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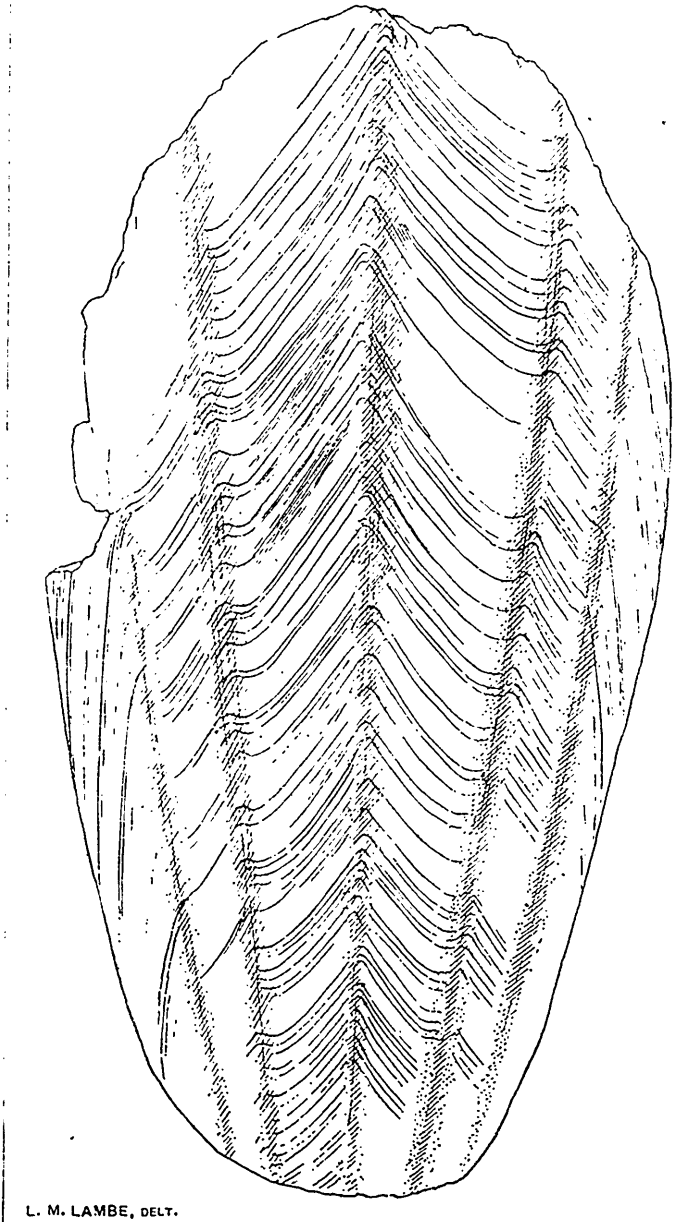


ACTINOSEPIA CANADENSIS.

THE

CANADIAN RECORD

OF SCIENCE.

VOL. VII. OCTOBER, 1897. No. 8.

On some remains of a Sepia-like Cuttle-fish from the Cretaceous rocks of the South Saskatchewan.

By J. F. Whiteaves.

In 1889, four rather remarkable fossils, which probably represent the dorsal side of the internal shell or sepiostaire of a new species of an apparently new genus closely allied to *Sepia*, were collected by Mr. T. C. Weston, of the Geological Survey of Canada, from the Montana or Pierre-Fox Hills formation of the Later North American Cretaceous, at the South Saskatchewan, opposite the mouth of Swift Current Creek.

Each of these fossils is imperfect posteriorly, and not a trace of the mucro is preserved in any of them. The most perfect of the four (which is represented, of the natural size, in the accompanying plate), is about six inches and a quarter in length by about three inches and a quarter in its maximum breadth. It is elliptical or elliptic-ovate in outline, slightly convex, but marked with five narrow, acute, but not very prominent longitudinal ridges, with rather distant, faint depressions or

shallow grooves between them. One of these ridges is median, but the two lateral ones on each side are slightly divergent, and a bilateral symmetry is very obvious.

A considerable portion of the surface of each of these fossils is obscured by a blackish and apparently bituminous substance, so that it is difficult to trace any of the lines of growth continuously, though they are remarkably well preserved in patches. Near the lateral margins the incremental striae are simply concentric, but in the median region (where they are fine, extremely numerous and much more densely crowded than it is possible to represent them in the figure, by this mode of reproduction), each one is produced anteriorly into an angular and acutely pointed lobe, with its apex upon the summit of the median ridge. From this fact it may be inferred that the anterior margin of the dorsal side of the shell was pointed in the middle when perfect.

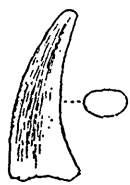
So far as the writer has been able to ascertain, there is no known genus of Sepiidae, fossil or recent, to which these fossils can be satisfactorily referred. They bear, no doubt, a certain general resemblance to the internal shells of *Sepia* itself, but, in the sepiostaires of all the recent species of that genus which the writer has been able to examine, the radii of the dorsal surface are broad, flattened and almost obsolete. As already suggested, they seem to indicate a new genus and species of Sepiidae, for which the name *Actinosepia Canadensis* may not be inappropriate. In any case these fossils are the first well marked remains of sepiostaires that have been found in a fossil state in Canada.

(This paper was read, and the specimens upon which it was based were exhibited, on the 23rd of August, 1897, in Section D (Zoology), at the Toronto meeting of the

British Association for the Advancement of Science. In the discussion which followed, Professors L. C. Miall, the President of the Section, and W. E. Hoyle, its Recording Secretary, expressed their opinion that the interpretation of the specimens suggested in the paper was probably the correct one.)

Note on a Fish Tooth from the Upper Arisaig series of Nova Scotia.[1]

By J. F. Whiteaves.



