Technical and Bibliographic Notes / Notes techniques et bibliographiques

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

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

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

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

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

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

- [ ] Additional comments:/ Commentaires supplémentaires:

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

10X	12X	14X	16X	18X	20X	22X	24X	26X	28X	30X	32X
						✓					

THE

CANADIAN RECORD

OF SCIENCE.

VOL. VII. JANUARY, 1897. No. 5.

CONTRIBUTIONS TO CANADIAN BOTANY.

By JAMES M. MACOUN.

X.

RANUNCULUS LAPPONICUS, L.

Shore of Seal Lake, Northern Labrador, 1896. (*A. P. Low.*) Not before recorded east of Lake Nepigon, Ont.

ANEMONE RICHARDSONI, Hook.

Along the Ungava River, Labrador. (*A. P. Low.*) Not before recorded from Labrador.

BERBERIS NERVOSA, Pursh.

Pend d'Oreille River, about 20 miles east of the Columbia River, B.C., 1896. (*Jas. McEvoy.*) Eastern limit.[1]

NELUMBIUM LUTEUM, Willd.; Macoun, Cat. Can. Plants, Vol. I, pp. 31 and 484.

In abundance in Lake Erie at Port Rowan, Ont. (*John Macoun, W. Scott, J. M. Dickson.*)

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

NASTURTIUM ARMORACIA, Fries.

Old fields at Prince Albert, Saskatchewan. (*John Macoun.*) Not before recorded west of Ontario.

CARDAMINE DIGITATA, Rich. in Frank. I. Journ., ed. 2 app. p. 26.

Near the mouth of the Mackenzie River, 1893. (*Rev. J. D. Stringer.*) Not rare between Lake Athabasca and Chesterfield Inlet. 1893. (*J. W. Tyrrell.*) Referred to *C. pratensis* by later American botanists. Easily separated from that species by its creeping, stoloniferous underground-stem, thinner, generally digitate leaves and smaller flowers. Not collected in America since first found by Richardson, but recorded from St. Lawrence Bay, Behring's Straits, by Chamisso and Eschscholtz. Fruiting specimens have never been collected.

LOBULARIA MARITIMA, Desv.

Alyssum maritimum, Lam.

Near the outer wharf, Victoria, Vancouver Island. (*John Macoun.*) Probably established in other parts of Canada, but not before recorded.

ALYSSUM INCANUM, DC.

Cultivated fields, Wallbridge, Hastings Co., Ont. (*A. Y. Massey.*) Not before recorded in Canada.

THELOPODIUM (?) SALSUGINEUM, Robinson, Syn. Fl. N. Amer., p. 175.

Sisymbrium salsugineum, Pall.; Macoun, Cat. Can. Plants, Vol. I., p. 47.

By a saline lake, Park-beg, west of Moose Jaw, Assiniboia, June 23rd, 1896. (*John Macoun.* Herb. No.

14, 292).[1] This interesting little Crucifer has been rarely collected, and there is still some uncertainty as to its true place among the Cruciferæ. It has already been referred to several genera, and Dr. Robinson has only doubtfully named it *Thelopodium.* He says: "The problematic *S. salsugineum,* Pall. with glabrous entire cordate-clasping leaves, purplish flowers and undivided stigma, may well be referred to *Thelopodium,* from which it appears to be distinguished only by its small size and slender habit." (Syn. Flora, p. 137). Its range in America, according to Dr. Robinson, is "Rocky Mountains from Colorado at South Park, *Porter,* to British America and shores of the Arctic Sea, *Richardson,* according to Hooker, l.c.," but it has never been found in our Rocky Mountains so far as we know.

CAPSELLA ELLIPTICA, C. A. Meyer.

C. divaricata, Walp.; Macoun, Cat. Can. Plants, Vol. I., p. 56 ; Can. Rec. Science, Nov., 1894, p. 147.

Damp places near a saline lake, Park-beg, Assa., 1896. (*John Macoun.* Herb. No. 12,390.) Not before recorded between Labrador and British Columbia.

VIOLA ROTUNDIFOLIA, Mx.

Moose Creek, Can. Atlantic Ry.; Jordan, Welland Co., Ont. (*John Macoun.*) Niagara Falls, Ont. (*R. Cameron.*) 20-mile Creek, west of St. Catharines, Ont. (*J. Dearness.*) Not before recorded from Ontario.

ARENARIA MACROPHYLLA, Hook.

Dr. Robinson in Proc. Amer. Acad. of Arts and Sciences, Vol. XXIX., p. 290, gives as the range of this species "eastward to Isle St. Ignace, Lake Superior."

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

Specimens collected in 1894 by Mr. A. P. Low at Lake Michikamow, Labrador, and in 1896 along the Koaksoak River, Northern Labrador, have been doubtfully referred here.

SAGINA NIVALIS, Lightf.

Along the Ungava River, Northern Labrador, 1896. (*A. P. Low.*) New to Canada.

HYPERICUM PROLIFICUM, L.

Sandy plains, along fence rows and in woods Caradoc township south of Strathroy, Ont., Aug., 1888. (*J. Dearness.*) New to Canada.

HYPERICUM NUDICAULE, Walt.

H. Sarothra, Mx.; Macoun, Cat. Can. Plants, Vol. I., p. 85.

Sandy fields south of Sandwich, Ont., 1892. (*John Macoun.*) Only authentic Canadian record.

GERANIUM BICKNELLII, N. L. Britton, Bull. Torr. Bot. Club, Vol. 24, p. 92.

"Similar to *G. Carolinianum*, but taller, the stems usually more slender, loosely pubescent. Leaves slender-petioled, somewhat angulate in outline, the segments oblong or linear-oblong, mostly narrower; peduncles slender, two-flowered, the inflorescence loose; sepals lanceolate, awn-pointed; ovary lobes pubescent; persistent filaments longer than the carpels; beak about 1′ line long, long-pointed, its tip 2″-3″ long; seeds reticulated."

"Nova Scotia (?) Maine to Western Ontario and Southern New York."

In the February number of the Bulletin of the Torrey Botanical Club, Dr. Britton describes *G. Bicknellii* as one of "two undescribed eastern species." Our herbarium sheets of *G. Carolinianum* have long been separated into two forms, both of general distribution from Ontario westward. Our herbarium specimens of *G. Bicknellii* give this plant a much wider range than is indicated by Dr. Britton. They are from Bedford, N.S.; Nepigon, Lake Superior; Killarney, Man.; Prince Albert, Saskatchewan; Banff, Rocky Mountains; Ainsworth, Kootanie Lake, B.C.; Spence's Bridge, B.C. (*John Macoun.*) Ottawa, Ont.; Observation Point, Lake Winnipeg. (*J. M. Macoun.*) North Shore of Lake Athabasca. (*J. W. Tyrrell.*) Arctic North America. (*Dr. Richardson.*) All the specimens from the above localities are separable at a glance from true *G. Carolinianum* by the much longer and very slender tip of the beak.

The specimens from Kootanie Lake were found growing with *G. Carolinianum* and were named var. *longipes*, Wat., a variety that must approach very closely *G. Bicknellii.*

GERANIUM CAROLINIANUM, L.

Not represented in the herbarium of the Geological Survey from eastern provinces. Belleville, Ont.; Cypress Hills, Assa.; Sproat, Columbia River, B.C.; Ainsworth, Kootanie Lake, B.C.; Mt. Finlayson, Victoria Arm, and Comox, Vancouver Island. (*John Macoun.*) Walpole Island, Lambton Co., Ont. (*C. K. Dodge.*)

We have no intermediate forms between *G. Bicknellii* and *G. Carolinianum.*

LUPINUS LITTORALIS, Dougl.

Sandy soil at Point Holmes near Comox, Vancouver Island, 1893. (*John Macoun.*) New to Canada.

AMORPHA FRUTICOSA, L.; Macoun, Cat. Can. Plants, Vol. I., p. 109.

In thickets by the Red River at Morris, Man., and at

River Park, Winnipeg, Man., 1896. (*John Macoun.* Herb. No. 12511.) Not reported since found by Douglas.

DESMODIUM CANADENSE, DC.

In thickets at Morden, Man., 1896. (*John Macoun.* Herb. No. 12525.) Western limit.

DESMODIUM ILLINOENSE, Gray.

Komoka, Ont., 1888. (*J. Dearness.*) New to Canada.

LATHYRUS LITTORALIS, Endl.

Ahousset, west coast of Vancouver Island. (*J. R. Anderson.*) New to Canada.

VICIA HIRSUTA, Koch.

In cultivated fields, Olds, Alberta. (*T. N. Willing.*) Not before recorded from prairie region.

AMPHICARPÆA MONOICA, Ell.

In thickets near the Assiniboine River at Brandon, Man.; thickets by the Red River, Winnipeg, Man., 1896. (*John Macoun.*) Not before recorded west of Lake Superior.

SAXIFRAGA REFLEXA, Hook.

Near the mouth of the Mackenzie River, 1893. (*Rev. J. D. Stringer.*) The reflexed calyx-segments, the two orange spots on the petals and the petaloid filaments are conspicuous characters of the fine specimens collected by Mr. Stringer. Herb. No. 14300.

PARNASSIA CAROLINIANA, Mx.

Boggy places near Stony Mountain, Man., 1896. (*John Macoun.* Herb. No. 12660.) Western limit in Canada.

DROSERA INTERMEDIA, Hayne, var. AMERICANA, DC.

In a muskeg north of Prince Albert, Saskatchewan, 1896. (*John Macoun.* Herb. No. 12669.) Western and northern limit.

DROSERA LINEARIS, Goldie.

In a muskeg north of Prince Albert, Saskatchewan, 1896. (*John Macoun.* Herb. No. 12668.) Not before recorded between Manitoba and Rocky Mountains.

LUDWIGIA POLYCARPA, Short & Peter.

First recorded from Canada in Part I. of these papers. Since collected by Mr. J. Dearness near Comber, Ont., and by Mr. C. K. Dodge near Sarnia, Ont.

LONICERA GLAUCESCENS, Rydberg, Bull. Torr. Bot. Club, Vol. XXIV., p. 90.

L. Sullivantii, Macoun, Cat. Can. Plants, Vol. I., pp. 197, 539.

L. glauca, Macoun, Cat. Can. Plants, Vol. I., p. 197, in part, and Vol. I., p. 539.

L. hirsuta glaucescens, Rydberg, Contr. U. S. Nat. Herb. III., 503.

From North-Western Ontario to the Rocky Mountains. Our herbarium specimens are from Manitoba House, Lake Manitoba; Fort Ellice, Assiniboine River, Man.; West Selkirk, Man. Herb. No. 12805; Rat River, Otterburne, Man.; Brandon, Man. Herb. No. 12804; Moose Jaw, Assa. Herb. No. 12803; Prince Albert, Saskatchewan, Herb. No. 12806; Banff and Kananaskis, Rocky Mountains; Waterton Lake, South Kootanie Pass, Rocky Mountains. Herb. No. 10802. (*John Macoun.*) Doghead, Lake Winnipeg. (*J. M. Macoun.*) Indian Head, Assa. (*W. Spreadborough.*) Milk River Ridge, Alta. (*Dr. G. M. Dawson.*) Red Deer River, Alta. (*H. H. Gaetz.*) Fort

Smith, Great Slave River. (*Miss E. Taylor.*) Additional Canadian localities given by Mr. Rydberg are River That Turns, Assa. (*John Macoun.*) Ontario (*Dr. and Mrs. Britton and Miss Timmerman; T. J. W. Burgess.*) Saskatchewan. (*E. Bourgeau.*)

LIATRIS SCARIOSA, Willd.

Since the publication of No. 9 of these papers, Dr. T. J. W. Burgess has written me that he collected this species at Leamington, Ont., in 1886, and Mr. J. Dearness reports it from Port Frank and Point Edward, Ont.

LIATRIS SPICATA, Willd.

Leamington, Ont. (*Dr. T. J. W. Burgess.*) The only other Canadian locality known to us is the vicinity of Sarnia, Ont., where this species is common.

RUDBECKIA COLUMNARIS, Pursh, var. PULCHERRIMA, Torr. & Gray; Macoun, Cat. Can. Plants, Vol. I., p. 243.

Near the Government Experimental Farm, Brandon, Man., 1896. (*John Macoun.* Herb. No. 12243.) The dark brown-purple rays of this beautiful plant separate it from *R. columnaris.*

BÆRIA MARITIMA, Gray.

On Bird Island, Barclay Sound, west coast of Vancouver Island. (*Chas. F. Newcombe.*) New to Canada. Only other known place of occurrence, Farallones Islands, off San Francisco.

ANTHEMIS ARVENSIS, L.

On ballast at Nanaimo, Vancouver Island, 1887. (*John Macoun.*) Common around Victoria, Vancouver Island. (*J. R. Anderson.*) Not before recorded west of the Maritime Provinces.

CHRYSANTHEMUM ARCTICUM, L.

Shore of Larcomb Island, Observatory Inlet, B.C. (*J. McEvoy.*) Southern limit on Pacific Coast.

CHRYSANTHEMUM PARTHENIUM, Pers.

On ballast heaps, Nanaimo, Vancouver Island, 1893. (*John Macoun.*) Not before recorded west of Ontario.

ARTEMISIA GLAUCA, Pall.; Macoun, Cat. Can. Plants, Vol. I., p. 255, and Vol. II., p. 335.

Common in Manitoba from Brandon southward. (*John Macoun.* Herb. Nos. 12257 and 12426.)

ARTEMISIA NORVEGICA, Fries, var. PACIFICA, Gray.

Mount O.K., near Alaskan boundary, B.C. (*H. W. E. Canovan.*) Yukon River. (*W. Ogilvie.*)

ARTEMISIA VULGARIS, L.

Along the C. P. Ry. at Brandon, Man.; waste places, Sicamous, B.C.; ballast heaps, Nanaimo, Vancouver Island. (*John Macoun.*) Not recorded west of Ontario.

ARTEMISIA VULGARIS, L. var. CALIFORNICA, Bess.

Specimens collected by Mr. Jas. Fletcher near Victoria, Vancouver Island, in 1883, were doubtfully referred here by Prof. Macoun. (Cat. Can. Plants, Vol. I., p. 258.) It has since been collected at Burrard Inlet, B.C., and at Sooke, Saanich Arm, and Qualicum, Vancouver Island, by Prof. Macoun.

PETASITES PALMATA, Gray.

Revelstoke, Columbia River, B.C.; Port Moody, B.C.; Comox, Sooke and Victoria, Vancouver Island. (*John Macoun.*) Nanaimo River, Vancouver Island. (*J. R. Anderson.*) Not before recorded west of the Selkirk Mountains.

CNICUS ALTISSIMUS, Willd., var. DISCOLOR, Gray.

In thickets, River Park, Winnipeg, Man. (*John Macoun.* Herb. No. 12292.) Not before recorded west of Sarnia, Ont.

CNICUS EDULIS, Gray.

Thickets, Sicamous, Shuswap Lake, B.C., and Ainsworth, Kootanie Lake, B.C. (*John Macoun.*) Not before recorded from interior of British Columbia.

ONOPORDON ACANTHIUM, L.

Waste grounds, Nanaimo, Vancouver Island, 1887. (*John Macoun.*) Not before recorded west of Ontario.

CENTAUREA CYANUS, L.

Waste places, Kootanie Lake, B.C. (*Dr. G. M. Dawson.*) Goldstream, Vancouver Island. (*John Macoun.*) Not before recorded west of Ontario.

CALENDULA ARVENSIS, L.

