02	30.19	29.89	.30	89	S.	20.6	64	....	....	....	7..........SUNDAY
8	55 87	66.0	47.0	19.0	30.06	30.26	29.90	.36	99	S.	12.4	00	0.98	....	0.98	8
9	44.37	48.5	39.0	9.5	30.30	30.33	30.26	.07	85	S.W.	10.6	28	....	....	....	9
10	44.43	50.7	36.1	14.6	30.18	30.29	30.08	.21	82	W.	13.1	37	....	....	....	10
11	52.34	59.0	40.3	18.7	29.96	30.08	29.88	.20	77	W.	14.4	91	....	....	....	11
12	58.07	64.6	50.9	13.7	29.94	30.01	29.88	.13	82	S.	20.7	95	....	....	....	12
13	57.92	66.2	48.0	18.2	30.11	30.15	30.01	.14	87	S.W.	9.5	67	....	.. .	....	13
SUNDAY........14	54.33	59.5	49.2	10.3	30.06	30.12	30.02	.10	94	S.	9.7	00	....	....	....	14..........SUNDAY
15	57.92	63.1	52.7	10.4	29.96	30.06	29.73	.33	79	S.W.	15.3	97	....	....	....	15
16*	47.64	63.5	34.3	29.2	29.82	30.08	29.61	.47	83	W.	25.0	26	0.23	0.0	0.23	16
17	38.06	43.5	30.0	13.5	30.13	30.26	29.93	.33	69	S.W.	20 5	88	....	....	....	17
18	47.36	57.5	39.5	18.0	29.85	30.02	29.76	.26	79	S.W.	23.9	55	0.00	....	0.00	18
19	34.57	38.2	30.5	7.7	30.20	30.27	30.02	.25	76	N.W.	12.1	87	....	....	....	19
20	39.55	48.1	30.3	17.8	30.22	30.30	30.14	.16	75	S.W.	12.4	88	....	....	....	20
SUNDAY........21	47.06	55.0	35.0	20.0	30.08	30.14	30.03	.11	83	S.W.	22.5	46	....	....	....	21..........SUNDAY
22	59.54	68.0	47.0	21.0	30.07	30.13	30.03	.10	81	S.W.	21.7	65	....	....	....	22
23	63.67	72.4	57.8	14.6	30.10	30.16	30.03	.13	91	S.E.	15.3	35	0.84	....	0.84	23
24	60.66	66.2	49.5	16.7	30.23	30.49	30.03	.46	83	S.W.	17.5	55	0.00	...	0.00	24
25	47.70	54.6	40.0	14.6	30.50	30.59	30.41	.18	84	N.	12.0	93	....	....	....	25
26	53.78	60.8	46.0	14.8	30.23	30.41	30.13	.28	87	S.E.	14.7	66	....	....	....	26
27	55.02	61.9	49.7	12.2	30.17	30.20	30.13	.07	91	N.	10.0	62	....	....	....	27
SUNDAY........28	49.54	55.0	46.0	9.0	30.19	30.25	30.12	.13	94	N.	7.3	32	....	....	....	28..........SUNDAY
29	52.66	59.9	44.7	15.2	30.02	30.12	29.95	.17	89	S.	7.5	00	0.13	....	0.13	29
30	44.40	50.9	35.1	15.8	30.25	30.40	29.99	.41	86	N.	25.7	96	0.03	....	0.03	30
31	41.47	49.7	31.0	18.7	30.38	30.44	30.31	.13	91	S.E.	17.6	37	....	....	....	31
Means............	52.45	60.10	44.25	15.86	30.143	30.245	30.039	.205	86.2	W. 44. 7° S.	14.99	52.9	2.25	0.0	2.25	..............Sums.
26 Years means for and including this month	45.90	52.89	38.98	13.91	30.013	....	......	.216	76.97	....	§ 13 39	¶41.60	3.01	0.0	3.11	26 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	1271	10	309	944	2630	3408	1687	894	
Duration in hrs..	81	2	36	62	192	178	142	44	7
Mean velocity....	15.7	5.0	8.6	15.2	13.7	19.1	11.9	20.3	

Greatest mileage in one hour was 36 on the 18th.

Greatest velocity in gusts was 42 miles per hour on the 18th.

Resultant mileage, 5330.
Resultant direction, W. 44. 7° S.
Total mileage, 11,153.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15, and 20 hours.

¶ 19 years only. § 14 years only.

The greatest heat was 75.7 on the 4th; the greatest cold was 30.0 on the 17th, giving a range of temperature of 45.7 degrees.