Dendrodus Arisaigensis.

Side view of the only specimen known to the writer.

Twice the natural size.

The only indication of the existence of vertebrate animals in the Silurian rocks of Canada that has yet been recorded is a single specimen of a Pteraspidian fish discovered by Dr. G. F. Matthew in the Nerepis hills of southern New Brunswick in 1886. This specimen, which consists of the rostrum, the lateral cornua, the dorsal and ventral scutes, and some other plates of the anterior armature of the fish, was subsequently described by its discoverer as the type of a new genus, under the name *Diplaspis Acadica*, though Mr. A. Smith Woodward claims that it should be referred to Lankester's genus *Cyathaspis*.

[1] Read Aug. 21, 1897, in Section C (Geology) at the Toronto meeting of the British Association.

However this may be, in the Museum of the Geological Survey at Ottawa there is a well preserved fish tooth from the Upper Arisaig series at McDonald's Brook, near Arisaig, N.S., collected by Mr. T. C. Weston in 1869. On the evidence of large numbers of other kinds of fossils, the upper portion of the "Arisaig series" is still held to be of about the same age as the Lower Helderberg group of the State of New York and the Ludlow group of England, but no Devonian rocks are known to exist at McDonald's Brook.

The tooth itself, which is not quite perfect at either end, is about eleven millimetres in height by about five in breadth at the base. It is conical, slightly curved and somewhat compressed, the outline of a transverse section a little below the mid-height being elliptical, and its surface is covered with a thin coat of a finely and longitudinally striated enamel. The figure is a line drawing of the tooth, as viewed laterally, with an outline of the transverse section, both of twice the natural size.

Judging by its external characters, this specimen seems to be what is usually called a dendrodont tooth, and therefore probably that of a crossopterygian, perhaps allied to *Holoptychius*, though its fore and aft edges are not trenchant. Only one specimen of it has been obtained, so that no thin sections of it have been made, to show its microscopical structure. As it does not seem referable to any known species, it may be convenient to call it provisionally *Dendrodus Arisaigensis*.

If the limestones from which this tooth was collected are, as there is every reason to believe that they are, of Silurian age, a second species can be added to the vertebrate fauna of that system in Canada; but if not, the tooth is still of interest as indicating the possible existence of Devonian rocks at a locality where such rocks have not previously been recognized.

Contributions to Canadian Botany.

By James M. Macoun.

XI.

Nesodraba megalocarpa, Greene, Pittonia, Vol. III., p. 253.

Central tuft of three leaves 3 inches high or more; leaves oblong-spatulate, obtuse, with a few coarse teeth near the summit; stout ascending peduncles 6 inches high, clothed below the raceme with oval sessile leaves ¾ inch long; pods linear-oblong, ½ to ¾ inch long, two or three lines wide, acutish, and tipped with an acute style.

Seal Rocks, Dawson Harbour, Skidegate Inlet, Queen Charlotte Islands, B.C., 1897. Herb. No. 16,928. (*Dr. C. F. Newcombe.*)

Dr. Greene's new genus, *Nesodraba*, includes three species, one of which, *N. grandis*, has long been a puzzle to botanists, having been by the earlier botanists referred to *Cochlearia* and by the later, with less reason, to *Draba*. *N. megalocarpa* is known only from Dr. Newcombe's specimens. *N. grandis* is common in herbaria as *Draba hyperborea*.

Polygala Senega, L., var. latifolia, T. & G.

Dry bank, Valley Inn near Hamilton, Ont., 1896, (*J. M. Dickson.*) Only other known Canadian station. Georgian Bay.

Cerastium arvense, L., var. villosum, Holl. & Britt.

In sod and along old paths near the cemetery at Hamilton, Ont., 1897. (*J. M. Dickson.*) New to Canada.

Sagina procumbens, L.

Growing in Mr. R. Cameron's yard at Niagara, Ont.

Probably indigenous, though not before recorded from Ontario.

TRIFOLIUM DIANTHUM, Greene, Pittonia, Vol. III., p. 217.

Very dwarf perennial, the rather stoutish stems, scarcely an inch long, surpassed by the upper petioles and peduncles; herbage deep green and very glabrous; leaflets obcordate or obovate, about ¼ inch long, rather sharply and mucronately dentate; peduncles shorter than the leaves, bearing an involucrate pair of purple flowers; involucre large for the plant, lacerately cleft; calyx with 10-nerved tube shorter than the teeth, these with oblong-lanceolate body tapering to a stoutish aristiform apex; corolla twice the length of the calyx, the petals purple, tipped with white.

Species founded on specimens collected at Esquimault near Victoria, Vancouver Island, by Prof. Macoun, May 13th, 1893. Herb. No. 97, and distributed as *T. pauciflorum.* Specimens collected at the same place by Prof. Macoun in 1875, and labelled *T. pauciflorum* var. (Herb. No. 18,015), are this species.

TRIFOLIUM AGRARIUM, L.

New Westminster, B.C. (*A. J. Hill.*) Not recorded west of Ontario.

PRUNUS MAHALEB, L.

Mountain side at Hamilton, Ont., May 15th, 1895. (*J. M. Dickson.*) Well naturalized. Not before recorded from Canada.

ASTER ANGUSTUS, T. & G.

Growing in railway round-house at Montrose, Ont. (*R. Cameron.*) Introduced from the west along railway.

ERIGERON MACOUNII, Greene, Pittonia, Vol. III., p. 162.

Low perennial, with a stout branching caudex bearing

many spatulate, linear, acute, entire leaves, and stoutish ascending, sparsely leafy monocephalous peduncles; the younger foliage canescently strigose, the older glabrate; heads large, hemispherical; bracts of the somewhat hoary-tomentose involucre subequal, in two series; rays about 50, rather broad, purple.