On ballast, St. John, N.B. (*G. U. Hay.*) New to Canada.

ECHINOPS GLOBIFER, Janka.

Escaped from cultivation and well established at Beeton, Ont. (*J. M. Dickson.*)

LAMPSANA COMMUNIS, L.

North Saanich, Vancouver Island. (*J. R. Anderson.*) Roadsides, Comox and Victoria, Vancouver Island. (*John Macoun.*) Not before recorded from Vancouver Island.

CREPIS OCCIDENTALIS, Nutt. var. GLANDULOSA, Torr.; Macoun, Cat. Can. Plants, Vol, I., p. 556.

Prairies, Farewell Creek, Cypress Hills, Assa. (*John Macoun.* Herb. No. 11709.) Eastern limit.

HIERACIUM GRACILE, Hook.

Mount Mark, Vancouver Island. Alt. 3,000 ft. (*John Macoun.*) Not before recorded from Vancouver Island. New stations for this species from interior of British Columbia are Queest Creek, Shuswap Lake, alt. 5,000 ft.; mountains north of Griffin Lake, alt. 6,000 ft.; Toad Mountain, Kootanie Lake, alt. 6,000 ft. (*J. M. Macoun.*)

HIERACIUM AURANTIACUM, L.; Macoun, Cat. Can. Plants, Vol. I., p. 557, and Vol. II., p. 336.

Since first collected at London by Mr. Dearness and near Lake Magog, Que., by Mr. Giroux in 1889, this plant has become a troublesome weed in parts of Quebec and Ontario. Our herbarium specimens are from Lake Memphremagog, Que. (*Dr. Ells.*) Mer Bleue, near Ottawa, Ont. (*Dr. Jas. Fletcher.*) Port Colborne, Ont. (*John Macoun.*)

LACTUCA CANADENSIS, L.

Damp thickets, Sicamous, and Revelstoke, B.C. (*John Macoun.*) Not before recorded from west of prairie region. Prof. Macoun (Cat. Can. Plants, Vol. I., p. 280) says that this species is quite common in thickets in the western prairie region, but our only herbarium specimens from the prairie were collected at Morden, Man., by Prof. Macoun in 1896. *L. leucophæa,* Gray, is common throughout the prairie region.

LACTUCA HIRSUTA, Mühl.

Alluvial soil near the Pembina River, three miles north of Killarney, Man., 1896. (*John Macoun.* Herb. No. 12346.) Not before recorded west of Ontario. Sandy woods near Ottawa and thickets west of Leamington (*John Macoun*) are new stations for Ontario.

LACTUCA LEUCOPHÆA, Gray; Macoun, Cat. Can. Plants, Vol. I, pp. 281, 559.

Additional western stations for this species are Sicamous, B.C.; Revelstoke, B.C.; Stanley Park, Vancouver, B.C., and Qualicum, Vancouver Island. (*John Macoun.*)

PRENANTHES ALATA, Gray; Macoun, Cat. Can. Plants, Vol. I., p. 283.

Shake River, Burrough Bay, Lat. 56° near Alaskan boundary. (*H. W. E. Canavan.*) Alberni Canal and Barclay Sound, Vancouver Island. (*John Macoun.*) Not rare on the west coast of Vancouver Island, collected at Muir Creek and Port San Juan. (*J. R. Anderson.*)

PRENANTHES RACEMOSA, Michx var. PINNATIFIDA, Gray.

Near Windsor, Ont. (*Wm. Scott.*) Walpole Island, Lambton Co., Ont. (*C. K. Dodge.*) New to Canada.

SONCHUS ARVENSIS, L.

In the C. P. Ry. station yard at Brandon, Man. (*John Macoun.*) Not before recorded west of Ontario.

TRAGOPOGON PORRIFOLIUS, L.

Waste places, Spence's Bridge, B.C. (*John Macoun.*) Not before recorded between Ontario and Vancouver Island.

LOBELIA DORTMANNA, L.

Shawnigan Lake, Vancouver Island. (*John Macoun.*) Not before recorded from any part of British Columbia.

VACCINIUM CANADENSE, Kalm.; Macoun, Cat. Can. Plants, Vol. I., pp. 290 and 560.

Revelstoke, B.C., and Craigellachie, B.C. (*John Macoun.*) Western limit.

VACCINIUM OVALIFOLIUM, Smith.

Revelstoke, B.C.; Ainsworth, Kootanie Lake, B.C.; Sicamous, B.C.; Comox and Mount Mark, Vancouver Island. (*John Macoun.*) Head of Bennett Lake, Lat. 61°, north of B.C. (*Dr. G. M. Dawson.*) Quesnel Lake, B.C. (*A. Bowman.*) Mount Chean, B.C. (*J. R. Anderson.*) Not before recorded in Canada west of the Selkirk Mountains, but evidently common throughout British Columbia.

ARCTOSTAPHYLOS ALPINA, Spreng.; Macoun, Cat. Can. Plants, Vol. I., p. 294.

Cross Portage, Sepawisk Lake, Nelson River, Kewatin, 1896. (*Jos. Tyrrell.*) Southern limit in Central Canada.

CHIOGENES HISPIDULA, T. & G.

Mossy woods, Sicamous, B.C. (*John Macoun.*) Western limit in Canada.

GAULTHERIA OVATIFOLIA, Gray.

In woods at Revelstoke, Columbia River, B.C. (*John Macoun.*) Eastern limit in Canada.

GAULTHERIA MYRSINITES, Hook.

Alpine summits, Ainsworth, Kootanie Lake, B.C., and north of Griffin Lake, B.C. (*John Macoun.*) Western limit in Canada.

LEDUM GLANDULOSUM, Nutt.; Macoun, Cat. Can. Plants, Vol. I., p. 562 and Vol. II., p. 339.

Additional stations for this species are Mount Aylmer, Devil's Lake, Rocky Mountains, alt. 6,000 ft., 1891. (*John Macoun.*) Mountains west of Okanagan Lake, B.C. (*Jas. McEvoy.*) Mr. McEvoy reports this to be common at between 5,000 and 6,000 ft. altitude on most of the mountains between Nicola River and Lake Okanagan, B.C. In the Rocky Mountains it seems confined to the vicinity of the Bow River.

RHODODENDRON ALBIFLORUM, Hook.

Additional stations for this species are Queest Creek, Shuswap Lake, B.C., alt. 5,000 ft.; mountains north of Griffin Lake, B.C., alt. 5,000 ft.; mountain woods, Ainsworth, Kootanie Lake, B.C. (*Jas. M. Macoun.*) Mountains south of Tulameen River, B.C., alt. 5,000 ft. (*Dr. G. M. Dawson.*) Alpine woods, Mount Arrowsmith, Vancouver Island. (*John Macoun.*) Not before recorded from Vancouver Island.

MONOTROPA UNIFLORA, L.; Macoun, Cat. Can. Plants, Vol. I., p. 307.

Not recorded by Prof. Macoun west of Lake of the Woods. Norway House, Lake Winnipeg. (*Dr. Richardson.*) Great Slave River. (*Miss E. Taylor.*) Sicamous, B.C.; between Qualicum and Alberni, Vancouver Island. (*John Macoun.*)

PTEROSPORA ANDROMEDA, Nutt.; Macoun, Cat. Can. Plants, Vol. I., p. 307.

Not recorded by Prof. Macoun, east of Quebec or west of the Saskatchewan. Pine woods, Prospect Creek, Prince Edward Island; Nanaimo, Vancouver Island. (*John Macoun.*) Mountains west of Lake Okanagan, B.C. (*Jas. McEvoy.*)

TRIENTALIS AMERICANA, Pursh.

In thickets north of Prince Albert, Sask. (*John Macoun.*) Black River, east of Lake Athabasca. (*J. W. Tyrrell.*) Northern and western limits in Canada.

DOUGLASIA ARCTICA, Hook.

A few specimens of this beautiful little plant were collected along the coast between the mouth of the Mackenzie River and Herschel Island by Rev. J. D. Stringer, May 25th, 1893. It has not been found since collected by Dr. Richardson to the east of the Mackenzie River. Herb. No. 14298.

ANAGALLIS ARVENSIS, L.

In waste places and on ballast heaps, Nanaimo, Vancouver Island. (*John Macoun.*) Not before recorded west of Ontario.

FRAXINUS VIRIDIS, Michx.

South of Moose Jaw, Assa., 1896, and Old Wives Lakes, Assa., 1895. (*John Macoun.*) Western limit in Canada.

VINCETOXICUM NIGRUM, Mœnch.

In cultivated grounds, Victoria, Vancouver Island, 1888. Adventitious. (*Dr. Jas. Fletcher.*) Only Canadian record.

GENTIANA ANDREWSII, Griseb.

Rich moist ground, Selkirk, Man. (*Jas. M. Macoun.*) Griswold, Man. (*Rev. W. A. Burman.*) Western limit in Canada.

PHLOX HOOKERI, Dougl.

Gilia pungens, var. *Hookeri,* Gray, Syn. Fl., p. 141.

Kettle River, east of Okanagan Lake, B.C. (*J. R. Anderson.*) New to Canada. First found by Douglas on Okanagan River a little south of the international boundary.

COLLOMIA GRANDIFLORA, Dougl.

Dry, rocky banks, Botanie Creek, near Lytton, B.C. (*Jas. McEvoy.*) Eastern limit in Canada.

GILIA LINIFLORA, Benth. var. PHARMACEOIDES, Gr.

Depressions on the prairie, Police Point, Medicine Hat, Assa., and near Cypress Lake, Assa. Herb. No. 5546. (*John Macoun.*) Not before recorded east of British Columbia.

PHACELIA TANACETIFOLIA, Benth.

A weed on the Experimental Farm, Brandon, Man., 1896. (*John Macoun.*) New to Canada.

CYNOGLOSSUM OFFICINALE, L.

Along an old road near the railway bridge, Brandon, Man., 1896. (*John Macoun.*) Not before recorded west of Ontario.

PHYSALIS PHILADELPHICA, Lam.

In a ravine, S.W. of Komoka, Ont. (*J. Dearness.*) New to Canada.

PHYSALIS VIRGINIANA, Mill. var. AMBIGUA, Gray ; Macoun, Cat. Can. Plants, Vol. I., p. 350.

Sandy hillside, shore of Lake Huron, Sept., 1891. (*J. Dearness.*) Not before recorded from Ontario, though some of the references under *P. Virginiana,* Macoun, Cat. Can. Plants, Vol. I. p. 350, are probably this variety.

GRATIOLA VIRGINIANA, L. ; Macoun, Cat. Can. Plants, p. 359.

Comox, Vancouver Island, 1893. (*John Macoun.* Herb. No. 706.) Distributed as *G. ebracteata.* Credited by Gray to British Columbia, but not before found by Canadian collectors.

MARTYNIA PROBOSCIDEA, Glox.

Niagara Falls, Ont., 1892. (*R. Cameron.*) Hamilton, Ont. (*J. M. Dickson.*) Not known to occur elsewhere in Canada.

PHRYMA LEPTOSTACHYA, L.

Damp thickets by a brook at Morden, Man. (*John Macoun.* Herb. No. 12431.) Not recorded west of Ontario.

TEUCRIUM CANADENSE, L.; Macoun, Cat. Can. Plants, Vol. I., p. 380 in part, and Vol. II., p. 349.

Apparently much rarer than *T. occidentale* even in Ontario. Our herbarium specimens are from Pt. Pelee, Essex Co., Ont. (*Dr. Burgess.*) Brampton, Ont. (*Jas. White.*) In thickets by the Assiniboine River at Brandon, Man. (*John Macoun.* Herb. No. 12416.) Not before recorded west of Ontario.

TEUCRIUM OCCIDENTALE, Gray; Macoun, Cat. Can. Plants, Vol. I., p. 574 and Vol. II., p. 349.

Our herbarium specimens are from Ottawa, Ont.; Belleville, Ont.; Bird's Hill, near Winnipeg, Man. Herb. No. 12288; Cypress Lake, Cypress Hills, Assa. Herb. No. 12890; Kamloops, B.C. (*John Macoun.*) London, Ont. (*Dr. Burgess.*) Burlington Beach, Hamilton, Ont. (*J. M. Dickson.*) Not before recorded from the prairie region.

ABRONIA MICRANTHA, Choiss.

Abundant in dry sand at the crossing of Many Berries Creek, north of Milk River, Assa., July 9th, 1895. (*John Macoun.* Herb. No. 12902.) New to Canada.

ANYCHIA DICHOTOMA, Mx.; Macoun, Cat. Can. Plants, Vol. I., p. 396.

Near Leamington, Ont., 1890. (*J. Dearness.*) Sandy fields near Leamington, Ont., 1892. (*John Macoun.*) Only once before collected in Canada.

AXYRIS AMARANTOIDES, L.; Macoun, Cat. Can. Plants, Vol. II., p. 352.

First collected in 1886, in Manitoba, by Dr. Fletcher, now common along the line of the Can. Pac. Ry. west to Medicine Hat, Assa., and in cultivated fields and waste places throughout Manitoba. Our herbarium specimens are from Winnipeg and Brandon, Man.; Indian Head, Moose Jaw and Medicine Hat, Assa.

ERIGONUM UMBELLATUM, Torr.; Macoun, Cat. Can. Plants, Vol. I., p. 406.

Additional stations for this species are Milk River Ridge, Alta.; Vermillion Mountain near Banff, Rocky Mountains; Lake Louise, Rocky Mountains; Sproat, Columbia River, B.C. (*John Macoun.*) Big Horn Mountains, west of Lake Okanagan, B.C. (*Jas. McEvoy.*) Not before recorded east of Rocky Mountains.

ERIGONUM HERACLOIDES, Michx.

Deer Park, Lower Arrow Lake, B.C. (*John Macoun.*) Eastern limit in Canada.

ERIGONUM OVALIFOLIUM, Nutt.; Macoun, Cat. Can. Plants, Vol. I., p. 407.

Big Horn Mountains, west of Okanagan Lake, B.C. (*Jas. McEvoy.*) Along Waterton Lake and on Sheep Mountain, South Kootanie Pass, Rocky Mountains. (*John Macoun.* Herb. No. 12948.)

ERIGONUM MULTICEPS, Nees; Macoun, Cat. Can. Plants, Vol. I., p. 407.

Wood Mountain, Assa. Herb. No. 12949; dry rocks along Waterton Lake, South Kootanie Pass, Rocky Mountains, 1895. (*John Macoun.*) Eastern limit in Canada.

ERIGONUM NIVEUM, Dougl.

Dry ground, Lake Okanagan, B.C., Sept. 15th, 1890. (*Dr. G. M. Dawson.*) New to Canada.

ERIGONUM CERNUUM, Nutt.

Sand hills at the crossing of Many Berries Creek near Milk River, Assa. Herb. No. 12947; on the banks of the South Saskatchewan at Police Point, Medicine Hat, Assa. Herb. No. 12946. (*John Macoun.*) New to Canada.

POLYGONUM BISTORTOIDES, Pursh.

On the summit of Sheep Mountain, Waterton Lake, Rocky Mountains, alt. 7,500 ft., July 31st, 1895. Herb. No. 12989. (*John Macoun.*) New to Canada. Arctic American specimens referred to *P. Bistorta* seem to be intermediate between that species and *P. bistortoides.*

SASSAFRAS OFFICINALE, Nees.

Near Sarnia, Lambton Co., Ont. (*C. K. Dodge.*) Northwestern limit in Ontario.

QUERCUS ALBA, L.

Elevated shore of Rainy Lake, Ont., 1896. (*W. McInnes.*) Western limit in Canada.