Warmest day was the 4th. Coldest day was the 17th. Highest barometer reading was 30.59 on the 25th. Lowest barometer was 29.61 on the 16th, giving range of .98 inches.

Minimum relative humidity observed was 59 on the 17th.

Rain fell on 10 days.
Snow fell on 1 day.
Rain or snow fell on 10 days.
Hoar frost on 2 days..
Fog on 5 days.
Thunder on the 5th.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1900.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	52.49	58.2	46.5	11.7	30.12	30.31	29.95	.36	91	S.E.	18.6	57	0.00	....	0.00	1
2	53.36	59.0	46.6	12.4	30.10	30.27	29.95	.32	88	S.W.	25.8	48	0.00	....	0.00	2
3	41.67	46.8	37.2	9.6	30.28	30.35	30.19	.16	92	S.W.	7.8	16	....	....	....	3
SUNDAY...... 4	46.82	58.5	37.0	21.5	29.94	30.19	29.82	.37	88	S.	19.4	87	....	....	....	4..........SUNDAY
5	43.07	48.0	38.2	9.8	29.73	29.82	29.68	.14	97	S.W.	8.2	00	0.36	....	0.36	5
6	39.80	43.5	35.0	8.5	29.91	30.02	29.70	.32	84	S.W.	16.3	84	....	...	....	6
7	41.78	44.2	38.0	6.2	29.92	30.02	29.85	.17	95	S.E.	11.4	00	0.57	....	0.57	7
8	43.42	45.1	40.2	4.9	29.77	29.85	29.66	.19	93	S.	9.2	00	0.50	....	0.50	8
9	36.24	39.5	28.4	11.1	29.36	29.66	29.19	.47	92	N.W.	33.8	00	0.16	8.5	1.01	9
10	32.94	34.0	28.4	5.6	29.70	30.02	29.34	.68	93	S.W.	28.8	00	....	0.3	0.03	10
SUNDAY........11	31.81	35.2	28.6	6.6	30.07	30.11	30.01	.10	93	S.W.	7.3	00	....	0.0	0.00	11..........SUNDAY
12	35.68	37.3	31.7	5.6	29.71	30.01	29.46	.55	88	S.	19.9	00	0.07	.. .	0.07	12
13	27.34	38.5	22.0	16.5	29.57	29.69	29.39	.30	88	S.W.	17.7	36	0.03	1.9	0.22	13
14	20.30	25.3	16.5	8.8	29.79	29.96	29.39	.57	90	S.W.	19.1	75	....	1.1	0.11	14
15	25.08	29.8	21.2	8.6	29.96	30.12	29.90	.22	95	S.W.	19.4	19	....	1.8	0.18	15
16	16.17	20.7	11.0	9.7	30.48	30.62	30.12	.50	86	W.	17.3	86	....	0.8	0.08	16
17	22.95	32.6	9.9	22.7	30.45	30.63	30.19	.44	85	S.	13.2	81	....	....	....	17
SUNDAY........18	33.74	37.1	30.0	7.1	29.98	30.19	29.86	.33	97	S.	18.6	00	0.12	1.2	0.24	18..........SUNDAY
19	25.92	33.0	20.6	12.4	30.26	30.40	30.04	.36	93	N.E.	22.2	00	0.56	....	0.56	19
20	35.45	37.5	33.0	4.5	29.96	30.04	29.85	.19	95	S.W.	10.3	00	0.96	....	0.96	20
21	44.09	56.9	35.0	21.9	29.45	29.85	29.16	.69	87	S.W.	33.5	02	0.73	....	0.73	21
22	33.71	39.0	31.4	7.6	29.85	29.99	29.32	.67	83	W.	26.4	38	....	0.6	0.06	22
23	36.94	43.5	29.5	14.0	29.91	30.26	29.59	.67	72	W.	27.6	91	0.05	....	0.05	23
24	25.56	29.5	22.0	7.5	30.42	30.49	30.26	.23	83	N.E.	10.6	59	....	....	....	24
SUNDAY....... 25	26.27	28.0	23.5	4.5	30.23	30.38	30.17	.21	95	N.E.	17.4	00	....	5.8	0.58	25..........SUNDAY
26	27.73	28.7	26.0	2.7	29.87	30.18	29.66	.52	96	N.E.	30.0	00	0.06	11.5	1.21	26
27	28.95	32.7	22.1	10.6	29.91	30.12	29.67	.45	86	N.E.	25.3	44	....	0.2	0.02	27
28	16.15	22.1 •	11.7	10.4	30.24	30.29	30.12	.17	88	N.E.	13.0	58	....	....	....	28
29	20.47	24.0	15.0	9.0	30.12	30.22	30.07	.15	95	N.E.	8.4	00	....	1.1	0.11	29
30	28.05	31.5	24.0	7.5	30.11	30.16	30.09	.07	90	N.	2.6	00	....	....	....	30
Means......	33.13	37.99	28.01	9.98	29.972	30.141	29.788	.352	89.9	W. 26° 8′ S.	17.98	29.4	4.17	34.8	7.65	..............Sums.
26 Years means for and including this month	32.61	38.90	26.71	12.19	30.015	....	......	.270	80.39	....	§ 16.03	¶28.95	2.37	13.31	3.73	26 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	767	2434	250	1086	1365	4045	1917	1083	
Duration in hrs..	57	131	25	67	99	201	80	56	4
Mean velocity....	13.5	18.6	10.0	16.2	13.8	20.0	24.0	19.4	