Summit of Sheep Mountain, Waterton Lake, Rocky Mountains, alt., 7,500 ft., July 31st, 1895. Herb. No. 10,858. (*John Macoun.*) Distributed as *Erigeron ochroleucus.*

ERIGERON KINDBERGI, Greene, Pittonia, Vol. III., p. 165.

Stems several, erect, from a perennial root, 6 inches high, pilose-pubescent, apparently flaccid and not conspicuously angled; lowest leaves oblanceolate, entire, acute, wholly glabrous and, in no degree, ciliate; the cauline narrowly linear, elongated, sessile by an abruptly dilated base; heads mostly solitary, small, the involucre barely three lines high; bracts very unequal, all narrowly linear and rather abruptly acute, glabrous and glandless, except at the pilose-pubescent base; rays very numerous, narrow and short; pappus scanty for the *E. acris* group, and not at all accrescent, dull-white, unchanged in age.

Meadows on the plateau east of Stump Lake, B.C., July 14th, 1891. Herb. No. 7,793. (*Jas. McEvoy.*) Named for Dr. Nils Conrad Kindberg, by whom some of the characters were indicated in 1892.

ERIGERON JUCUNDUS, Greene, Pittonia, Vol. III., p. 165.

E. acris, Macoun, Cat. Can. Plants, Vol. I., p. 547 in part.

E. acris, var. *Drœbachensis,* Macoun, Cat. Can. Plants, Vol. I., p. 547 in part.

E. alpinus, Macoun, Cat. Can. Plants, Vol. I., p. 234 in part.

Perennial, 2 to 10 inches high, the several stems monocephalous, or in larger plants with several and corymbose-

racemose rather large heads; herbage, light-green and flaccid, more or less pilose-pubescent, and at least the upper parts of the plant glandular-viscid; lowest leaves spatulate-ovate and oblanceolate, obtuse, mucronulate, entire, or with one or two pairs of crenate and mucronulate teeth below the apex, both faces sparsely pubescent and the petioles as sparsely ciliate; the cauline oblong-lanceolate, entire; heads three or four lines high, but involucral bracts notably shorter than the flowers, unequal, nearly linear, the inner acuminate, the tips of all more or less spreading, the whole involucre as well as the peduncles viscid-glandular, the basal parts hirsute-pubescent; rays apparently 60 to 80, not extremely narrow; pappus, copious and accrescent, dull white, little darker in age.

Distributed freely from the Herbarium of the Geological Survey of Canada as *E. acris*, *E. acris*, var. *Drœbachensis* and *E. alpinus*, to which species it was at various times referred by Dr. Gray and Dr. Watson. Easily distinguished from *E. Drœbachensis* by its very different habit, pubescence and inflorescence; and the pappus of the latter, at least in the American plant, becomes of a rich and beautiful brown-red in age. The peduncles in the present species, though slender, are abruptly and conspicuously enlarged at summit under the involucre.

Summit of Sheep Mountain, Waterton Lake, Rocky Mountains, alt., 7,000 ft. Herb. No. 10,841; Lake Louise, Rocky Mts., alt., 6,500 ft. Herb. No. 7,794; Kicking Horse Lake, Rocky Mts., alt., 7,000 ft. Herb. No, 18,010; Roger's Pass, Selkirk Mountains, alt., 5,000 ft. Herb. No. 11,005; Revelstoke, B.C. Herb. No. 18,011. (*John Macoun.*) Western summit of North Kootanie Pass, Rocky Mountains. Herb. No. 18,012. (*Dr. G. M. Dawson.*) Mount Queest, Shuswap Lake, B.C., alt., 6,000 ft. Herb. No. 11,009. (*Jas. M. Macoun.*) Dr. Kindberg was of the opinion that the Lake Louise plant agreed very nearly

with *E. politus* Fr., but *E. politus* is not only glabrous, but it has none of the viscid-glandulosity which is so characteristic of *E. jucundus.*

E IGERON ELATUS, Greene, Pittonia, Vol. III., p. 164.

E. alpinus, var. *elatus*, Hook. ; Macoun, Cat. Can. Plants in part.

Collected by Drummond in the Rocky Mountains, Lat. 54°–56°, re-discovered by Prof. Macoun in 1890. Kicking Horse Lake, Rocky Mountains. Herb. No. 18,014 ; Cave Avenue, Banff, Rocky Mountains. Herb. No. 11,018. (*John Macoun.*)

ERIGERON ALPINUS, L.

The specimens, collected by Dr. Dawson and referred here by Prof. Macoun in Cat. Can. Plants, Vol. I., p. 234, are *E. jucundus.* Our only specimens of *E. alpinus* were collected by Prof. Macoun at Kicking Horse Lake, Rocky Mountains, in 1885, when they were referred to *E. acris.*

ERIGERON PEREGRINUS (Pursh), Greene, var. DAWSONI, Greene, Pittonia, Vol. III., p. 166.

Differs from the type in having its leaves gradually reduced from the middle of the stem upward almost as much as in *E. salsuginosus ;* and more notably different in having twice as many and much more slender involucral bracts, and about 50 rather narrow rays. In damp, grassy thickets, Queen Charlotte Islands, B.C. Herb. No. 11,205. (*Dr. G. M. Dawson.*) Referred provisionally to *E. salsuginosus*, var. *Unalaschkensis*, Less, by Prof. Macoun in Cat. Can. Plants, Vol. I., p. 233, where some of its distinguishing characters were indicated.

IVA XANTHIFOLIA, Nutt.

Along Grand Trunk Railway near Clifton, Ont. (*R. Cameron.*) Waste ground, St. Catherines, Ont. (*W. C. McCalla.*) Introduced from the west along railway.