CYPRIPEDIUM ACAULE, Ait.; Macoun, Cat. Can. Plants, Vol. II., p. 22.

Dry hillock of sand and boulders. Lat. 57° 30′, Long. 107°. (*Jas. W. Tyrell.*)

UVULARIA PERFOLIATA, L.; Macoun, Cat. Can. Plants, Vol. II., p. 44.

Near Niagara, Ont., 1890. (*J. Dearness.*) Jordan Station, near Niagara, Ont., 1892. (*John Macoun.*) Very rare and not collected for many years.

ALETRIS FARINOSA, L.; Macoun, Cat. Can. Plants, Vol. II., p. 23.

Common at Sandwich, Ont. (*John Macoun.*) Near Sarnia, Lambton Co., Ont. (*C. K. Dodge. J. Dearness.*) Only recorded before from Leamington, Ont.

ERYTHRONIUM ALBIDUM, Nutt.; Macoun, Cat. Can. Plants, Vol. II., p. 41.

Stag Island in St. Clair River, 5 miles below Sarnia, Ont. (*C. K. Dodge.*) North-western limit.

SCIRPUS CAMPESTRIS, Britton.

S. maritimus, Macoun, Cat. Can., Vol. II., p. 100 in part.

Common throughout the prairie region. Our herbarium specimens are from Red River, Man. (*Douglas.*) File Hills, Assa.; Thunder Creek, Moose Jaw, Assa.; Park Beg, Assa. Herb. No. 16411; Milk River, Alberta. Herb. No. 16412. (*John Macoun.*)

SCIRPUS SMITHII, A. Gray.

In wet sand, Toronto Island, Ont., 1886. (*Wm. Scott.*) New to Canada.

SCIRPUS DEBILIS, Pursh.

Muddy places, Queenston Heights, Ont., 1896. (*Wm. Scott.*) New to Canada.

FIRMBRISTYLIS CASTANEA (Michx.), Vahl.

Walpole Island, Lambton Co., Ont., 1894. (*C. K. Dodge.*) New to Canada.

ELEOCHARIS MUTATA (L.), R. & G.

E. quadrangulata, R. & S.

Sarnia Bay, near Sarnia, Ont., 1896. (*C. K. Dodge.*) New to Canada.

DESCRIPTION OF A NEW GENUS AND SPECIES OF CYSTIDEANS FROM THE TRENTON LIMESTONE AT OTTAWA.[1]

By J. F. WHITEAVES.

ASTROCYSTITES OTTAWAENSIS.

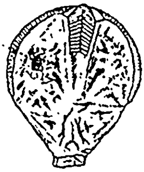


Fig. 1.

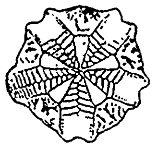


Fig. 2.

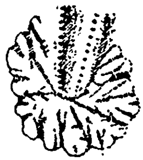


Fig. 3.

Figs. 1–3. *Astrocystites Ottawaensis.* Fig. 1. Side view of a nearly perfect specimen, shewing the small plates surrounding and perhaps covering the anus, on the left side of one of the ambulacral areas, at A, and the peculiar sculpture of part of the calyx, natural size. Fig. 2. Summit view of the same specimen, also of the natural size. Fig. 3. Radial plate on the left of the anal region of another specimen, twice the natural size, to shew the peculiar shape and sculpture of this plate, also the overlap by the distal portion of one of the ambulacral areas above, and the modification of the upper margin of the plate on the anal side: A—relative position of the anus.

Body or "crown" of the organism globose, almost spherical but narrowing rapidly below into a very short, slender column or stem, and somewhat five-sided as seen from above.

Calyx or dorsal cup broadly conical and entire below the midheight, but divided above into five large, pointed and slightly incurved, sepaloid lobes, with rather oblique and slightly convex sides, by the decurrent portions of the ambulacral areas. The greater part of one of these lobes, as seen at A, in Fig. 1, is occupied with a cluster of minute plates, which surround and either partially or wholly cover the anal opening.

[1] Communicated by permission of the Director of the Geological Survey.

Surface of the calyx marked by small, short, branching grooves, which radiate from the centre and anastomose at the margins of large plates of irregular shape. The exact outlines of some of these plates are not clearly defined in any of the three specimens that the writer has seen, but two of the latter have part of the calyx crushed in such a way as to shew parts of the margins of at least two of the radials and of one of the basals. Judging by these indications of the outlines of the plates and by the peculiar sculpture of others, the composition of the calyx would seem to be essentially as follows. In the undivided and lower moiety of the divided portion there appears to be a circlet of large, subpentagonal and presumably basal plates, immediately above the columr On the surface of these plates the branching grooves radiate upward and outward, but not backward, and, consequently, only the front and part of the lateral margins of each of these plates is minutely sinuated. Next to these supposed basal plates and alternating with them there is a circlet of five large radials. These radials are irregular in outline, but their margins are minutely sinuated all round, except in the middle of the summit, where each of these plates is overlapped by the distal portion of the ambulacral area, as shewn in Fig. 3., On each side of the anal region the upper and inner portions of the margin of each of the two radials that partially bound it, are slightly modified, as also shown by Fig. 3, in which A represents the relative position of the middle of the anal region. In the upper and lobate portion of the calyx there appears to be a comparatively small and presumably interradial plate, whose outline it is not yet possible to define precisely, in or near the middle of each of four of the lobes, the corresponding part of the fifth lobe being *occupied by the group of small plates which* surround and apparently cover the anus.

The summit, or entire upper surface above the calyx, is exclusively occupied with five large linear lanceolate, radiating ambulacral areas, which extend a little beyond and below the midheight and alternate, at and near the centre, with five small narrowly elongated, subtriangular, almost bottle-shaped plates. The ambulacral areas consist of well defined grooves, which are partially and perhaps in perfect specimens were wholly roofed over with two rows of small, transversely elongated and alternately arranged covering plates, from the centre of the summit, where they interlock and probably cover the presumably subtegminal mouth. In the only specimens known to the writer these plates roof over the ambulacral grooves, from the middle of the summit, for distances varying from one-half to fully two-thirds of the entire length of each groove, but always, at least, as far outward as to the bases of the small alternating subtriangular plates. On some of the ambulacral grooves only eight covering plates can be counted on each side, in a longitudinal direction, but on others there are as many as fourteen on each side. In the latter case the circumstance that several of the outermost covering plates are crushed down into the ambulacral grooves leads to the inference that the grooves may have been almost or completely roofed over in perfect specimens. A central area at the summit, in which the ambulacral areas or covered inner ends of the ambulacral grooves are everywhere in close contact with the small alternating subtriangular plates, is bounded by the bases of the latter. Outside of this area the ambulacral areas suddenly become more widely divergent, and their grooves are bordered on each side by a prominent raised rim. At the outer end of each of the ambulacral areas, where the covering plates have been removed or are absent, there is a longitudinal row of marginal pores on the inner surface of the raised rim which bounds the groove on both sides, as shewn in

Fig. 3, and the whole of the outer declivity or downward slope of the rim is transversely corrugated or ribbed.

When examined with a lens, the whole surface of the calyx, of the covering plates of the ambulacral grooves and of the small subtriangular plates which alternate with the inner ends of the ambulacral areas at the summit, is seen to be densely pitted or perhaps perforated.

Two specimens of this species, both collected by Mr. John Stewart in 1886 from the Trenton limestone at Division street, Ottawa, are in the Museum of the Geological Survey of Canada, and an imperfect specimen from the same locality has been kindly lent to the writer by Mr. Walter R. Billings. All three of these specimens, when found, were almost completely covered with a very tenacious shaly limestone, and although they have been both carefully and skilfully cleaned, it is just possible that some of the covering plates of the ambulacral grooves may have been accidentally removed in the cleaning. At present, also, it is not possible to ascertain from either, whether the dense pitting of so large a portion of their surface is caused by "conjugate" pores or not. It is only proper to add that the general outlines of the plates of which the calyx is composed in this species, were first suggested to the writer by Mr. W. R. Billings, who, as is well known, has devoted much time to the study of the crinoids and cystideans of the Trenton limestone of the Ottawa valley.

Astrocystites would seem to be most nearly related to *Asteroblastus*, Eichwald, and is probably referable to the same family, though it clearly differs from that genus in several important particulars. Thus, a comparison of the plates of which the calyx is composed in these two genera shews that, although they have much the same shape and style of sculpture, yet those of *Asteroblastus* are both small and very numerous, while those of *Astrocystites* are large and comparatively few in number. The anal region of *Astrocystites*, too, is lateral and well defined, but no indications of any such region have yet been observed in *Asteroblastus*. The summit, also, is very differently constructed in these two genera. In *Asteroblastus* there is a central oral aperture, immediately surrounded by five apical plates, and the ambulacral areas, which are comparatively broad and short, do not reach to the centre. No traces of the oral aperture are visible anywhere on the summit of *Astrocystites*, the mouth in that genus being apparently subtegminal, and the ambulacral areas, which are long and narrow, extend to the centre, where their covering plates interlock.

The ambulacral areas of *Astrocystites* are somewhat like those of *Blastoidocrinus*, but, in the latter genus (which is still known only from the few fragments collected by E. Billings from the Chazy limestone of the Island of Montreal and its immediate vicinity, and from the imperfect specimens from the "Orthoceratitenkalk" of Pulkowa, Russia, described and figured by Friedrich Schmidt) the spaces between them are completely filled with the large deltoids, which, according to E. Billings, "extend the whole length of the pseudambulacra."

There are, also, apparently, some points of resemblance between *Astrocystites* and *Cystoblastus*, Volborth, but in Zittel's description of the latter genus, which is the only one that the writer has access to, there are said to be two pectinated rhombs in the calyx, whereas no traces of such structures have been observed in the dorsal cup of *Astrocystites*.

In 1874[1] Schmidt expressed the opinion that *Blastoidocrinus*, *Asteroblastus*, *Mesites* and *Cystoblastus* are all cystidea which may be regarded as intermediate in their characters between that class and the blastoids, and it

[1] "Memoirés de l'Académie Imperiale des Sciences de St.-Pétersbourg, VIIe Serie, tome XXI., p. 25."

is quite clear that these are the genera to which *Astrocystites* is most closely allied, "Blastoids," writes Dr. Charles Eastman, in the first volume of his translation of Zittel's Text-book of Palæontology, published in 1896, "have not been recognized, as such, up to the present time, in strata lower than the Silurian ; but it is possible that several genera occurring in the Ordovician of North America and Russia (*Blastoidocrinus, Asteroblastus,* etc.), which are now referred to the Cystids, may eventually be transferred to the Blastoidea." In that event, *Astrocystites* would, of course, have to be included in the same category. On the other hand, Etheridge & Carpenter, on page 129 of their "Catalogue of the Blastoidea in the Geological Department of the British Museum," published in 1886, say distinctly, "we have no certain evidence of the existence of true Blastoidea anterior to the Upper Silurian period. For we much doubt, as we have explained in the previous chapter, whether the problematical *Blastoidocrinus* from the Lower Silurian of Canada and Russia can properly be referred to this group." Nicholson & Lyddeker, in the first volume of their "Manual of Palæontology," published in 1889, follow Johannes Muller's classification of the Cystoidea, and divide the class "into the three orders of the Aporitidæ Diploporitidæ and Rhombiferi, according as the calycine plates are imperforate, are pierced by yoked pairs of pores indiscriminately distributed, or have their pores arranged in pore-rhombs." Of these three orders, *Astrocystites* would seem to be most probably referable to the Diploporitidæ. In conclusion, the writer begs to tender his cordial thanks to his friend and colleague, Mr. L. M. Lambe, F.G.S., for the accurate and original drawings which are reproduced in this paper.

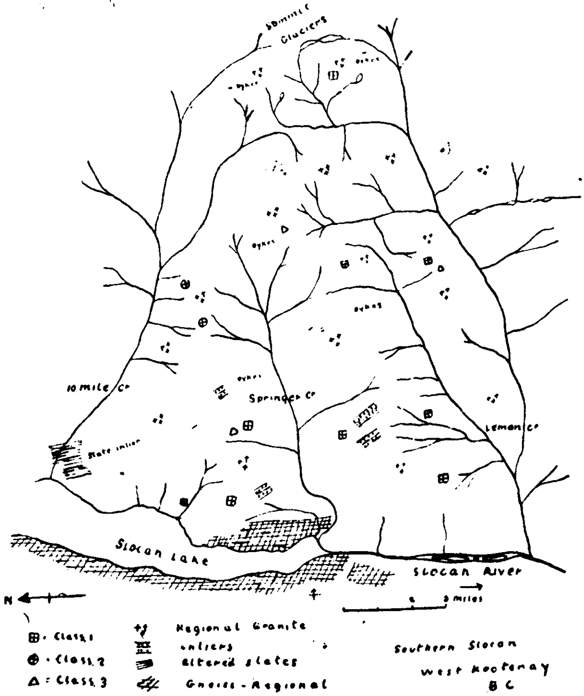
OTTAWA, April 28th, 1897.

SOME ORES AND ROCKS OF SOUTHERN SLOCAN DIVISION, WEST KOOTENAY, BRITISH COLUMBIA.

By J. C. GWILLIM, B.A.Sc., and W. S. JOHNSON, B.A.Sc.,
Slocan City, B.C.

The section of country taken up by this paper is a part of the Slocan Mining Division of West Kootenay, British Columbia.

As may be seen from the accompanying sketch map, this particular area lies in the drainage basins of Ten



Mile, Springer and Lemon Creeks, west of the divide between Kootenay Lake and Slocan Lake and River.

This area, therefore, lies immediately south of the rich silver-lead district of the Slocan proper, and it is, in itself, a richly mineralized district.. In the study of the characteristic rocks of this district the writers were much aided by the kindness of Dr. F. D. Adams, of McGill University, to whom they are indebted for the microscopical examination of a number of rock sections and as well as for suggestions upon the nature and origin of various specimens sent to him.

The country rock of this district is a granite. It is bounded to the north, some six miles above Ten Mile Creek, by the Slocan Slates of McConnell, in which occur the rich silver-lead mines now being so extensively and profitably worked.

To the west there is a contact with a great region of gneissoid rocks and dark schists, which, for the most part, lie west of the great trough formed by Slocan Lake and Slocan River, but which also cross over to the east side of the Lake at a point somewhat south of Twelve Mile Creek, and continue along the east shore, at least, until Springer Creek is reached, and probably occur along the lower slopes of the mountains further south. To the south and east the characteristic granite continues towards Kootenay Lake and the western arm of Kootenay Lake.

The contact of the gneissoid rocks with the mineral-bearing granites to the east of it is not well defined, excepting the fact that the block of gneiss and schists which lies east of the Lake forms a low bench, and the hills which rise above this bench are of a different nature and are *well mineralized*, which cannot be said of any portion of the gneisses so far prospected.

Between the gneiss and the granite proper, however, there usually intervenes a wide band of a highly silicious somewhat cleavable rock, which may possibly be a felsite. This band is mineralized, but is considerably broken.

With the exception of a few isolated patches of a highly silicious metamorphic rock of a dark color, the district under consideration is composed of a granite having the following characters.

This granite is of a dark grey color and is composed of quartz, feldspars, biotite and hornblende, with a good deal of accessory sphene.

Its striking visible feature, however, is the occurrence in it of large crystals of impure orthoclase, giving it a porphyritic appearance. These crystals are usually a half to one inch long, and are commonly twinned parallel to the orthopinacoid. Small scales of biotite are scattered through the crystals, and the analysis, as here given, shows a good deal of lime and soda for an orthoclase.