Greatest mileage in one hour was 72 on the 21st.

Greatest velocity in gusts was 72 miles per hour on the 21st.

Resultant mileage, 2395.
Resultant direction, W. 26° 8′ S.
Total mileage, 12,947.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100.

¶ 19 years only. § 14 years only.

The greatest heat was 59.0 on the 1st; the greatest cold was 9.9 on the 17th, giving a range of temperature of 49.1 degrees.

Warmest day was the 2nd. Coldest day was the 16th. Highest barometer reading was 30.63 on the 17th. Lowest barometer was 29.16 on the 21st, giving a range of 1.47 inches.

Minimum relative humidity observed was 68 on the 23rd.

Rain fell on 14 days.
Snow fell on 13 days.
Rain or snow fell on 23 days.
Lunar Halos on 3 nights.
Fog on 2 days.

ABSTRACT FOR THE MONTH OF DECEMBER, 1900.

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

DAY	THERMOMETER.				*BAROMETER.				‡Mean relative humidity.	*a* WIND.		Per cent. 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 per hour					
1	32.92	34.0	31.0	3.0	30.03	30.09	29.99	.10	88	W.	5.0	00	0.05	0.7	0.12	1
SUNDAY...... 2	33.92	35.5	31.6	3.9	30.20	30.23	30.08	.15	90	W.	5.7	00	....	0.0	0.00	2..........SUNDAY
3	33.57	34.2	33.0	1.2	30.18	30.24	30.11	.13	95	S.W.	5.5	00	0.07	0.6	0.13	3
4	31.13	34.0	27.2	6.8	29.88	30.11	29.53	.58	98	N.E.	12.1	00	....	3.4	0.34	4
5	23.57	27.2	21.1	6.1	29.67	29.88	29.52	.36	89	N.E.	13.0	00	...	3.2	0.32	5
6	24.66	27.0	21.7	5.3	30.08	30.20	29.88	.32	90	E	6.8	00	....	0.5	0.05	6
7	23.23	26.7	19.0	7.7	30.15	30.22	30.08	.14	94	S.	6.7	00	....	2.0	0.20	7
8	16.83	21.2	8.7	12.5	30.06	30.22	29.68	.54	89	N.E.	13.0	00	....	....	....	8
SUNDAY........ 9	13.17	33.9	− 5.5	39.4	29.66	30.07	29.30	.77	83	W.	28.8	84	0.00	2.2	0.22	9.........SUNDAY
10	− 5.48	− 1.4	−12.4	11.0	30.25	30.33	30.07	.26	85	W.	20.8	88	....	...	....	10
11	1.78	4.6	− 4.7	9.3	30.06	30.21	29.97	.24	95	S.	8.7	04	....	0.3	0.03	11
12	0.95	5.2	− 3.6	8.8	30.15	30.23	30.04	.19	90	W.	11.7	72	....	0.6	0.06	12
13	7.68	12.1	2.1	10.0	29.73	30.05	29.58	.47	91	W.	18.3	00	....	5.8	0.58	13
14	2.37	9.5	− 4.8	14.3	30.30	30.53	29.83	.70	89	W.	17.7	16	....	....	....	14
15	6.59	8.5	4.2	4.3	30.57	30.60	30.52	.08	95	W.	2.7	00	....	0.0	0.00	15
SUNDAY........16	5.74	8.2	1.4	6.8	30.58	30.61	30.57	.04	92	S.	4.3	00	....	0.0	0.00	16.........SUNDAY
17	1.83	3.3	− 0.6	3.9	30.46	30.57	30.34	.23	90	S.	2.7	00	....	0.5	0.05	17
18	3.67	11.2	− 2.5	13.7	30.19	30.34	29.98	.36	91	E.	1.8	00	....	0.0	0.00	18
19	25.46	35.1	10.1	25.0	29.90	29.98	29.86	.12	91	S.W.	20.0	00	0.06	0.5	0.11	19
20	31.72	35.8	22.3	13.5	29.91	30.05	29.85	.20	88	W.	18.4	00	0.01	0.3	0.04	20
21	16.79	22.3	12.4	9.9	30.05	30.12	30.01	.11	92	N.W.	7.5	85	....	....	....	21
22	14.94	22.8	7.5	15.3	30.00	30.05	29.98	.07	84	E.	11.3	24	....	....	....	22
SUNDAY........23	22.00	36.9	11.0	25.9	29.93	30.00	29.81	.19	85	S.	16.1	00	0.05	....	0.05	23..........SUNDAY
24	35.37	39.0	30.6	8.4	29.77	29.81	29.71	.10	80	W.	21.0	28	....	...	....	24
25	32.04	34.3	29.2	5.1	29.71	29.79	29.67	.12	80	S.W.	19.3	21	....	0.0	0.00	25
26	20.37	30.0	10.6	19.4	29.84	30.10	29.69	.41	90	W.	20.3	27	....	1.6	0.16	26
27	11.67	25.1	0.6	24.5	30.18	30.25	30.09	.16	88	W.	19.4	63	....	0.0	0.00	27
28	23.79	30.8	12.0	18.8	29.89	30.09	29.78	.31	87	W.	19.3	21	....	2.3	0.23	28
29	22.37	28.3	9.5	18.8	29.83	29.80	29.73	.07	82	W.	27.2	00	....	0.0	0.00	29
SUNDAY........30	29.69	34.1	22.6	11.5	29.73	29.77	29.68	.09	89	S.W.	25.3	49	....	0.5	0.05	30..........SUNDAY
31	33.50	36.0	29.6	6.4	29.74	29.84	29.69	.15	93	W.	16.1	00	....	0.2	0.02	31
Means............	18.64	24.05	12.09	11.95	30.022	30.141	29.891	.250	89.1	W. 16.7° S	13.78	18.8	0.24	25.2	2.76	..............Sums.
26 Years means for and including this month	19.14	26.19	12.00	14.19	30.029	....	......	.295	83.42	....	§ 16.27	¶27.96	1.32	23.55	3.61	26 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	330	864	412	47	1048	2326	5140	77	
Duration in hrs..	52	63	51	7	98	130	307	6	30
Mean velocity....	6.3	13.7	8.1	6.7	10.7	17.9	16.7	12.8	