SENECIO MACOUNII, Greene, Pittonia, Vol. III., p. 169.

Tufted and apparently somewhat stoloniferous perennial, the slender, nearly naked stems about a foot high, simple, subcorymbose at summit, leafy below, floccose-tomentose throughout; leaves chiefly at and near the base of the stem, hoary-tomentose beneath, more deciduously so above, 3 to 6 lines long, including the slender petiole, this much longer than the obovate or oblong-lanceolate or oblanceolate blade, which is 3-nerved and with variously crenate, or dentate or repand-denticulate margin; heads small (as in *S. Fendleri*), in a rather compact cymose corymb; bracts of the involucre about 12 or 15, lanceolate, thinnish; rays as many, yellow; achenes light colored, 5-angled, with 5 intervening striæ; pappus fine and soft.

Goldstream, (Herb. No. 554), and Mount Benson. (Herb. No. 555), Vancouver Island. (*John Macoun.*) Distributed as *S. lugens*, var. *exaltatus*, Gray.

SENECIO COLUMBIANUS, Greene, Pittonia, Vol. III., p. 169.

Taller and stouter than *S. lugens*, often 3 feet high, the stems solitary, not clustered, and without a root stock, but proceeding from a not at all deep-seated fascicle of fibrous roots; leaves scattered up and down the lower half of the stem (not clustered at base of a nearly naked stem), pubescence scanty, curled-hairy rather than fine and lanate or tomentose; heads three or four times as large as in *S. lugens*, more than twice as numerous, and the corymb compound; bracts of the involucre more thick and fleshy, scarcely black-tipped; mature achenes light-colored, scarcely angled or even striate.

Hillsides, Farewell Creek, Assiniboia. Herb. No. 11,637; grassy slopes, Guichon Creek, B.C. Herb. No. 16,586. Typical. (*Dr. G. M. Dawson.*) Confounded with *S. lugens* and figured as that species in Hooker's *Flora Boreali-Americana*, probably from specimens collected in British Columbia by Douglas, while Richardson's

description in the same volume was from sub-arctic specimens of his own collecting. *S. lugens* is well represented in our herbarium, and seems to be an exclusively sub-arctic and Rocky Mountain species. Specimens from Old Man's River, about 30 miles north of the International Boundary, answer to Richardson's description even better than specimens in our herbarium of his own collecting.

SENECIO NEWCOMBEI, Greene, Pittonia, Vol. III., p. 249.

Slender and weak, simple stemmed and monocephalous perennial, with thin membranaceous foliage; leaves few and remote, long-petioled, reniform-palmate, *i.e*, of reniform outline, but distinctly and evenly 7-lobed, the lobes not deep, from broadly triangular to broadly oval, mucronulate, the whole hardly an inch wide, all the lower on elongated petioles dilated and clasping at the base; the uppermost cuneate or spatulate and sessile; the whole plant with a little loose and probably deciduous lanate pubescence; involucre short and broad, almost campanulate; bracts broad, thin, almost biserial; calyculate bracts, none; rays, 10 or 12, $\frac{1}{2}$ to $\frac{3}{4}$ inch long; ovaries glabrous; pappus rather coarse, almost barbellulate.

Seal Rocks, Dawson Harbour, Skidegate Inlet, Queen Charlotte Islands, 1897. Herb. No. 16,929. (*Dr. C. F. Newcombe.*) As pointed out by Dr. Greene, this plant resembles superficially a debilitated and monocephalous *Chrysanthemum segetum*, and in its pappus, as well as broad involucre, it seems to approach *Arnica*. But if not a *Senecio*, it represents a new genus.

PHACELIA FRANKLINII, Gray; Macoun, Cat. Can. Plants, Vol. I., p. 333.

Additional stations for this species are burnt hillsides north of Prince Albert, Saskatchewan, Herb. No. 12,220. (*John Macoun.*) East of Lake Athabasca, 1893. (*J. W.*

Tyrrell.) Miles Canon, Lat. 52°, north of British Columbia, 1887. (*Dr. G. M. Dawson. Wm. Ogilvie.*)

PHACELIA SERICEA, Gray; Macoun, Cat. Can. Plants, Vol. I., pp. 333 and 567.

P. sericea, Gray, var. *Lyallii*, Gray; Macoun, Cat. Can. Plants, Vol. I., p. 333 in part and p. 567.

Common in the Rocky Mountains from Lat. 52° south to the International Boundary, Roger's Pass, Selkirk Mountains, alt. 4,500 ft.; Mount Arrowsmith, Vancouver Island, alt. 5,500 ft. (*John Macoun.*)

PHACELIA SERICEA, Gray, var. LYALLII, Gray.

Our only Canadian specimens of this species were collected in 1895 by Prof. Macoun on the high slopes of Sheep Mountain, Waterton Lake, Rocky Mountains.

AMSINCKIA ECHINATA, Lehm.

Near an old mining camp at Revelstoke, B.C., July 21st, 1890. Introduced from the United States. (*John Macoun.*) New to Canada.

AMSI CKIA LYCOPSOIDES, Lehm.

A. lycopsoides, Lehm. var. *bracteosa*, Macoun, Cat. Can. Plants, Vol. I., p. 568.

Mary Island, Gulf of Georgia, B.C., 1885. (*Dr. G. M. Dawson.*) Our only Canadian specimens. The type was collected by Scouler on an island or along the shores of the Straits of Juan de Fuca.

AMSINCKIA LYCOPSOIDES, Lehm, var. BRACTEOSA, Gr.; Macoun, Cat. Can. Plants, Vol. I., p. 338.

Common on Vancouver Island, B.C.

MYOSOTIS COLLINA, Hoffen.