SiO_2	59·86
$Al_2 + Fe_2O_3$	20·26
K_2O	12·39
Na_2O	5·76
CaO	2·90
MgO	0·78
Total	101·95

The lime is probably present as calcium carbonate.

An analysis of the granite gave :—

SiO_2	60·09
Al_2O_3	17·20
Fe_2O_3	6·73
CaO	8·24
Na_2O	2·45
K_2O	6·23
MgO	·47
Total	101·41

A microscopical examination of a specimen of this granite, taken from within a few feet of a quartz vein, was made by Dr. Adams. It was found to be a crushed biotite granite containing a good deal of plagioclase. The quartz and feldspar show marked indications of great pressure. Much biotite, partially altered to chlorite is present and is associated with epidote, perhaps also an alteration product, having, however, in one case a core of allanite.

This specimen was considerably decomposed, being from near a vein and also near the surface. Two other specimens, one of them from a granite horse in a quartz vein, and the other from a cross-cut tunnel several miles distant, showed much the same characteristics, especially in the evidence of great crushing. The hand specimens do not show this crushing to any great extent, though the feldspar crystals are not very regular in outline at times. In this granite, which by the way, differs a good deal from the intrusive granites which break through the Slocan Slate series, near Three Forks, to the north, there are several distinct classes of mineral-bearing veins. These classes of veins differ both in origin and in the nature of the material filling them, but all occur in this typical porphyritic granite.

Class I. The most common and the most characteristic consists of irregular veins of coarsely crystallized opaque quartz. They vary quite rapidly in width, both laterally and in depth; their usual width is under four feet; their dip is very low, being from 10° to 50° from the horizon. No one of these veins has yet been explored to a greater depth than 100 feet. Hence all observations are confined to little more than surface showings.

Where shafts have been sunk a good deal of displacement is revealed along slickensided planes, more or less parallel to the strike of the vein, *i.e.*, usually parallel to the hill-slope wherever it may be.

The displacements are seldom more than a few feet, and the plane of faulting carries a good deal of gouge or selvage matter. Where the vein ends abruptly it is commonly found again by following the rule of normal faulting. The broken off, or rather the abrupt endings of the quartz veins, have a smooth and rounded appearance, which is hardly warranted by the slight throw, and, moreover, the vein when found again does not always correspond in thickness to where last seen.

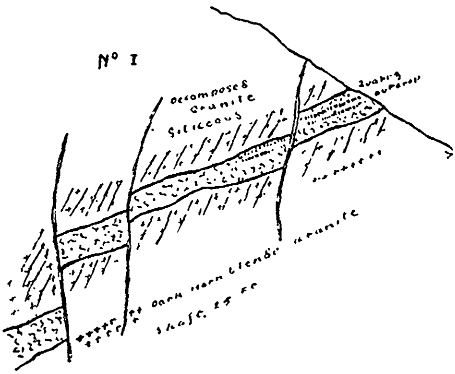
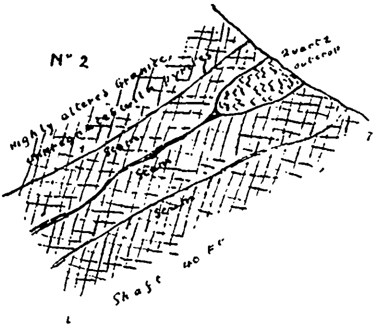


Figure 1 illustrates this faulting. It represents an actual section, as seen in a prospect shaft. A curious feature of these veins is the general tendency to pitch in towards the centre of any given mountain, ridge or range from all sides of that mountain. Possibly this may be only a result of easier discovery of veins so situated, and there may be other ones dipping outwards with the mountain slopes, as, indeed, they do in a few cases.

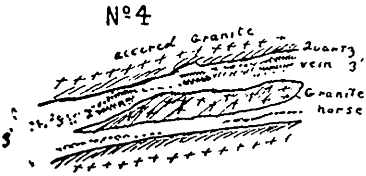
There is no general direction for these veins, this being a distinction from the silver lead veins, immediately north of this district, which have some tendency toward a north-easterly strike. Generally speaking, the veins are free from the granite walls and have more or less selvage matter along these walls, but it is not uncommon to find the decomposed granite and quartz firmly "frozen" or cemented together even on walls which, in other places, are quite free along the vein.

Figure 2 illustrates the sudden pinching out of a quartz vein. The quartz, which carries a high value in gold, suddenly rounds off like a boulder, and only a seam of selvage matter is left, whilst on either side of the seam the granite has been decomposed to a soft greenish silicious matter, which is impregnated with large crystals of pyrite. In all faulting and sudden ceasing of the ore bodies there is little evidence of dragging aside of the vein matter or other indication of which way the continuation may be found.



Aside from displacements and rapid variations in width, these quartz veins show great persistence both in reappearance and in mineralization.

The mineralization of these veins is sporadic, or chute-like, with a tendency to banding where the ore body is of regular width. Usually the enlargements give rise to a more cellular and comb-like structure, and in such places the richest minerals are found.



Horses, such as shown in Figure 4, are common. The one figured shows marked evidence of great crushing, probably anterior to the forming of the vein matter. An analysis of this horse gave :—

SiO_2	71·70
Al_2O_3	18·25
Fe_2O_3	3·18
MgO	2·12
CaO	3·36
Total	98·61

The alkalies were not determined, but are evidently much lower than the normal granite.

The precious metals, gold and silver, are found in such veins in a native state. The silver in leaf form along cleavage lines, the gold in coarse particles, sometimes crystallized; also as a natural alloy of gold and silver where the gold and silver are nearly equal in per cent., and associated with the loose granular iron pyrites occurring in these veins. This pyrites often occupies little cells in the apparently massive quartz; when the quartz is broken the pyrites falls out, leaving a clean little cell, with often some black powder, which is probably argentite.

The pyrites contains ½ oz. of gold and 200 oz. of silver, to 2 oz. of gold and 50 oz. of silver. They sometimes present a more massive or crystallized form, being still rich in silver. The locality seems to determine their richness.

The chief mineral distinctive of these veins, however, is argentite, either as a coarse aggregation of crystals, at times weighing over a gramme, which fill interstices in the quartz or as a very finely disseminated powder, which gives the quartz a bluish black appearance. The coarsely crystalline variety is more common where the powdery form is absent. The crystals appear often to fill in the spaces between well developed crystals of quartz.

A good deal of iron oxide, rich in free gold and argentite, occupies the central combed cavities of some of the veins, also iron oxide, as limonite and haematite fills up some of the interstices and cells, appearing thus to be crystallized.

Referring to the map, it will be seen that the veins of Class I. occupy a small area between Twelve Mile and Springer Creeks, nearly all the country between the Springer Creek and first north branches of Lemon Creek, and also in some very typical cases they are found south of these branches.

As one goes to the south, the gold and silver ratios of value change from about 1 to 10 to equality along the north branch of Lemon Creek, and finally further south the gold value becomes the greater.

Although the argentite, as far as known, carries little or no gold, there appears to be a direct ratio between the value of gold and silver in any one vein, or part of it. In the area defined as belonging peculiarly to this class of ores, there are few veins of any other character, save some doubtful replacement zones of low grade galena, and some quartz veins which carry mixed crystallized pyrites and galena; in these the gold and silver values are low, yet they are in the heart of the richer ore bodies.

Class II., of ore bodies, is not largely represented as yet, but it is a very distinct one, and consists of narrow veins dipping at high angles to the horizon. The ore body is mixed quartz and secondary limestone. The ore itself is galena and a very dark zinc blende, both rich in silver, and almost devoid of gold. This ore is singularly well collected along the walls of the vein, the outside slickensided portions of which consist often of the fine grained galena, called steel galena, the inner portions being a coarser galena and dark blende. Usually in this district the zinc blende is low grade in silver; here it is not so.

This class of veins has not been seen in immediate association with those of Class I. It is more distinctive of the Ten Mile slopes. The country rock is the same to all appearances.

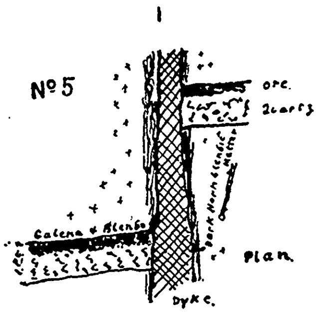


Figure 5 represents one of these veins, also the interference of the vein by a narrow dyke of a soft, soapy and grey matter, probably a micaceous trap. A very dark hornblendic biotite granite occurs in patches along this dyke also.

Class III. Some veins of this class are remarkable for their richness in silver. Though in nature and structure they appear quite common, the veins of this class show evidence of a replacement of the granite country rock by ore. These veins, or ore bodies, are nearly perpendicular.

The replacement seems to have taken place along a line of decomposed granite, often along two parallel seams, which give the impression of being the walls of a vein.

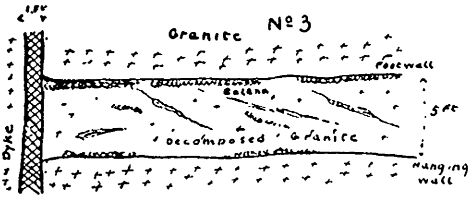
The intervening granite is penetrated by ramifying stringers of quartz and patches of galena and zinc blende. In some cases the galena is exceptionally high grade in silver. When this is the case, argentite is probably present along the cleavages of the galena. At other times the galena is low grade, far below the general average of Slocan galenas, which is somewhat over 100 oz. per ton. The blende is low grade. A case of dyke interference also occurs with one of these ore bodies. This is a narrow band of rock very similar to the one described before, only of a darker color. Under the microscope it shows itself to be a much decomposed basic "mica trap" allied to the minettes.

Such dykes, together with others rich in hornblende, are common in all this district.

An assay of rock from this dyke gave 4 oz. silver to the ton. This may have been accidental, being from an exposure in a tunnel. An analysis gives:—

SiO_2	39·38
CaO	13·44
Al_2O_3	22·94
Fe_2O_3	11·33
MgO	9·93
K_2O	Not det.
Na_2O	"
Total	97·02

On passing through this dyke, which cuts the ore body at right angles, no more ore is found. It may be that the dyke appeared before the ore did, though at first sight this seems unlikely. The dyke walls are slickensided.



Plan

Figure 3 illustrates this occurrence.

In addition to these three main classes of ore bodies there are many modifications in filling material and in structure. These, however, are not important, with the exception of a widely represented class, which occurs along the upper waters of Lemon Creek. They are low grade, patchy galena bodies in a silicious gangue. At times these may be very rich in silver also. They have little or no gold.

Another more important class is a sugar grained quartz vein, which carries some pyrites and galena as well as a fair proportion, say, 40% of free milling gold. These ore bodies are physically like Class I. They occur south of Lemon Creek. In one place on Lemon Creek there is an occurrence of free gold and galena intimately associated, but this is rare.

Concerning the small areas of dark cleavable rock, microscopical examination goes to show that they are very finely grained, altered sedimentaries. An analysis of one gave:—

SiO_2	61·74
Al_2O_3 and Fe_2O_3	19·66
CaO	14·00
MgO	2·28
K_2O	Not det.
Na_2O	"
Total	97·68

Iron pyrites is also present.

The Gohna Landslip.[1]

By Prof. W. M. Davis, Harvard University.

A remarkable instance of foresight in averting disaster is found in an account of the Gohna landslip on a head branch of the Ganges, in the Garhwal Himalaya, and of the flood that followed on the overflow of the resulting lake, as published by the Public Works Department of the Government of India (Calcutta, 1896). The slip occurred in September, 1893, continuing three days with deafening noise, darkening the air with the dust from shattered rocks, and clogging the narrow valley with 800,000,000 tons of detritus. The fall descended about 4,000 feet, spreading about two miles along the valley and rising 850 feet above the former stream level. It resulted from the undercutting of strata that dipped into the valley, and hence should be classed with those slides that follow the erosion of narrow valleys in uplifted masses; as such, being a characteristic of vigorous young mountains.

Careful study of the ground made it clear that no artificial discharge could be made for the rising lake. As the impending flood could not be controlled, every effort was made to insure the safety of the people in the valley below by timely warning of the disaster. A telegraph line was constructed from Hardwar, on the Ganges at the edge of the plains, to Gohna, 150 miles within the mountains. In April, 1894, August 15th was set as the probable date of the flood. A number of suspension bridges were dismantled and removed. Safety pillars were set up on the valley slopes, at intervals of half a mile, and at heights of from 50 to 200 feet above the ordinary river level, thus indicating the probable limit of the flood, above which there would be no danger.

The lake back of the dam grew to be four miles

[1] Reprinted from Science for March 12th, 1897.

long and half a mile wide. At midnight of August 25th–26th, during a heavy rainfall, the flood began. In four hours the lake was reduced to two miles in length and a quarter of a mile in breadth; 10,000,000,000 cubic feet of water were discharged, cutting down the barrier 390 feet; advancing at a rate of twenty miles an hour at first, and ten miles an hour further down the valley, sweeping away many miles of valley road, completely destroying two bridges that had been left standing, because of remonstrances from local authorities against their removal, and leaving no vestige of many villages and three considerable towns; yet so fully was the danger announced that not a single life was lost.

On the Origin and Relations of the Grenville and Hastings Series in the Canadian Laurentian.

By Frank D. Adams and Alfred E. Barlow, with Remarks by R. W. Ells.[1]

As the exploration of the more remote portions of the great Canadian protaxis of the North American continent progresses, accompanied by the detailed mapping of its more accessible parts, the true character, structure and origin of the Laurentian System is being gradually unfolded. The work of Logan during the early years of the Canadian Geological Survey, though excellent in the main, is being supplemented and, in certain directions corrected; and as the work is now being pushed rapidly forward, it is believed that the time is not far distant when, difficult as the study is, we shall possess as complete a knowledge of these ancient rocks as we now do of many more recent formations. In a paper which appeared in 1893,[2] it was demonstrated that Logan's "Upper

[1] Published by permission of the Director of the Geological Survey of Canada.

[2] Adams, F. D.—Ueber das Norian oder Ober-Laurentian von Canada, Neues Jahrbuch fur Mineralogie. Beilage Band viii, 1893.

Laurentian" does not exist as an independent geological series, the anorthosites, which were considered as constituting its main feature, being in reality great intrusive or batholitic masses; while in a subsequent paper,[1] it was shown that in the remaining portion of the Laurentian, two distinct classes of rocks could be distinguished, the first being beyond all doubt igneous rocks, and the second consisting of highly altered rocks of aqueous origin. In addition to these two classes of rocks of which the origin could be recognized, there was yet a third class, concerning the genesis of which there remained some doubt.

Since the appearance of these papers, the present writers have been working together in mapping a large area (about 4,800 square miles) of the Laurentian in Central Ontario, comprising map-sheet No. 118, and a portion of 119, of the Ontario series of geological maps, the district lying to the north of Lake Ontario, along the margin of the Protaxis, and being especially well suited for purposes of study. Portions of three summers have already been spent in the district, and as two years more must probably elapse before the work can be completed, it is desired here to present a general outline of the results so far obtained, indicating certain conclusions which seem likely to be reached concerning the origin of the rocks in question.

The Fundamental Gneiss, as shown by the work of the Canadian Geological Survey, occupies by far the larger portion of the protaxis as a whole; while the Grenville Series has probably its principal development along the south-eastern margin, although as the exploration of this vast area is continued, new and possibly more extensive areas of these rocks may yet be found. Strata, belonging to this series, are already known to occur on the upper Manicuagan River, the lower Hamilton River, on the

[1] Adams, F. D.—A Further Contribution to our Knowledge of the Laurentian, Am. Journal of Science, July, 1895.