Greatest mileage in one hour was 40 on the 9th.

Greatest velocity in gusts was 44 miles per hour on the 9th.

Resultant mileage, 6035.

Resultant direction, W. 16.7° S.

Total mileage, 10,244.

a—Wind on the 10th, 17th and 18th from City Hall Anemometer.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 19 years only. § 14 years only.

The greatest heat was 39.0 on the 24th; the greatest cold was 12.4 below zero on the 10th, giving a range of temperature of 51.4 degrees.

Warmest day was the 24th. Coldest day was the 10th. Highest barometer reading was 30.61 on the 16th. Lowest barometer was 29.30 on the 9th, giving a range of 1.31 inches.

Minimum relative humidity observed was 71 on the 23rd.

Rain fell on 6 days.

Snow fell on 24 days.

Rain or snow fell on 25 days.

Hoar frost on the 16th, 17th and 18th.

Lunar Halo on the 22nd.

Fog on 1 day.

Meteorological Abstract for the Year 1900.

Observations made at McGill College Observatory, Montreal, Canada.—Height above sea level 187 ft. Latitude N. 45° 30′ 17″. Longitude 4h 54m 18·67s W.

C. H. McLEOD, *Superintendent*.

Month.	Thermometer. † Mean.	Thermometer. ¶ Deviation from 26 years, means.	Thermometer. Max.	Thermometer. Min.	Thermometer. Mean daily range.	* Barometer. † Mean.	* Barometer. Max.	* Barometer. Min.	* Barometer. Mean daily range.	‡ Mean relative humidity.	Wind. Resultant direction.	Wind. Mean velocity in miles per hour.	Per cent. possible bright sunshine.	Precipitation. Inches of rain.	Precipitation. Number of days on which rain fell.	Precipitation. Inches of snow.	Precipitation. Number of days on which snow fell.	Precipitation. Inches of rain and melted snow.	Precipitation. No. of days on which rain *and* snow fell.	Precipitation. No. of days on which rain *or* snow fell.	Month.
January	16.28	+ 3.98	42.0	− 7.8	19.29	29.983	30.73	29.26	.401	87.4	W. 42.5° S.	14.36	30.2	1.93	5	36.6	17	5.84	2	20	January
February	16.03	+ 0.36	44.2	− 13.5	13.50	29.958	30.70	29.92	.355	86.6	S. 44.8° W.	18.19	43.7	2.98	5	31.5	15	6.35	2	18	February
March	19.66	− 4.65	39.2	− 5.8	15.73	29.951	30.67	29.23	.331	87.4	W. 42.5° S.	20.82	56.6	0.13	3	46.4	20	5.30	3	20	March
April	43.44	+ 2.97	72.7	21.9	15.20	29.971	30.48	29.40	.210	60.9	W. 13.6° S.	16.52	51.0	1.39	15	0.7	5	1.46	3	17	April
May	51.32	− 3.34	80.0	28.0	20.09	29.880	30.39	29.44	.196	68.9	W. 7.6° N.	15.99	54.0	3.11	11	0.0	3	3.11	..	14	May
June	65.16	+ 0.26	86.0	47.5	18.74	29.877	30.19	29.37	.191	75.3	W. 41.2° S.	15.49	68.5	4.33	14	....	..	4.33	..	14	June
July	67.76	− 1.08	87.0	48.8	14.81	29.870	30.16	29.34	.155	78.7	W. 59.1° S.	15.19	52.4	7.41	19	....	..	7.41	..	19	July
August	67.81	+ 1.05	87.9	49.5	15.83	29.993	30.29	29.70	.125	76.4	West.	11.10	60.4	3.14	13	....	..	3.14	..	13	August