Low fields, Edmonton, Ont., 1890. (*Jas. White.*) New to Canada. Introduced.

MYOSOTIS VERNA, Nutt, var. MACROSPERMA, Chapm.

New stations for this species are Agassiz, B.C., and Deer Park, Lower Arrow Lake, B.C. (*John Macoun.*) Eastern limit in Canada. Not a very well defined variety and probably only a western form of *M. verna*, which has not been collected in Canada west of Ontario.

SYMPHYTUM ASPERRIMUM, Sims.

Waste places at Spence's Bridge, B.C., 1889. (*John Macoun.*) Escaped from cultivation, and naturalized. Not before recorded from Canada.

ONOSMODIUM CAROLINIANUM, DC., var. MOLLE, Gray.

New stations for this plant are Souris, Man. (*Thos. L. Walker.*) Brandon, Man. Herb. No. 12,258 and Stand-Off, Belly River, Alta. Herb. No. 11,841. (*John Macoun.*)

IPOMÆA QUAMOCLIT, L.

Climbing over weeds near the upper Suspension Bridge at Niagara Falls, Ont. (*R. Cameron.*) Probably a garden escape, but not before recorded as being naturalized.

SOLANUM TRIFLORUM, Nutt.

Along the C. P. Railway at Port Arthur, Ont. (*Dr. and Mrs. N. L. Britton* and *Miss Timmerman.*) Introduced from the west.

ANTIRRHINIUM ORONTIUM, L.

Niagara Falls, Ont. (*R. Cameron.*) Only record for Eastern Canada.

LINARIA VULGARIS, Mill.

Waste places, Beacon Hill, Vancouver Island, B.C. (*John Macoun.*) Not recorded west of Ontario.

MIMULUS ALATUS, Ait.

Wet places in a ditch which crosses the 2nd concession

line, township of Harwich, and runs into the foot of Rondeau Harbour, Elgin Co., Ont., Aug. 18th, 1897. (*Dr. A. J. Stevenson and J. Dearness.*) New to Canada.

MIMULUS ALSINOIDES, Benth.; Macoun, Cat. Can. Plants, Vol. I., p. 358 in part.

Abundant on Vancouver Island. North Arm, Burrard Inlet, B.C. (*J. M. Macoun.*) Yale, B.C., and Agassiz, B.C. (*John Macoun.*) This species seems to be confined in Canada to the vicinity of the Pacific coast.

MIMULUS FLORIBUNDUS, Dougl.

Botanie Creek, north of Lytton, B.C. (*Jas. McEvoy.*) Damp places at Sproat, Columbia River, B.C. (*John Macoun.*) Elk River, Kootanie River, B.C. (*Dr. G. M. Dawson.*) Not before recorded from Canada. The specimens referred to this species in Macoun's Catalogue of Canadian Plants, Vol. I., p. 571, prove to be small plants of *M. moschatus*, Dougl.

MIMULUS MOSCHATUS, Dougl.; Macoun, Cat. Can. Plants, Vol. I., p. 358.

M. floribundus, Macoun, Cat. Can. Plants, Vol. I., p. 571.

Beaver Creek, Selkirk Mts., B.C.; Revelstoke, B.C.; Kootanie River, near its junction with the Columbia River, B.C.; Burrard Inlet, B.C.; common on Vancouver Island. (*John Macoun.*) Quesnell Lake, B.C. (*A. Bowman.*) Anstey Creek, Shuswap Lake, B.C. (*J. M. Macoun.*) The var. *sessilifolius*, Gray, is much commoner than the type on Vancouver Island, but has not been found elsewhere in Canada.

MIMULUS NASUTUS, Greene; Macoun, Cat. Can. Plants, Vol. I., p. 571.

Lower Arrow Lake and Sproat, Columbia River, B.C.; common on Vancouver Island. (*John Macoun.*) Among the specimens from Sproat are some which are very

canescent and vary somewhat from the type as to foliage, but they do not appear to be separable from *M. nasutus.*

MIMULUS LUTEUS, L.

There are some thirty or forty sheets of *Mimulus*, labelled *M. luteus*, in our herbarium. These include many forms and varieties, and we believe several species, but we find it impossible even with Dr. Greene's "*Mimulus luteus* and some of its allies" in hand to satisfactorily separate and determine our specimens. They cover a wide range—from the Cypress Hills, Alberta, through the Rocky Mountains and British Columbia north to the Aleutian Islands, including Unalaska, the locality from which seeds of *M. Langsdorffii* were taken to Europe, but the various forms so intergrade that our present knowledge does not enable us to definitely and finally separate them.

ORTHOCARPUS PALLESCENS, Gray.

Lower Arrow Lake, Columbia River, B.C. (*Dr. G. M. Dawson. John Macoun.*) First collected by Dr. Dawson in 1889 and referred to *Castillcia pallida.* New to Canada.

PEDICULARIS CONTORTA, Benth.

New stations for this rare plant are Mt. Aylmer, Devil's Lake, Rocky Mountains, alt. 6,000 ft. (*John Macoun.*) Toad Mountain, Kootanie Lake, B.C., alt. 6,000 ft. (*Jas. M. Macoun.*)

PEDICULARIS RACEMOSA, Dougl.; Macoun, Cat. Can. Plants, Vol. I., pp. 368 and 572.

Common on sub-alpine slopes throughout British Columbia. Near the road to Union Mines, Comox, Vancouver Island; Mount Mark, V.I., alt. 3,000 ft. (*John Macoun.*) Not before recorded from Vancouver Island.

PENSTEMON CONFERTUS, Dougl.; Macoun, Cat. Can. Plants, Vol. I., pp. 354 and 570.

Prairies near Sage Creek, Milk River, Assa. Herb. No. 11,859. (*John Macoun.*) Eastern limit in Canada.