Manouan Branch of the Peribonka and on the lower part of the Ungava River, in the Labrador peninsula; while similar rocks, which would seem to belong to this series, but which have not as yet been thoroughly examined, have been met with about southern Baffin's Land, and possibly about Baker Lake near the head of Chesterfield Inlet, as well as on the west coast of Hudson Bay and also at Cross Lake on the Nelson River.

The Fundamental Gneiss consists of various igneous rocks closely allied in petrographical character to granites, diorites and gabbros, and which almost invariably have a more or less distinct foliation. Where this foliation is scarcely perceptible it becomes very difficult to decide whether the rock is an intrusive granite or diorite, or a very massive form of the gneiss in question. The different varieties of gneissic rock alternate with or succeed one another across the strike, or sometimes cut one another off, suggesting a complicated intrusion of one mass through the other, but there is usually a general direction of strike to which, in any particular district, the foliation of all the varieties conform. The associated basic rocks are very dark or black in color and are usually foliated, but sometimes this foliation is absent and the rock occurs in masses of all sizes and shapes scattered through the acid gneisses, and in the great majority of cases so intimately associated with the latter that it is impossible to separate the two in mapping. The smaller of these masses can be distinctly seen to have been torn from the larger, which latter are often of enormous size. This process can be observed in all its stages. The granitic gneiss invades the great basic masses, sending off wedge-like arms into them, which tear them apart and anastomose through them in the most complicated manner. These smaller masses can then be observed to be separated into still smaller fragments, which either from the fact that they split most readily in the direction of their foliation or owing to subsequent movements, when the rock was in a more or less plastic condition, often assume long ribbon-like forms. That great movements have taken place in the whole series during or after this invasion is shown by the complicated twisting of these darker bands and masses into all manner of curious and intricate forms, as well as in the frequent rolling out of great blocks of the amphibolite, after having been penetrated in all directions by small pegmatite veins, resulting in masses of a dark basic gneissoid rock, filled with strings, bunches, separated fragments or grains of quartz or feldspar, giving to the mass a pseudo-conglomeratic appearance.

There can be but little doubt that the various gneissic rocks, constituting the more acid part of the series, are of truly igneous origin; and there is no evidence whatever of their having ever formed part of a sedimentary series.

The true character of the more basic members is more uncertain, but they are probably closely related to the pyroxene granulites of Saxony, and doubtless represent either differentiation-products of the original magma, or basic intrusions whose structural relations and characters have been largely masked by the great movements which have taken place in the whole series at a later date.

The Grenville Series differs from the Fundamental Gneiss in that it contains certain rocks whose composition marks them as highly altered sediments. These rocks are chiefly limestones, with which are associated certain peculiar gneisses, rich in sillimanite and garnet, having a composition approaching ordinary shale or slate, or else very rich in quartz and passing into quartzite, having thus the composition of sandstone. These rocks, as has been shown in one of the papers before referred to, usually occur in close association with one another, and are quite different in composition from any igneous rocks hitherto described. They are considered as constituting the essential part of the Grenville series. They usually, however, form but a very small proportion of the rocky complex in the areas in which they occur, and which, owing to their presence, is referred to the Grenville series. They are associated with and often enclosed by much greater volumes of gneissic rocks, identical in character with the Fundamental Gneiss. The limestones are also almost invariably penetrated by masses of coarse pegmatite, and occasionally large masses of the limestone are found embedded in what would otherwise be supposed to be the Fundamental Gneiss. The whole thus presents a series of sedimentary rocks, chiefly limestones, invaded by great masses of the so-called Fundamental Gneiss, and in which, possibly, some varieties of the gneissic rocks present may owe their origin to the partial commingling of the sedimentary material with the igneous rocks by actual fusion. There is, however, no reason to believe, from the evidence at present available, that any considerable proportion of the series has originated in the last mentioned manner.

It will be readily seen that an exact delimitation of areas of the Grenville series is thus sometimes a matter of great difficulty, as they often appear to shade away into the Fundamental Gneiss, and it has hitherto been difficult in the case of the Grenville series to account for the existence of such a comparatively small proportion of sedimentary strata, intimately associated with such great volumes of igneous gneisses.

The relations of the two series, as determined by the investigations of the last two seasons, throws new light upon the subject, and indicates the probable explanation of the difficulty.

The north-western half of the more restricted area at present under consideration is underlain by Fundamental Gneiss, presenting the characters described above. A smaller area of the same gneiss occurs at the southwestern corner of the area, in the townships of Lutterworth, Snowdon and Glamorgan, while in the southern and south-eastern portions of the area there are other occurrences, which, however, present a more normally granitic character.

The south-eastern portion of the area is underlain by rocks of the so-called Hastings Series, consisting chiefly of thinly-bedded limestones, dolomites, etc., cut through by great intrusions of gabbro-diorite and granite. These limestones and dolomites are usually fine-grained and bluish or greyish in color, with thin interstratified layers, holding sheaf-like bundles of hornblende crystals. As compared with the limestones of the Grenville series they are comparatively unaltered. They form beyond all doubt a true sedimentary series, and in the south-eastern corner of the area are associated with conglomerates or breccias of undoubtedly clastic origin. Between the great area of Fundamental Gneiss in the north-west, and the Hastings series in the south-east of the sheet, there lies an irregular-shaped belt of rocks, presenting the characters of the typical Grenville series as above described, the limestones having in all cases the form of coarsely crystalline, white or pinkish marbles, although more or less impure. The strike of the foliation of the Grenville series follows in a general way the boundaries of the Fundamental Gneiss, and is seen in an especially distinct manner to wrap itself around the long and narrow development of the gneiss exposed in the south-west corner of the area. Isolated masses of the limestone and gneiss characteristic of the Grenville series are also found in the form of outlying patches about its margin, as, for instance, in the townships of Lutterworth and Stanhope. The relations of the Grenville series to the Fundamental Gneiss are such as to suggest that in the former we have a sedimentary series later in date than the Fundamental Gneiss, which has sunk down into and been invaded by intrusions of the latter series when this was in a semi-molten or plastic condition. The limestones, while themselves rendered more or less plastic by the same heat which softened the lower gneisses, do not show any distinct evidence of absorption or solution by the invading rocks, unless some of the highly garnetiferous gneisses usually associated with the limestones are formed by a commingling of the two rocks. Masses of the highly crystalline limestone or marble in some cases lie quite isolated in what are, to all appearances, the lower gneisses, as if they had been separated from the parent mass, and had passed outward or downward into the gneissic magma.

The contact of the Fundamental Gneiss and the Grenville series would appear therefore to be a contact of intrusion, in very many cases at least.

The question of the relations of the Grenville series to the Hastings series then presents itself. Although repeated traverses have been made from one series into the other, no sharp line of division has been found. Towards the south-east the limestones of the Grenville series in many places, though still highly crystalline, seem to be less highly altered, and finally, as the Hastings series is approached, present in places the bluish color of the limestones of the latter series; so that it is often impossible to determine to which series they should be referred. The limestones of both series also have the numerous small interstratified gneissic inclusions or bands so frequently referred to in the descriptions of the limestones of the Grenville series, making the resemblance still more complete. In fact, although the true relations of the two series are obscured by the presence of numerous great intrusions of granitic and basic pyroxenic rocks, and can only be determined with absolute certainty by the completion of the mapping, the investigations so far indicate that in the region in question the Hastings series would seem to represent the Grenville series in a less altered form. In other words, the Hastings series, when invaded, disintegrated, fretted away and intensely metamorphosed by and mixed up with the underlying magma of the Fundamental Gneiss, constitutes what has elsewhere been termed the Grenville series. The Grenville series may, however, represent only a portion of the Hastings series, and the work so far done in this district has not been sufficient to determine the stratigraphical position of this portion.

Concerning the age of the Hastings series but little is known as yet. To the south-east of the area under consideration, however, its clastic character is well marked, breccias and conglomerates, often greatly deformed by pressure, being present as well as certain fine-grained and comparatively unaltered limestones, in which a very careful search may yet be rewarded by the discovery of fossils. Both lithologically and stratigraphically the rocks bear a striking resemblance to rocks mapped as Huronian in the region to the north and north-east of Lake Huron, and it seems very likely that the identity of the two series may eventually be established. The two areas, however, are rather widely separated geographically, so that the greatest care will have to be exercised in attempting such a correlation.

Like the Grenville series, the rocks of the Hastings series are unconformably overlain by and disappear beneath the flat-lying Cambro-Silurian rocks of the plains, which limit the protaxis on the south and are separated from it in time by an immense erosion interval. Further investigation in this area, as well as in that adjoining to the east, now being mapped by Dr. R. W. Ells, will, however, it is hoped, before long throw additional light on the age of this very interesting and important series of rocks. If further investigation proves that the relations of the several series have been correctly diagnosed, and that the explanation of these relations as given above is correct, the Laurentian system of Logan will resolve itself into an enormous area of the Fundamental Gneiss, which is essentially of igneous origin and which there is every reason to believe forms part of the downward extension of the original crust of our planet, perhaps many times remelted and certainly in many places penetrated by enormous intrusions of later date; into which Fundamental Gneiss, when in a softened condition, there have sunk portions of an overlying series, consisting chiefly of limestones.

Farther east, in that portion of the Province of Quebec where the Grenville series was first studied by Logan, the rocks of the Hastings series proper have not been recognized. The Lower Paleozoic strata rest directly upon the Grenville series and would cover up the Hastings series to the south should it extend as far east as this. The limestones of the Grenville series, moreover, here extend much farther back from the edge of the protaxis in bands and streaks conforming to the strike of the underlying gneissic rocks, so that the origin of the series and its relations to the Fundamental Gneiss is not so clearly indicated. When, however, its relations here are interpreted in the light of the Ontario occurrences, there seems to be no reason why the same explanation might not be offered to account for its origin also. The bands of limestone, which often vary in thickness from place to place, and are frequently interrupted in their course or abruptly cut off, might be considered as having taken their form from long folds in the series from which they were derived as it settled down into the magma beneath, or as having been separated by great lateral intrusions of the gneissic magma. Their original shape and character has, however, without doubt been greatly altered by the enormous movements to which both series of rocks have been subsequently subjected.

If again this proves to be the true explanation of the relations of these series, the Grenville series will cease to be an anomaly among our Archæan formations and will, so far as its mode of occurrence is concerned, bear the same relation to the Fundamental Gneiss as the Huronian does farther west in the Lake Superior and Huron district, as shown by Lawson and Barlow; the similarity in position, however, not implying identity in age.

The recognition of the Grenville series as consisting of a series of sedimentary rocks, largely limestones, invaded by igneous material which now makes up by far the greater portion of the series and consists largely of extravasations of the Fundamental Gneiss, is now pretty certainly established by the field evidence. Its recognition as a portion of the Hastings series which has been intensely metamorphosed, will probably be more clearly established as the field work progresses. Since subordinate areas of the Grenville series also occur to the south of the St. Lawrence in the Adirondack region, and are now being mapped, it will be of great interest to ascertain whether the same relations do not also exist in that area, and whether a continuation of the Hastings series to the south cannot be recognized in the "Huronian Schist" of St. Lawrence and Jefferson counties, shown upon the Geological Map of the State of New York, which has just been issued by the Geological Survey of this State.

It is perhaps unnecessary to draw attention to the fact that the recent investigations of Messrs. Wolff, Brooks, Nason, Kemp, Westgate and others on the crystalline limestones of New Jersey have a certain bearing on this subject.

Remarks by R. W. Ells:

In connection with the statements advanced in the preceding paper by Dr. Adams and Mr. Barlow, it is but right that the conclusions arrived at from the study of the similar rocks in their eastern and northern extension should be stated. The investigations in this quarter have now been carried on for six years, and have extended over a very large area to the north of the Ottawa, in which is included the typical Grenville series of Sir W. E. Logan, and extending far up the Gatineau River; while to the westward, the work has been carried on till the vicinity of the area, described in the accompanying paper, has been reached. It may be said therefore that the detailed examination of the rocks which make up the Grenville and Hastings series has extended over an area about 250 miles in length by 75 miles in breadth.

In the early days of the study of these rocks much difficulty was experienced. Firstly there was a great and almost inaccessible wilderness, the only available means of travel over the greater portion being by canoes; and in the second place there was an almost entire lack of trained observers to carry on the work. Add to this the entire absence of microscopical determinations, and one can readily comprehend the difficulty experienced in the attempt to solve this most difficult of the problems in Canadian geology.

Foliation and stratification were considered conclusive evidence of sedimentation, and as most of the rocks of the great Laurentian complex gave evidence of these forms of structure, the inference naturally followed that the greater portion of the gneissic, granitic and anorthositic rocks were of sedimentary origin. So far was this sedimentary theory carried out that, in the earlier reports of the Geological Survey, even the masses of binary granite and many of the pyroxenic rocks were included in the same category. This was at the time a very natural conclusion, since many of these masses have a regular bedded structure and conform, over very considerable areas, to the regular stratification of the rocks, either gneiss or crystalline limestone. As the country became more accessible the field investigations showed very clearly in the intrusive nature and later age of many of these masses, while the aid of the microscope fully established the non-clastic and igneous character of the great bulk of the gneisses. The more recent and probably sedimentary origin of the limestones and associated gneisses of the Grenville series, as distinct from the great mass of the underlying Laurentian Fundamental Gneiss, was pointed out some years ago in a paper by the author, read before the Geological Society of America. The subsequent investigations on these rocks, to the west and south-west, showed that the conclusions then presented were correct, but that as the work extended westward to the south side of the Ottawa the character of the various groups of rocks gradually changed. The areas of limestone became much more extensive, and there was a large development of hornblende and other dark-colored rocks, rarely seen to the north of the Ottawa. The limestones also were very often highly dolomitic, and in certain areas were blue and slaty, with but little of the aspect of the Grenville limestones, except where they were in close contact with masses of intrusive granite or diorite. There is also in the rocks of this group to the south of the Ottawa, where they have been styled the Hastings series, from the fact that they were first studied in the county of Hastings, a very considerable proportion of schists, micaceous, chloritic and hornblendic, with certain regu-gularly slaty beds, and others of true conglomerate containing quartz pebbles. In certain portions the lithological resemblances between the Grenville and Hastings rocks are very close, and they may, for all practical purposes, be regarded as one and the same series. From a number of sections made in the counties of Renfrew on the south of the Ottawa, and in Pontiac, to the north of that river, it would appear that the original Grenville limestones and associated grey and rusty gneiss from the lower part of the series, since it is only on their development westward towards the typical Hastings locality that the characteristic Hastings schists and associated strata are met with.

In character and general aspect these rocks of the Hastings series are almost identical with many of those which in the Eastern Townships and in New Brunswick have been regarded as probably Huronian for many years; and so marked is the resemblance that the author, in presenting his summary report for 1894, referred the rocks seen near the Bristol iron mines to that division. It now appears very conclusively established that both in the eastern and western areas we have a well developed series of rocks, including limestones, gneiss and schists, which are of undoubted sedimentary origin, but which have been enormously acted upon by great intrusive masses as well as by other dynamic agencies, so that in many parts their original characters have almost entirely disappeared.

NOTE ON CARBONIFEROUS ENTOMOSTRACA, FROM NOVA SCOTIA, IN THE PETER REDPATH MUSEUM, DETERMINED AND DESCRIBED BY PROF. T. RUPERT JONES, F.R.S., AND MR. KIRKBY.