September	59.94	+ 1.48	89.0	46.0	14.14	30.021	30.37	29.05	.245	87.4	W. 30.8° S.	12.97	51.0	3.62	11	....	..	3.62	..	11	September
October	52.45	+ 6.55	75.7	30.0	15.86	30.143	30.59	29.61	.205	86.2	S. 44.7° W.	14.99	52.9	2.25	10	0.0	1	2.25	1	10	October
November	33.13	+ 0.52	59.0	9.9	9.98	29.972	30.63	29.16	.352	89.9	W. 31.7° S.	17.93	29.4	4.17	14	34.8	13	7.65	4	23	November
December	18.64	− 0.50	39.0	− 12.4	11.95	30.022	30.61	29.30	.250	89.1	W. 36.7° S.	13.78	18.8	0.24	6	25.2	24	2.76	5	25	December
Sums for 1900	...	....	....	....	....	....	....	....	....	...	....	....	....	34.70	126	175.2	98	53.22	20	204	Sums for 1900
Means for 1900	42.63	+ 0.63	....	....	15.43	29.970	....	....	.252	80.3	W. 30.0° S.	15.60	47.41	....	....	....	..	4.43	..	..	Means for 1900
Means for 26 years ending Dec. 31, 1900	42.00	....	....	....	....	29.981	....	....	....	75.43	....	*a* 15.01	§15.99	28.65	135	120.92	79	40.67	16	202	Means for 26 years ending Dec. 31, 1900.

* Barometer readings reduced to 32° Fah. and to sea level. † The monthly thermometer and barometer means are derived from bihourly readings taken from self-recording instruments, beginning 1 h. 0 m. Eastern Standard time. ¶ "+" indicates that the temperature has been *higher*: "—" that it has been *lower* than the average for 26 years inclusive of 1900. ‡ Humidity relative, saturation being 100; the humidity means are derived from observations made at 8.15, and 20 hrs. § For 19 years only. *a* For 14 years only. The anemometer and wind vane are on the summit of Mount Royal, 57 feet above the ground and 810 feet above sea level.

The greatest heat was 89.0° above zero on September 3rd; the greatest cold was 13.5 below zero on Feb. 27th. The extreme range of temperature was, therefore 102.5. Greatest thermometer range one day was 40 2 on Feb. 25; least range was 1.2° on Dec. 3rd. The warmest day was Aug. 26th, when the mean temperature was 79.3° above zero. The coldest day was Feb. 26th, when the mean temperature was 9.5° below zero. The minimum relative humidity observed was 34 on April 26th. The greatest mileage of wind recorded in one hour was 72 on Nov. 21st, and the greatest velocity in gusts was at the rate of 72 miles per hour on Feb. 13, and Nov. 21st. The total mileage of wind was 133,613. The resultant direction of the wind for the year was W. 30.0° S. and the resultant mileage 92,620. Lunar halos were observed on 12 nights; lunar coronas on 18 nights; fog on 30 days; thunderstorms on 9 days. First sleighing of winter in city was on Nov. 9th. The first appreciable snowfall of the autumn was on Nov. 9th. The first trace of snow was on Oct. 16th.

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