PENSTEMON DIFFUSUS, Dougl.; Macoun, Cat. Can. Plants, Vol. I., p. 357.

New stations for this species are Botanie, north of Lytton, B.C.; Griffin Lake, B.C. (*Jas. M. Macoun.*) Agassiz, B.C.; Cowichan River, Vancouver Island. (*John Macoun.*)

PINGUICULA VILLOSA, L.; Macoun, Cat. Can. Plants, Vol. I. p. 376 and Vol. II., p. 349.

Bogs, Lat. 60° 30′, Long. 104°. (*J. W. Tyrrell.*) The Lake Mistassini, reference, (Pursh), is, as Prof. Macoun suggests in his catalogue, to *P. vulgaris*, which is very common about that lake.

VERBENA HASTATA, L.; Macoun, Cat. Can. Plants, Vol. I., p. 379.

Sicamous, B.C.; near Victoria and at Sumas River, Vancouver Island. (*John Macoun.*) Not before recorded west of Gold Range, B.C.

LAMIUM AMPLEXICAULE, L.

A weed in gardens at Comox, Vancouver Island. (*John Macoun.*) Not recorded from west of Ontario.

LYCOPUS LUCIDUS, Turcz., var. AMERICANUS, Gray; Macoun, Cat. Can. Plants, Vol. I., p. 382.

Kamloops, B.C. (*John Macoun.*) Bonaparte River, B.C. (*Jas. McEvoy.*) Not recorded west of

MONARDA FISTULOSA, L., var. RUBRA, Gray.

In thickets at Wingham, Ont. (*J. A. Morton.*) New to Canada.

NEPETA GLECHOMA, Benth.

Waste places, Battle Harbour, Labrador. (*Rev. A. Waghorne.*) Not before recorded from Labrador.

PLANTAGO BOREALIS, Lange.

P. maritima, Macoun, Cat. Can. Plants, Vol. I., pp. 393 and 575 in part.

Commonly referred to *P. maritima*, but a good species. Our specimens are from Battle Harbour, Labrador, Herb. No. 16,890. (*Rev. A. Waghorne.*) Fort Chimo, Labrador, Herb. No. 15,955. (*A. P. Low.*) Nachvak, Labrador, Herb. No. 16,891; Nottingham Island, Hudson Strait, Herb. No. 16,892. Fort Churchill, Hudson Bay. Herb. No. 16,889. (*Dr. R. Bell.*) *P. pauciflora*, Pursh, is a very different plant, and has nothing to do with this species.

ASARUM CANADENSE, L.

Mr. E. P. Bicknell, in the Bulletin of the Torrey Botanical Club for November, 1897, has described a new species of *Asarum*—*A. reflexum*—hitherto confounded with *A. Canadense*. We have in the herbarium of the Geological Survey typical specimens of both species from the United States, *A. Canadense* from the New England States, *A. reflexum* from Ohio. Our Canadian species are all from Ontario. Those collected at Ottawa in the eastern part of the province very nearly approach *A. Canadense*, as described and figured by Mr. Bicknell; those from the western part of the province are referable to *A. reflexum* rather than to *A. Canadense*, but none of our specimens are typical representatives of either species, the series apparently connecting the two species. Canadian collectors should study this genus in the field with Mr. Bicknell's descriptions in hand.

Since writing the above Mr. J. M. Dickson, of Hamilton, has sent me drawings of two specimens of *Asarum*, one of which represents *A. Canadense*, the other *A. reflexum*,

probably the variety *ambignum*, as Mr. Dickson writes that the calyx is tomentose and the lobes very long-pointed.

TRILLIUM GRANDIFLORUM, Salisb.

Monstrosities of this species are not uncommon in South Western Ontario, a fine series in our herbarium having been received from Mr. J. Dearness, London, Ont.; Mr. R. Cameron, Niagara, Ont.; Mr. J. M. Dickson, Hamilton, Ont., and Mr. Wm. Scott, Toronto, Ont. Mr. Dickson, after studying in the field the different forms found in the vicinity of Hamilton, sent me the following notes :—

"A few years ago several green flowered Trilliums were observed growing in a flat piece of woods on the banks of the Waterdown Creek, near this city. To see if they were persistent and not merely sports of a season, I visited the locality during the latter part of May, 1897, and, upon a close inspection, found several remarkable forms not previously noted. Some of these may be described as below :—

"1st. Several with white edgings and markings on sepals. The most remarkable of these had one sepal green, one half green and half white and the third pure white, while both sepals and petals were inserted in a distinct spiral on the axis; the leaves were normal.

"2nd. Leaves and sepals normal. Petals marked with green lines or bands toward the base.

"3rd. Leaves and sepals normal. Petals green, with a narrow white margin.

"4th. Leaves distinctly petiolate. Petioles one to three inches long; sepals white, with a green stripe down the midrib. Petals narrowed, lanceolate, white, with broad green band in centre, running from base, and terminating near the apex.

"5th. Leaves as in No. 4. Sepals normal. Petals

obovate. Apiculate long clawed, with broad green centres and white margins.

"6th. Leaves ovate, long acuminate, petioled. Petioles ascending, widely spreading, seven inches long, inserted about two inches above the root stock and six or seven inches below the flower. Sepals normal. Petals green, with white margins.

"All the flowers seemed to be perfect, some having a sterile filament, which might be due to accident."

No. 6 was potted and photographed by Mr. Dickson. When photographed the stem was 10 inches high, the peduncle being 8 inches in length. The petioles were 8½ inches long; leaves 2½ inches long, 1½ inches broad, long-acuminate.