By SIR WILLIAM DAWSON, LL.D., F.R.S.

Having had occasion recently to look over some specimens of these interesting animals in the Peter Redpath Museum, it occurs to me as likely to be useful to collectors and geological workers to summarize in the *Record of Science* what is known of them as occurring in Nova Scotia.

When preparing my Acadian Geology, and especially the second edition of that work,[1] as well as later papers

[1] 1868.

supplementary to it, I took advantage of the kindness of Prof. Rupert Jones, F.R.S., the highest authority in the study of the Palæozoic Entomostrăca, to place in his hands for determination the specimens which I had collected. The material thus submitted to Prof. Jones, between the years 1855 and 1884, was eventually in the latter year published in a collected form in a paper contributed by him to the *London Geological Magazine*, with a page of excellent illustrations, some of which are copied, by permission, in the present note. A little later, in 1889, Prof. Jones published in the same magazine an additional note on specimens collected by Mr. Foord, F.G.S., in the coal-formation at Mabou, Cape Breton, and which were communicated to him by Mr. Whiteaves, F.G.S., Palæontologist to the Geological Survey of Canada. These, however, added no new species to those previously known. Still later, in one of his reports to the British Association, he notices an example of *Estheria Dawsoni*, collected by Mr. Fletcher of the Geological Survey, at Five Islands.

The specimens described or noticed in the paper of 1884[1] were partly from the Horton series of the Lower Carboniferous, at Lower Horton, Horton Bluff and the Strait of Canseau, and partly from the Middle Coal-formation of Cumberland, Colchester, Pictou and Cape Breton; and in order to indicate their stratigraphical positions, it may be best to take them here in the order of time, as constituting two groups, one Lower Carboniferous (Sub-Carboniferous of Dana, Tweedian and Calciferous of Great Britain and Culm of the continent of Europe), the other belonging to the time of the Middle or Productive Coal-Measures.

[1] Carboniferous Entomostraca from Nova Scotia, by T. Rupert Jones and James W. Kirkby, Geological Magazine, August, 1884. Some of the species had been separately mentioned or described in the same journal in 1870, 1878 and 1881.

I.—LOWER CARBONIFEROUS.

The Lower Carboniferous collections belong to the beds holding plants and fish remains which locally underlie or replace the marine limestones, and which I have called the Horton Series, from their great development and good exposure at Lower Horton and Horton Bluff, where they were examined and recognized as the equivalent of the lowest member of the Carboniferous in Scotland, by both Lyell and Logan. In specimens collected in these beds and the corresponding beds on the Strait of Canseau and in Pictou, the following species have been recognized by Prof. Jones.

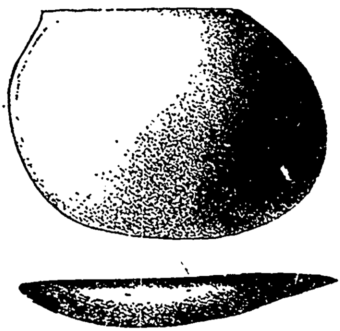


Fig. 1. Left Valve. 1*b*. Valve edgewise. x 25.

1. *Leperditia Okeni*, Munster (Fig. 1) and its variety *L. Scotoburdiegalensis* of Hibbert, a very widely distributed species and characteristic of the Lower Carboniferous in Russia, Bavaria and Scotland. In the latter it occurs abundantly in the shale and limestone of Burdiehouse, near Edinburgh, celebrated for fish remains; and in which I first saw this fossil in my student days in Edinburgh before I had collected it in Nova Scotia. Prof. Jones remarks: "It is of especial interest to meet with so old a friend, so abundantly and with so robust a habit, for we have not seen larger examples of it in Scotland, in

Carboniferous rocks on the American side of the Atlantic." I may add that in Nova Scotia, as in Scotland, it is associated with fishes of Carboniferous genera and with Lepidodendra and Ferns of Lower Carboniferous types, the whole being, as I have shown in "Acadian Geology" and in my report on the Flora of the Lower Carboniferous in Nova Scotia,[1] a very precise equivalent of the European beds representing this interesting formation, the earliest precursor of the conditions of the Coal-Measures.

I have specimens of this Leperditia less perfectly preserved, from the Lower Carboniferous shales of the East Branch of the East River of Pictou.

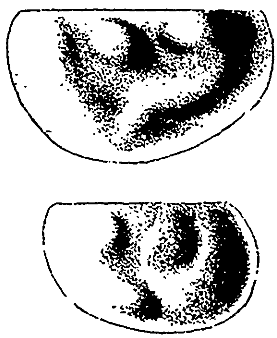


Fig. 2. Right and Left Valves, x 25.

2. *Beyrichia Nova Scotica*, Jones and Kirkby (Fig. 2.) This seems to be a new species, but is very near to one found by Eichwald in Russia—*B. Colliculus*, Eichwald. This species is less plentiful in my collections than the previous one.

Fig. 3, x 25.

3. *Beyrichia* Sp. (Fig. 3.) A single small valve from Horton represented this species in the collections sub-

[1] "Acadian Geology," p. 252, *et seq.* Report on Fossil Plants of Lower Carboniferous, etc., Geol. Survey of Canada, 1873.

mitted to Prof. Rupert Jones. It seems very rare, and may be merely a depauperated variety or immature state of the last mentioned.

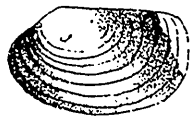


Fig. 4, x 5.

4. *Estheria Dawsoni*, Jones[1] (Fig. 4.) The specimen described by Prof. Jones is from Horton but the same species has more recently been collected by Mr. Fletcher, of the Geological Survey, at Five Islands, and was identified by Prof. Jones on being submitted to him. It has also been found in Scotland. I have either the young of this species or a similar one of smaller size from the East River of Pictou.

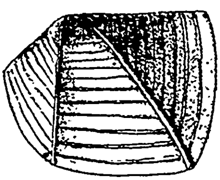


Fig. 5, x 5.

5. *Leaia Leidyi*, Jones (Lea Sp.), var. *Salteriana*, Jones (Fig. 5.) This species, unique in my collections, from the Lower Carboniferous of the Strait of Canseau, is widely distributed in the Carboniferous on both sides of the Atlantic. It was first discovered in Pennsylvania, but a second species or variety of larger size has been found in Illinois. (*L. tricarinata*, Meek & Worthen.) It seems to be rare in Nova Scotia, which is unfortunate, as it is so

[1] Geol. Mag., 1870, p. 220, Pl. IX., Fig. 15.

well marked a species, and so useful as an indicator of the Lower Carboniferous in disturbed districts.

Fig. 6, x 25.

6. *Cythere* (Species), (Fig. 6.) Valves, apparently representing two species, occur in the Horton shales, but have not been identified as yet with any known species.

II.—COAL FORMATION.

Small bivalve Entomostraca are very abundant in some carbonaceous shales and bituminous limestones at the South Joggins, Chiganois River, East River of Pictou, Glace Bay, Cape Breton, Sydney, C.B., Mabou, C.B., &c., where they seem to bave swarmed in the lagoons of the coal swamps, as Cyprids do in some modern ponds, but the species do not seem to be numerous. Those noticed in the paper in question are the following:—

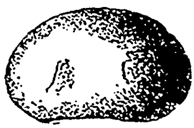


Fig. 7, x 25.

1. *Carbonia fabulina,* Jones & Kirkby (Fig. 7.) This is one of the most abundant species at all the localities, and sometimes covers the entire surfaces of layers of shale

and shaly limestone. It is also a characteristic British species.

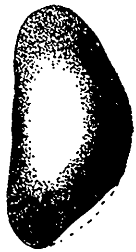


Fig. 8, x 25.

2. *Carbonia bairdioides,* J. & K. (Fig. 8.) Less abundant than the preceding, at the Joggins and also at Mabou, where it was collected along with the preceding by Mr. Foord, but it is abundant in the Upper Coal Formation of Smelt Brook, East River, Pictou. It is also a common Scottish species.

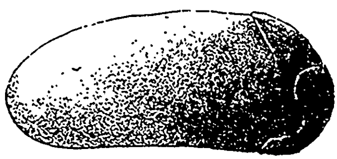


Fig. 9, x 25.

3. *Candona elongata,* J. & K. (Fig. 9.) 'Larger and more elongated than the preceding forms, but much less abundant. It attains the length of $\frac{1}{14}$th of an inch.

Prof. Jones has some interesting remarks on the very wide distribution of all these species in the Northern Hemisphere, in connection with the fact that they were probably shallow-water, or even brackish-water species. This indicates means of transit for such animals, by shallow areas either now oceanic or now land. It concurs with many other facts in showing that the comparative rarity of great ocean depths and high mountain ranges in the Carboniferous period had important connection with its equable climate and uniform animal and vegetable life over vast areas. Prof. Jones's discussion of this subject shows how much can be learned from the careful study of very minute and inconspicuous animal remains.

Note.—All the figures, except Nos. 4 and 5, are magnified about 25 diameters.

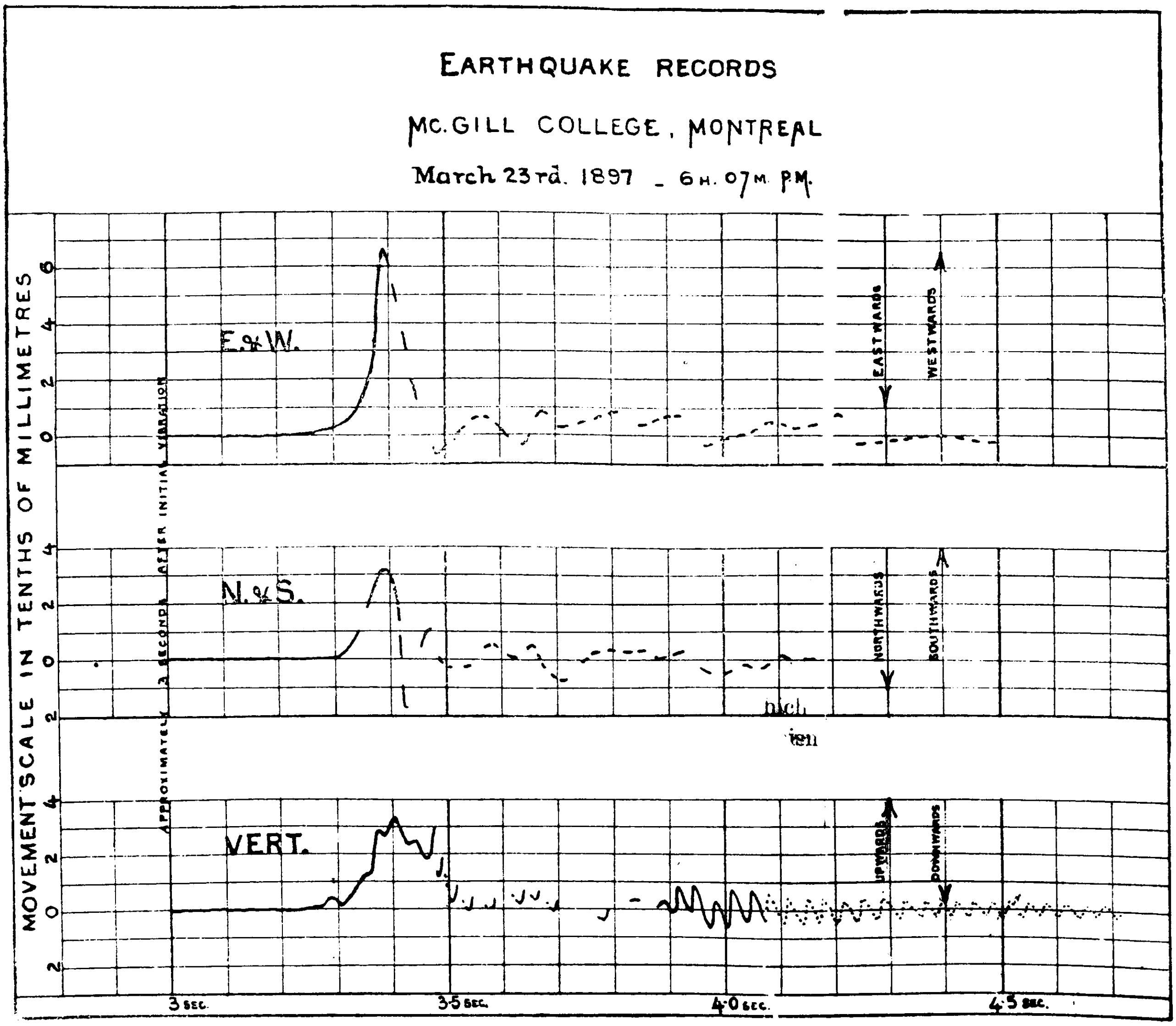
OUR RECORD OF CANADIAN EARTHQUAKES.

By PROF. C. H. MCLEOD and PROF. H. L. CALLENDAR.

In *The Canadian Record of Science* for January, 1894, will be found a very complete account of recorded Canadian earthquakes, by Sir J. William Dawson. This record includes a slight shock felt in the neighborhood of Toronto on Feb. 23rd, 1894. The first record following that date was on August 27th, 1894, at Montreal, at 0h. 44m. a.m., a slight rumbling sound following the principal shock, which was of moderate intensity. In 1895 the following records are given :—April 17th, Richmond, Brome, St. Hyacinthe and Montreal. At Montreal the shock lasted about 10 seconds, general direction towards the south-east, and the time of its occurrence was 11h. 15m. a.m. On October 25th a shock was recorded at several points on the British Columbia coast and in Vancouver Island. On December 9th, at 0h. 25m. a.m., a shock, with a rumble lasting 18 seconds, was noted at Montreal. In 1896 portions of British Columbia (records at Esquimalt and Keeper Island), experienced shocks on Jan. 3rd, and again on Oct. 29th (record at Rivers Inlet.) In 1897 shocks have up to this date been observed on four days, all of which were in the month of March. On the 7th records were had at Pont de Mont, Thorold, St. Catharines, Lewiston and Niagara. On the 23rd a shock, which although falling short of the destructive class, was probably amongst the most severe which have visited this portion of Canada in recent years, was recorded at Montreal and throughout Quebec Province and Eastern Ontario. The disturbance covered an area measuring approximately 300 miles by 100 miles, having its major axis along the St. Lawrence Valley and the Island of Montreal at its centre. On the 25th of March a shock was recorded at Esquimalt. On the 26th Montreal and parts of Quebec and Eastern Ontario were again visited by a slight but sharply distinct earthquake. The main shock occurred at 0h. 4m. 20s., Eastern standard time, at McGill College, being preceded and followed by a distinct tremor of buildings with the usual rumbling noise. The tremor was first observed at 5 seconds before the main shock, and lasted for about 10 seconds after it. This earthquake is a somewhat exceptional one in Canadian records, as it seems to have been heralded by a slight tremor at about midnight, and to have been followed by another similar tremor at about 5 o'clock a.m.

The earthquake of March, the 23rd, is of interest locally, not only on account of its severity, but also as it was the first of which a record was obtained in Canada. A set of Ewing Seismographs had recently been set up in the Physics Building which, although frequently deranged by the engineering operations in the vicinity, fortunately happened at the time to be in adjustment and on the look out for a chance earthquake.