A remarkable form, sent from Niagara by Mr. Cameron, has the petals changed into petioled leaves (petioles more than an inch long.) Mr. Cameron has also sent me a photograph of a very large flowered plant with 21 pure white petals. It was found on Navy Island, Niagara River, by Mr. Cameron in 1896. He transplanted it, and last summer two flowers were produced, each with 21 petals. Mr. Cameron also reports a double yellow-flowered dwarf specimen from Niagara Falls, but this is probably some other species.

Crystallised Pyrrhotite from Frontenac County.

By Professor Wm. Nicol.

Among other minerals sent to the School of Mining for identification, was a reddish-colored, coarsely-crystalline marble containing small but well-formed crystals of pyrrhotite or magnetic iron pyrites, closely associated with crystals of apatite and masses of iron pyrites. The crystals were from one to three millimetres in diameter

and in general tabular in form. Some of them, however, were pyramidal in habit. The crystals were secured by treating the mass for several days with acetic acid. The faces of some of the crystals were plane and glancing, and hence gave fairly good reflections for measuring the angles on the reflecting goniometer. The measurements were made with the "two-circle" goniometer in the laboratory of Professor Dr. Victor Goldschmidt in Heidelberg. The reflections were single, though faint in some cases, but by using the magnifying apparatus in connection with the instrument the faces, were determined beyond doubt. The following forms were observed :—

c =	0	$\{0001\}$	r =	10	$\{10\bar{1}1\}$
m =	$\infty 0$	$\{10\bar{1}0\}$	s =	20	$\{20\bar{2}1\}$
			v =	40	$\{40\bar{4}1\}$

The basal plane is usually large and sometimes in combination with the prism m alone. In other crystals the basis c occurs in combination with the prism m and pyramid s. Fig. 1 shows an ideal top view of the crystal, and Fig. 2 shows the actual form of the distorted basal plane and pyramids. Fig. 3 shows the crystal in perspective. Owing to distortion the crystal has a somewhat rhombic appearance, but the measurements show that it belongs rather to the hexagonal system.

Laboratory, School of Mining,
Kingston, Ont.

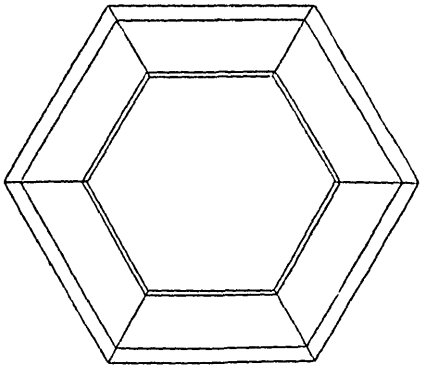


Fig. 1.

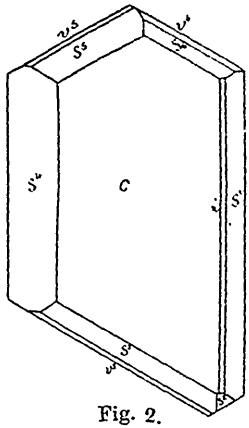


Fig. 2.

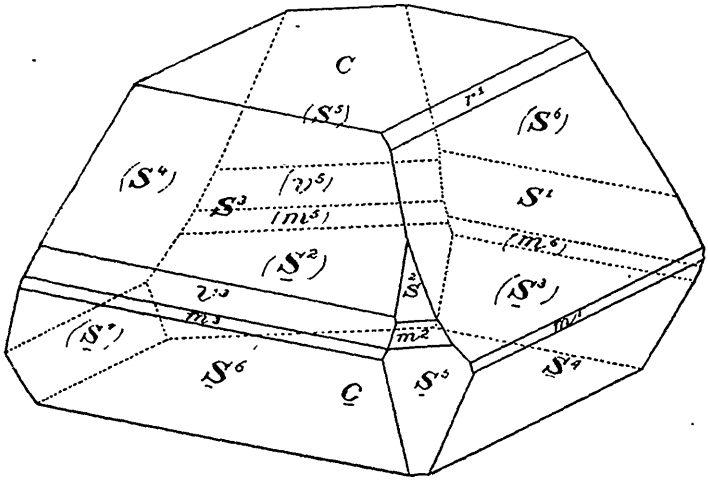


Fig. 3.

Problems in Quebec Geology.

Read at the meeting of the British Association, Toronto, August, 1897.

By R. W. Ells, LL.D., F.R.S.C.

Probably no questions in Canadian geology are of greater interest, or have been more widely discussed, than those connected with the complicated structure of some of the rock formations, found in the Province of Quebec, which are located on both sides of the St. Lawrence river. That on the north of the river relates to the vexed question of the origin and structure of the oldest crystallines or the rocks of the Laurentian system; while to the east of the St. Lawrence the relations of the several divisions of the fossiliferous sediments to each other, and to the crystalline schists of the Sutton Mountain range, as well as the structure of the latter group, have long been a subject for study to those interested in the interpretation of one of the most puzzling problems with which the Canadian Survey has had to deal.

The history of the attempt to work out the structure of the Archæan or Laurentian rocks north of the St. Lawrence dates back nearly fifty years. After several seasons devoted, in part, to the general examination of the rock masses along the course of the St. Lawrence, Sir William Logan, in 1853, began the detailed study of an area north of the River Ottawa, in the county of Argenteuil, which might be taken as the foundation of all subsequent work on these oldest rocks in Canada. The complicated arrangement of the various gneisses, limestones and quartzites, with granite, greenstone and other igneous masses, which is there presented has furnished, for half a century, a problem of undiminished interest to the geologist.