The object of these instruments is to record the actual extent, direction and velocity of the movement of the ground at any time during the shock. It has been abundantly shown of the researches of Ewing and others, especially in Japan, that no adequate record can be obtained by any of the older methods, which, at best, give only the direction or amplitude of the principal movement,


EARTHQUAKE RECORDS
MC.GILL COLLEGE, MONTREAL
March 23rd. 1897 - 6H. 07M. P.M.
E.&W.
N.&S.
VERT.
MOVEMENT SCALE IN TENTHS OF MILLIMETRES
APPROXIMATELY 2 SECONDS AFTER INITIAL VIBRATION
EASTWARDS
WESTWARDS
NORTHWARDS
SOUTHWARDS
UPWARDS
DOWNWARDS
3 SEC.
3·5 SEC.
4·0 SEC.
4·5 SEC.

and are in general quite misleading. Moreover, the destructive effect of an earthquake depends quite as much on the velocity as on the amplitude of the motion.

In the Ewing Seismographs the actual movement of the ground in an earthquake is recorded by means of three delicately balanced pendulums, to which light styles are attached, tracing the relative movements of the pendulums on a revolving plate of glass covered with a thin film of smoke black. Two horizontal pendulums are used for recording the movements in the east and west and north and south directions respectively. The traces made by these pendulums magnify the actual movement five times. A third pendulum gives the vertical movement on a scale magnified twice. By combining the three records, the actual movement of a point of the earth's surface at any time may be obtained. In general, the earth movement is extremely complicated, and lasts for a considerable time, consisting of irregular vibrations, which have no relation to the direction of propagation or the origin of the disturbance, and cannot be specified as a single shock of definite direction.

The accompanying figures represent the record of the earthquake of Tuesday, March 23rd, 1897, 6 hrs. 7 min. p.m., at the McDonald Physics Building. The apparatus was started by means of a delicate seismoscope, making an electric contact, three seconds before the main shock which, in this instance, consisted practically of a single movement followed by small subsidiary oscillations. The seismoscope starts a clock, which records the time of the shock, and also marks the time in half seconds on the revolving plate.

The records obtained on the glass plate have been enlarged to forty times the actual earth movement and are drawn to a uniform scale. The scale of tenths of a millimetre shows the actual extent of the movement of the earth's surface. As compared with the horizontal, the vertical movement was unusually violent and rapid. As a consequence of this, the record for one or two seconds after the main shock is dotted.

The minuteness of the motion of the ground in an earthquake is at first sight rather surprising. There can be no doubt, however, that these instruments record the movement correctly, as they can be very easily tested, and the theory is very simple. The profound impression on the senses produced by an earthquake shock is due to the irresistible nature of the motion and the immense masses of matter affected by it. In the earthquake of March 23rd, the maximum extent of the movement of the ground is seen by the records to have been only about one-fortieth of an inch. That of the very similar shock of March 26th, midnight, was only one-hundredth of an inch. These movements appear at first sight excessively minute, but it appears from records of many other earthquakes taken in a similar way that a vibration of only a tenth of an inch, if sufficiently rapid and long continued, may be exceedingly destructive, especially to solidly founded buildings.

Book Notices.

Lakes of North America, a Reading Lesson for Students of Geography and Geology.—By Israel C. Russell, Professor of Geology, University of Michigan. Ginn & Company, Boston and London, 8vo., pp. 125.

Mr. Russell, who, for thirteen years, was connected with the Geological Survey of the United States, and thus had ample opportunity of carefully studying the topographical features of various parts of the continent, including Alaska, has, in this book, given in popular form a description of lakes and their various relations, illustrating his descriptions chiefly from the wealth of examples afforded by the lakes of North America.

Mr. Russell's original contributions to this field are extensive and of the highest order, the most notable being his "Geological History of Lake Labontan," which appeared as one of the monographs of the United States Geological Survey, and his personal studies thus render him eminently fitted to treat the subject as a whole. A companion volume on the Glaciers of North America by the same author, has just been announced.

The subject is discussed under the heads of the Origin of Lake Basins, the Geological Functions of Lakes, the Topography of Lake Shores, the Relation of Lakes to Climatic Conditions, the Life History of Lakes, and concludes with a special study of the history of three important lake systems, namely, the Pleistocene Lakes of the St. Lawrence Basin, Lake Agassiz and the Pleistocene Lakes of the Great Basin. The numerous illustrations add greatly to the interest of the book.

The subject of the Origin of Lakes is one which has been much discussed by various writers, and on certain minor points there are still differences of opinion. But certain great types of lakes can be selected, concerning whose origin there can be no question.

Thus there are the lakes which occupy depressions in what was the old sea bottom, in tracts of country recently elevated above sea level. These are not common in America, for the reason that while large portions of our coast are sinking new land areas are rare. The lakes of Florida, however, are good examples of this class. Other lakes of this type, whose present positions, however, have been partly determined by the rising or sinking of great blocks of the earth's crust along extended lines of fracture, are the lakes of the Great Basin, that vast area of interior drainage between the Sierra Nevada and the Rocky Mountains. Many of these, though still large in size, are mere remnants, left by the evaporation of the very much larger lakes which, in the Pleistocene age, were found in this region. Thus Great Salt Lake and Sevier Lake, Utah, are the remnants of a great inland sea which has been named by Gilbert, Lake Bonneville, while Pyramid, Walker and other lakes in Nevada mark the position of another great body of water which Mr. Russell has called Lake Labontan.

Another class of lakes are the "Ox-box" Lakes, which represent portions of former river courses which have been cut off by rivers straightening their channels as they wander through a wide flood plain. Such crescent-shaped lakes are found in many places along the course of the Lower Mississippi. Then, again, there are lakes which owe their origin to glacial agencies, and which, owing to the fact that so large a portion of North America was formerly covered with ice, are extremely abundant. These, in some cases, occupy actual rock basins, scooped out by moving ice, while in other cases they lie in the morainic deposits left by the ice upon its retreat. Such lakes, ranging in size from mere pools up to splendid water sheets, many square miles in extent, are so abundant over the formerly ice-covered portion of North America that the position of the southern boundary of the old ice sheet may be approximately traced on an accurate map by noting the southern limit of the lake-strewn portion. In the country south of the glacial limit, lakes are almost entirely absent. The "Finger Lakes" of the central part of New York probably belong to this class.

Lakes due to volcanic action, although by no means so numerous, have an especial interest. Of these perhaps Crater Lake, in North-Western Oregon, which has been described by Dutton and more recently by Diller, is the most remarkable, and is situated 30 miles north of Klamath Lake at an elevation of over 6,000 feet above sea level. It is six miles in diameter, and is surrounded by precipitous cliffs, rising from 900 to 2,200 feet above the lake and plunging down into the deep water of the lake without leaving even a margin wide enough to walk upon. This is also the deepest lake in North America, the sounding line striking bottom at 2,000 feet. The lake marks the site of an old volcano, whose summit was either blown away by a mighty series of explosions like those which blew 5,000 feet from the summit of Krakatoa some few years since, or else the mountain was melted from within, its summit sinking down into the gulf, giving rise to the depression now partially filled by the placid and mysterious waters.

Lakes, like all other things in nature, have their life history. Their period of birth, youth, maturity, decadence and old age leading to extinction. The tracing out of such histories is one of the most fascinating tasks of the geologist, and the last chapter, in which the histories of several of the great lakes of North America are given, is perhaps the most interesting in the book, and will serve to bring clearly before the general reader the great changes which have passed over the face of the continent in comparatively recent times.

Mr. Russell's book, while not containing very much new matter, is interesting and well written, and affords a valuable addition to our literature.

FRANK D. ADAMS.

McGill University.

SUMMARY REPORT OF THE GEOLOGICAL SURVEY DEPARTMENT FOR THE YEAR 1896.

Not the least interesting or instructive of the many valuable volumes issued by this important branch of the Civil Service of Canada is the summary report of its proceedings, which is presented by the Director at the close of each year. This gives a brief but comprehensive account of the work of all divisions of the Geological Survey, not only of the explorations and discoveries made, but also of the work done in the chemical and petrographical laboratories, the publications and their distribution, and the important questions of the care of the museum and the financial statement of the Department.

The present report, which has recently appeared, contains 144 pages, and can be obtained from the Librarian of the Geological Survey Department for the sum of 10 cents.

In conciseness of form and arrangement of details, it is marked by the clearness and precision which characterize the reports of the able Director of the Geological Survey.

During the year 1896 the field work was of the usual extensive and practical character. Investigations were made in the most important gold mining regions, viz., Kootanie, Rainy River, the Eastern Townships and Nova Scotia, a deep boring was made in the petroleum district of Athabasca, while questions of less immediate economic importance, but of equal scientific and ultimate value, were studied in all parts of the Dominion.

In British Columbia Mr. McConnell made a geological examination of the noted mineral region south of the Kootanie River. This whole district is remarkable for the great preponderance of igneous rocks. These are of two distinct series, representing at least two periods of volcanic eruption, the older comprising groups of porphyrites, gabbros and associated eruptives, the latter, an area of granite. The relations of the different members of the older series to one another is best known in the vicinity of Trail Creek. Of these Mr. McConnell says: "At Rossland, the central member of the group is a fine to coarse-grained gabbro, apparently passing in a couple of places into a uralitic granite. The gabbros occupy an irregular shaped area with a length of about four miles and an average width of one mile. * * * The gabbros are fringed with a varying width of augite and uralite-porphyrites and fine-grained green diabases. The passage from the porphyrites to the gabbros is nowhere sharply defined, and the two rocks have apparently originated from the same magma, but have cooled under different conditions. The gabbros and bordering porphyrites are important from an economic standpoint, as most of the ore bodies at present being worked are situated either on or close to their line of junction. The roughly concentric arrangement of the Trail Creek rocks, and the gradual passage outward from a holocrystalline central area through semi-crystalline rocks to bedded volcanic fragmentals, suggest an ancient (although now deeply eroded) volcanic centre, situated near the site of the present town of Rossland, from which lavas and ashes deluged the surrounding district. The presence of small bands of coral bearing limestones with the agglomerates and tuffs also makes it probable that a shallow sea existed at the time of the outburst, and that the eruptions were intermittent and continued during a lengthened period."

The ores contained by these rocks were found to be of a rather low grade, but with better facilities for smelting and transportation, the number of paying lodes would be greatly increased and the value of all enhanced. Mr. McConnell believes that the greater number of the ore deposits occur in the form of replacement veins.

The newer series of eruptive rocks consists chiefly of granite in varied forms, but owing to its less complex nature the detailed structure is not so important.

In the Shuswap district of the same province, Mr. McEvoy completed the investigation necessary for the geological map sheet of that area. This work was begun by Dr. Dawson, now Director of the Survey, with the assistance of Mr. McEvoy, in the summer of 1890.

In the North-West Territories and Keewatin, Mr. Tyrell made a reconnaisance through the country lying to the north of Lake Winnipeg and between the Nelson and Saskatchewan rivers.

In the course of this journey of about 1,100 miles, the northern limits of the Palaeozoic system were determined and a hitherto unknown area of Huronian rocks was defined. A large section of fertile land was crossed on the western side of the Nelson River. This seems to be well adapted for agricultural purposes and, with proper railway communication, might offer a promising field for settlement.

The work performed in the Lake Superior district was under the direction of Mr. McInnes. Two chief geological systems are recognized in this region, the Laurentian, and Huronian (?) The latter consists of two series, known as the Coutchiching and Keewatin. Through all these intrusions of granite are frequent. After an examination of a large number of mines and mining locations from Rainy Lake to Lake of the Woods, Mr. McInnes says: "Here, as in the Seine River country, gold has been found, in every case of which we have any record, at no great distance from the contact between the Keewatin and intrusive granitoid rocks, which occur most frequently as narrow rims along the edge of the more extensive areas of biotite-gneiss, but which also invade the Keewatin rocks as isolated intrusive masses. I know of no case where gold-bearing veins have been found to occur in the main body of the biotite-gneiss areas which we have classed as Laurentian."

Dr. Adams and Mr. Barlow were associated in an examination of the part of Central Ontario known as the Haliburton Sheet of the Geological Survey's series of maps. The geological divisions here distinguished are the Lower Laurentian (Fundamental Gneiss), the Grenville Series and the Hastings. The investigation of the relations of these to one another promises very interesting results. On the north side of the Ottawa River, Dr. Adams has previously shown ("Report on the Geology of a Portion of the Laurentian Area Lying to the North of the Island of Montreal," Geol. Survey of Canada, Vol. VIII. (N.S.)) that the Grenville Series is, in part, a very old altered sediment. In this district this conclusion is corroborated and an intrusive contact between the Grenville Series and the Fundamental Gneiss shown to be probable. The relations existing between the Grenville and the Hastings Series have also received special attention, and, from the examinations thus far made, it seems probable that the Grenville will be ultimately found to represent the more highly metamorphosed portions of the Hastings Series, and these, it is suggested, may be of Huronion age.

In the township of Carlow on this sheet, Mr. Ferrier, in a separate research, found a deposit of Corundum probably of very considerable economic importance.

On the north side of the Ottawa River, Dr. Ells continued the extensive researches in which he has been engaged for several seasons. He has examined the region drained by the Coulonge and Black rivers, and has extended his investigations on the south shore to the region of the Bonnechere, Madawaska and Mississippi. The northern limit of the Hastings Series is noted, the relations of the crystalline limestones observed, and the mineral occurrences recorded.

Dr. Bell and party made a reconnaisance survey from Mattawa to Lake Mistassini and Rupert's River. A part of the limits of the great belt of the Huronian system, which extends from Lake Superior to Lake Mistassini, was traced and a smaller belt of the same horizon was approximately defined. These, with Laurentian Gneiss and Chloretic Schist of an undetermined age, were the chief rocks observed.

The surface geology of the Eastern Townships formed the subject of the researches of Mr. Chalmers. This work is of great economic importance, as it implies the development of the gold mining of the townships of Dudswell and Ditton and in the Chaudiere Valley. Nor has it less of a purely scientific interest. The efforts to trace the auriferous gravels to their origin, the various mining locations, and the conditions that prevailed during the glacial periods, of which Mr. Chalmers distinguishes two, formed the chief topics of this very interesting investigation.

Mr. Low has continued his already well-known explorations in the Labrador peninsula. Here the limits of a large area of rich iron deposits were defined and many other observations of important geological and geographical interest were made.

Three parties were employed in field work in the Province of Nova Scotia under Prof. Bailey and Messrs. Fletcher and Faribault. Prof. Fletcher's work consisted of a general examination of the southwestern part of Nova Scotia. Mr. Fletcher continued his examination of the coal fields, while Mr. Faribault was engaged in the investigations necessary for the detailed mapping of the gold-producing localities.

In the Department of Chemistry and Mineralogy six hundred and ninety-seven specimens were received for examination during the year, and the necessary information in all cases was given. Important additions have been made to the Museum, and collections aggregating 5,040 specimens have been given to educational institutions.

In the Department of Mining and Mineral Statistics a complete system of reference to all mineral statistics is being established, so that any desired information within its scope can be promptly communicated.

Important petrographical and palaeontological work has been done and large additions have been made to the Museum.

Four maps were completed during the year 1896, and eleven are expected to be finished in the present year. The Director makes a strong appeal for provincial aid to the Geological Survey in the preparation of topographical maps.

The number of visitors to the Museum for the year 1896 was 31,595, as compared with 26,785 in the previous year, a fact which, in itself, speaks very strongly of the interest felt by the public in this department.

This interest, which is rapidly increasing, must soon become too strong to allow the Geological Survey to remain longer in its present insufficient quarters.

The work of the Survey is a great one, whether we consider the actual amount of work done, its value to the country from an ec mic standpoint or as a contribution to science. Nor should it be appreciated less highly from the fact that all this work, much of it requiring technical skill of a high order, costs the country scarcely one hundred thousand dollars a year.

And when it is remembered, too, that this work is performed under very disadvantageous circumstances, and that the vast collections in the Museum and the records of half a century of work of inestimable importance to the country are in great and constant danger of destruction by fire, the need of better accommodation is strongly felt. It is, indeed, a poor reward to such an admirably conducted department, and betokens little regard for the important work which it performs and the public interests it subserves, that the Geological Survey has not been provided with a fire-proof Museum and offices and laboratories equipped according to modern requirements and to the needs of the country.

JOHN A. DRESSER.

St. Francis College,
Richmond, P.Q.

ABSTRACT FOR THE MONTH OF APRIL, 1897.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	†Mean pressure of vapor.	Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY
1	37.73	44.9	30.0	14.9	30.4105	30.543	30.217	.326	.1273	55.2	23.7	S.W.	20.67	3.5	8	0	91	....	....	....	1
2	38.05	45.5	28.6	16.9	30.1938	30.350	30.141	.209	.1118	49.8	20.8	N.E.	19.42	0.5	3	0	97	....	....	....	2
3	28.18	35.5	20.8	14.7	30.4990	30.551	30.443	.108	.1195	75.3	21.5	N.E.	7.88	0.3	2	0	96	....	....	...	3
SUNDAY........4	.....	50.1	26.4	23.7	......	......	......	....	.....	....	....	S.E.	8.54	..	......	..	85	....	....	....	4.......... SUNDAY
5	42.10	53.6	37.0	16.6	29.6662	29.795	29.593	.202	.2535	93.7	40.2	S.	11.88	9.2	10	7	9	0.26	....	0.26	5
6	40.73	50.8	35.1	15.7	29.6892	29.868	29.599	.269	.2292	88.8	37.8	S.W.	12.78	10.0	10	10	6	0.04	....	0.04	6
7	33.83	40.2	28.8	11.4	30.0412	30.082	29.956	.126	.1305	66.2	24.0	N.	11.41	3.2	10	0	91	....	....	....	7
8	36.90	46.1	28.1	18.0	30.0413	30.091	29.995	.096	.1660	74.2	29.7	S.W.	8.67	5.5	10	0	34	....	....	....	8
9	36.68	40.6	33.5	7.1	29.8573	29.968	29.725	.243	.1838	84.8	32.5	N.E.	15.42	10.0	10	10	00	0.07	....	0.07	9
10	31.38	33.0	28.5	4.5	29.8775	30.048	29.731	.317	.1623	91.8	29.5	N.E.	17.79	10 0	10	10	00	0.05	1.9	0.30	10
SUNDAY........11	.....	41.5	31.5	10 0	......	......	....	....	... .	....	....	W.	8.67	...	...	...	21	....	0.0	0 00	11...........SUNDAY
12	39.35	46.5	34.0	12.5	30.4223	30 499	30.270	.229	.1525	63.2	28 0	S.E.	8.46	0.5	3	0	98	0.04	....	0.04	12
13	43 37	51.5	32.4	19.1	30.2833	30.483	29.949	.534	.1748	62.2	31.2	S.	18.38	8.0	10	0	7	0.04	....	0.04	13
14	44.83	50.5	40.9	9.6	29.8960	29.975	29.844	.131	.2507	84.0	40.2	S.W.	24.46	10.0	10	10	00	0.15	....	0.15	14
15	40.70	45.5	37.4	8.1	29 8703	29.976	29.749	.227	.2307	90.8	38.0	S.W.	11.96	10.0	10	10	00	0.51	....	0.51	15
16	47.00	56.6	39.0	17.6	29.8038	29.846	29.782	.064	.2193	70.2	36.8	S.W.	18.04	4.8	10	0	87	0.11	....	0.11	16
17	40.82	44.0	36.4	7.6	29.7313	29.820	29.630	.190	.2237	87.2	37.3	S.W.	13.33	10.0	10	10	00	0 73	....	0.73	17
SUNDAY........18	.....	53.4	33.1	20 3	....	......	.....	....	.....	....	....	S.W.	23.50	....	..	...	95	0.01	....	0 01	18...........SUNDAY
19	33.97	51.3	13.5	37.8	29.8915	30.372	29 574	.798	.1682	78.0	28.0	S.W.	31.88	5.8	10	0	8	0.15	....	0.15	19
20	23.32	32.6	10.9	21.7	30.4743	30.558	30.428	.130	.0957	73.8	16.2	S.W.	21.13	2.2	5	0	94	....	....	....	20
21	39.47	50.0	27.6	22.4	30.4293	30.478	30.397	.081	.1513	64.3	29.2	S.W.	24.58	0.0	0	0	94	....	....	....	21
22	47.57	59.5	32.0	27.5	30.2540	30.384	30.098	.286	.2042	61.5	34.7	S.	19.50	6 7	10	0	12	0.00	....	0.00	22
23	62.07	74.3	49.5	24.8	30.0625	30.134	29.992	.142	3690	66.5	50.2	S.W.	19.83	4.8	10	0	68	0.11	....	0.11	23
24	61.40	69.0	56.2	12.8	29.9947	30.041	29.938	.103	.4470	82.8	55.8	S.W.	13.75	6.5	10	0	59	0.11	....	0.11	24
SUNDAY........25	.....	72.8	49.9	22.9	. .	.....	......	....	...	....	...	S.W.	21.79	..	....	...	8	0.41	....	0.41	25.......... SUNDAY
26	46.62	55 9	38.6	17.3	29.5787	29.736	29.444	.292	.2460	73 3	39 8	S.W.	13.67	6.3	10	0	47	0.07	....	0.07	26
27	39.35	44.0	32.0	12.0	29.7462	29.853	29.564	.289	.1797	74.2	31.8	N.W.	26.71	10.0	10	10	00	0.20	....	0.20	27
28	47.57	55.4	41.4	14.0	29.9588	30.015	29.912	.103	.2380	72 3	38.8	N.	12.58	5.0	10	0	38	0.00	....	0.00	28
29	50.78	62.8	39.0	23.8	30.0062	30.120	29 941	.179	.2835	77.0	43.3	N.E.	9.08	2.8	10	0	49	....	....	....	29
30	50.57	61.2	40:0	21.2	30.0768	30.122	30.036	.086	.2635	70.5	41.2	N.	18.75	3.3	8	0	76	....	....	...	30
31	.....	....	....	....	....	......	......	....	.....	....	....	......	....	....	...	....	....	....	....	....	31
Means	41.71	50.62	33.74	16.88	30.0268	30.1426	29.9211	.2215	.2070	74.49	33.85	S. 56¼° W.	16.48	5.72	8.4	3.0	45.37	3.02	1.9	3.27	... .Sums.
23 Years means for and including this month......	40.14	48.67	32.41	16.25	29.9606	......	.....	.204	.1729	67.0	...	......	§16.70	6.1	....	..	¶51.1	1.67	5.8	2.26	23 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	1324	1319	51	405	1545	5559	376	1288	
Duration in hrs..	92	88	9	47	81	289	35	71	8
Mean velocity....	14.39	14.99	5.67	8.62	19.07	19.24	10.74	18.14	

Greatest mileage in one hour was 53 on the 19th.
Greatest velocity in gusts, 60 miles per hour on the 19th.

Resultant mileage, 4725.
Resultant direction, S. 56¼° W.
Total mileage, 11867.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 16 years only.

e 11 years only.

The greatest heat was 74°3 on the 23rd; the greatest cold was 10.°9 on the 20th, giving a range of temperature of 63.4° degrees.

Warmest day was the 23rd. Coldest day was the 20th. Highest barometer reading was 30.558 on the 20th. Lowest barometer was 29,411 on the 26th, giving a range of 1,114 inches. Maximum relative humidity was 98.0 on the 5th.

Minimum relative humidity was 36 on the 2nd.

Rain fell on 18 days.

Snow fell on 2 days.

Rain or snow fell on 19 days.

Auroras were observed on 1 night, on the 1st.

Fog on 3 days—on 6th, 9th and 25th.

Thunder storms on 23rd and 25th.

ABSTRACT FOR THE MONTH OF MAY, 1897.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	Max.	Min.	Range.	†Mean pressure of vapor	Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY
1	52.58	64.4	41.5	22.9	30.0447	30.061	30.024	.037	.3305	82.3	47.2	N.	12.63	5.0	10	0	25	0.04	....	0.04	1
SUNDAY........2	.....	60.3	43.0	17.3	......	......	......	....	.....	....	....	N.E.	15.17	.	......	...	00	0.08	....	0.08	2........... SUNDAY
3	52.25	60.3	48.5	11.8	29.7968	29.824	29.744	.080	.3583	91.5	49.8	N.E.	14.67	8.5	10	6	18	0.19	....	0.19	3
4	52.28	61.5	45.4	16.1	29.8487	29.913	29.814	.099	.3228	82.7	46.7	N.E.	11.04	6.7	10	0	19	0.03	....	0.03	4
5	57.75	70.3	44.4	25.9	29.9730	30.050	29.915	.135	.3072	61.8	44.2	N.E.	11.09	4.3	10	0	60	....	....	....	5
6	47.75	57.3	40.0	17.3	30.1175	30.176	30.069	.107	.1235	36.5	22.7	N.E.	17.59	0.7	4	0	95	....	....	....	6
7	44.35	54.5	33.8	20.7	30.1895	30.280	30.147	.133	.1432	48.3	25.8	N.	19 92	0.7	2	0	97	....	....	....	7
8	49.03	57.3	33.9	23.4	30.2742	30.395	30.132	.263	.1695	49.2	29.8	S.W.	12.17	4.5	10	0	82	....	....	....	8
SUNDAY.........9	.....	69.0	47.0	22.0	......	......	......	....	.....	...	....	S.W.	13.92	...		...	45	0 27	....	0.27	9...........SUNDAY
10	48.82	54.4	46.0	8.4	29.6992	29.781	29.658	.123	.3210	93.3	46.8	N.E.	8.79	9.5	10	7	02	0.05	....	0.05	10
11	58.42	71.5	44.2	27.3	29.8437	29.897	29.802	.095	.3282	69.0	47.3	S.W.	10.38	5.8	10	0	80	Inap.	....	Inap.	11
12	59.35	64.3	55.6	8.7	29.6970	29.820	29.620	.200	.4360	86.2	54.8	S.	16.21	9.5	10	8	00	0.25	....	0.25	12
13	58.70	64.7	51.8	12.9	29.7623	29 817	29.722	.095	.3925	80.5	52.2	S.W.	18.54	7.8	10	0	02	Inap.	....	Inap.	13
14	58.62	72.1	49.0	23.1	29.7457	29.843	29.610	.233	.3967	83.0	52.5	S.W.	10.38	8.8	10	5	45	0.54	....	0.54	14
15	52.23	59.0	47.6	11.4	29.9743	30.132	29.791	.341	.2700	69.7	42.5	S.W.	21.09	4.0	10	0	85	0.06	....	0.06	15
SUNDAY........16	.....	63.3	42.2	21.1	....	..	.....	....	.....	....	....	N.W.	7.42	....	...	...	96	....	....	...	16...........SUNDAY
17	57.15	67.8	44.7	23.1	30.1755	30.246	30.113	.133	.2713	58.0	42.0	W.	8.25	0.8	2	0	97	....	....	....	17
18	58.92	70.3	48.0	22.3	30.0415	30.160	29.929	.231	.2707	52.2	41.3	S.W.	19.83	3.5	8	0	67	0.02	....	0.02	18
19	48.00	56.2	35.5	20.7	30 2528	30.351	30 121	.230	.1868	54.8	32.5	S.W.	14.75	3.7	10	0	77	....	....	....	19
20	50.50	55.6	46.0	9.6	29.7963	30.073	29.510	.563	.3442	93.0	48.5	N.E.	13.79	10.0	10	10	00	0.39	....	0.39	20
21	50.87	59.1	43.5	15.6	29.6577	29.842	29.475	.367	.3265	85.0	46.7	S.W.	18.25	7.2	10	0	00	0.26	....	0.26	21
22	54.08	65.2	39.8	25.4	29.8460	29.894	29.795	.099	.2195	52.7	36.5	S.W.	17.08	0.5	3	0	92	....	....	....	22
SUNDAY........23	.....	69.4	47.5	21.9	......	......	......	....	...	....	....	S.	15.12	...	.....	...	04	0.29	....	0.29	23........... SUNDAY
24	61.22	70.4	55.2	15.2	29.8285	29.938	29.768	.170	.4130	77.0	53.3	W.	14.46	7.5	10	0	59	0.04	....	0.04	24
25	45.62	51.1	41.8	9.3	30.0870	30.180	30.024	.156	2532	82.2	40.5	N.	20.88	8.3	10	0	00	0.43	....	0.43	25
26	51.78	60.6	42.4	18.2	30.2082	30.247	30.165	.082	.2383	62.8	38.8	N.E.	8.00	5.5	10	0	74	Inap.	....	Inap.	26
27	50.00	56.2	42.8	13.4	30.0108	30.171	29.842	.329	.2923	80 5	44.0	N.	12.29	10.0	10	10	00	0.09	....	0.09	27
28	52.43	54.5	49.8	4.7	29.6657	29.762	29.583	.179	.3800	95.8	51.3	N.	8.54	10.0	10	10	00	0.71	....	0.71	28
29	53.38	56.8	50.5	6.3	29.6105	29.682	29.575	.107	.3698	90.5	50.7	S.W.	18.54	9.0	10	5	01	Inap.	....	Inap.	29
SUNDAY........30	.....	68.5	50.0	18.5	......	......	......	....	.....	....	....	S.W.	16.04	...	..	...	69	....	....	....	30 .... SUNDAY
31	54.85	60.7	48.7	12.0	29.7528	29 797	29.729	.068	.2940	67.8	44.0	S.W.	22.38	4.0	10	0	69	Inap.	....	Inap.	31
Means	53.11	62.15	45.16	16.99	29.9192	30.0128	29.8338	.1790	.2984	72.55	43.55	S. 67¼° W	14.68	6.07	8.8	2.3	43.8	3.74	....	3.74	.... Sums.
23 Years means for and including this month	54.67	64.02	45.73	18 73	29.9339	......	...	.170	2891	66 0	...	......	‡14.52	6.2	...	..	¶50.6	2.98	....	2.98	23 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	1395	2009	164	678	915	4148	776	837	
Duration in hrs..	92	148	23	57	66	233	56	69	
Mean velocity....	15.16	13.57	7.13	11.89	13.86	17.80	13.86	12.13	

Greatest mileage in one hour was 33 on the 30th.
Greatest velocity in gusts, 40 miles per hour on the 15th.

Resultant mileage, 2419.
Resultant direction, S. 67¼° W.
Total mileage, 10922.
Average 14.68 miles per hour.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 16 years only.

g 11 years only.

The greatest heat was 72°1 on the 14th; the greatest cold was 33.°8 on the 7th, giving a range of temperature of 38.3 degrees.

Warmest day was the 24th. Coldest day was the 7th. Highest barometer reading was 30.395 on the 8th. Lowest barometer was 29.475 on the 21st, giving a range of .920 inches. Maximum relative humidity was 100 on the 4th.

Minimum relative humidity was 27 on the 6th.

Rain or snow fell on 19 days.

Aurora was observed on 1 night; lunar halo on 1 night; lunar corona on 1 night.

Thunder storms on the 20th.

Earthquake shocks on the 27th.