In the earliest days of their study a working hypothesis was adopted which held that the greater portions of the

strata or rock masses there found were originally sedimentary deposits; and that by subsequent metamorphism these passed into the condition of crystalline rocks such as gneiss, limestone and quartzite as we now find them displayed. In this category were also included the great masses of anorthosite rocks which have a very considerable development to the north of the city of Montreal; and these were supposed, from their presumed relations to the crystalline limestones, to represent the upper member of the Laurentian system. The Laurentian was, therefore, practically divisible into three parts, viz., a lower fundamental gneiss, a middle gneiss and limestone series, and an upper or anorthosite division, all of which were held to be originally of sedimentary origin. These were, however, usually described under two heads, a lower and an upper, and the whole of the rocks pertaining to the system beneath the anorthosite was placed in the lower division of the Laurentian. The syenites of Grenville and certain dykes of trappean or diabase rock were regarded as of igneous origin.

As early as 1877–78 the study of the anorthosites by Vennor led to the expression of the opinion on his part that these, in part at least, were intrusive in the crystalline limestones, and this view was shortly after supported by Dr. Selwyn. Subsequent study of the granitic and anorthosite masses by McConnell and Adams showed that this new view was the correct one, and that all these rocks should be removed from the position they had long held as the upper portion of the Laurentian, as an altered sedimentary series, and that they were clearly intrusive and newer than the limestones and quartzites with which they were associated. The series of limestones and grey gneisses became, therefore, the upper member of the Laurentian. The sedimentary origin of these has also been called in question by some geologists, but the recent

study of these rocks, by the aid of the microscope, has established their clastic character.

As regards the sedimentary nature of the underlying or Fundamental Gneiss, it has also been clearly shown that the early view as to its origin cannot now be maintained, but that these oldest of the Laurentian rocks are igneous in their character and represent metamorphosed portions of the original cooled crust of the earth. It would appear, therefore, that in the Laurentian system there are two distinctly separable series of rocks, viz., an altered igneous or basal portion and an altered sedimentary or upper portion (Logan's Grenville series in part), while the original upper member of the system is relegated to a different class entirely.

The grey gneiss, limestone and quartzite of the Grenville series represent, therefore, presumably, the oldest series of clastic or sedimentary rocks on the American continent. The term Grenville, like many others which have appeared in Canadian geology, is useful for purposes of comparison, though great portions of the rock masses which were originally included in this series have in recent years been removed from their original place in the scale. In the present use of the term "Grenville series" it is proposed to include only those rocks concerning whose origin there is no doubt and to confine the use of the term to the clastic members of the series as far as this is possible. These have a wide distribution throughout the Ottawa basin, and are apparently continuous to the west with the series described by Vennor in Ontario, nearly thirty years ago, as the "Hastings series." In character, however, many of the rocks of the latter differ from those of the original Grenville series. Thus, in the Hastings series, there is a large preponderance of schists of various kinds, along with dolomites and slaty limestones, which present a much less altered aspect than is found in the limestones of the

Grenville division. There are also undoubted conglomerates and slaty beds and the clastic nature of many of the rocks is easily seen. There is also seen a large development of hornblendic and granitic rocks, the former being rarely found in the Grenville series north of the Ottawa, while in the character of certain of the gneisses and crystalline limestones there is a marked resemblance. It would appear, therefore, that these rocks of the Hastings series are not easily separable from those of the Grenville series. They appear on stratigraphical grounds to represent an upper portion of the Grenville series, though for purposes of discussion the two series may be considered as one and the same, in so far at least as our investigations in this direction have extended. As for their position in the geological scale, it may be said that they rest upon the Fundamental Gneiss as a distinct clastic series, but whether they should be styled an upper division of the Laurentian or the lowest member of the Huronian is not of much moment, so long as their relations to the underlying rocks and to each other are clearly established. In character, lithologically, they are very like the schists and limestones, which in New Brunswick and the eastern townships of Quebec have been styled pre-Cambrian and probably Huronian.

On the east side of the St. Lawrence, throughout the area extending from the Vermont boundary on the south, to the city of Quebec, and thence eastward along the south side of the St. Lawrence to the extremity of the Gaspé peninsula, a peculiar development of slates, limestones, sandstones and conglomerates extends, distinct in character from most of the horizontal formations found in the more immediate vicinity of the St. Lawrence basin, where the characteristic strata of the Cambro-Silurian system have a wide development and an extended range from the Potsdam sandstone to the summit of the Hudson River or Lorraine formation. In the eastern

portion of the area a great development of crystalline rocks, comprising schists of various kinds, limestone, altered slates, diorites, diabases, serpentines, etc., are found, which constitute the rocks of the Sutton Mountain chain, the extension northward of the Green Mountain range of the state of Vermont, and these, in Canada, with some interruptions, continue for many miles in the area south of the St. Lawrence, reappearing again in the northern part of the Gaspé peninsula.

All the sedimentary formations throughout this area are well defined by the characteristic fossils peculiar to each, and can be readily recognized. These have been divided into groups of strata and named according to the system of nomenclature adopted by the Geological Survey of the state of New York many years ago. The delimitation of the several divisions of the Cambro-Silurian rocks in this area presents but few difficulties, other than those which are due to the fact that, over large portions of the country, great deposits of clays are found by which the underlying sediments are frequently concealed. To the east of these flat-lying sediments, however, and separated from them by a series of faults, some of which are of considerable extent, is the group of strata first alluded to; the series as a whole being highly inclined, folded and sometimes overturned, and presenting at many points features quite distinct from the ordinary Cambro-Silurian formations, so that for many years great difficulty was experienced in reconciling these with well established horizons, or in finding a secure geological basis for their proper disposition in the general scheme of classification.

This, it is hoped, has at length been achieved through the careful work, both from the stratigraphical and palæontological standpoints, of the last ten to twelve years, and it is thought desirable that a brief resumé of the results arrived at in this work should here be

presented; embodying the views that have been stated in the latest scientific publications on this subject, by the Canadian Geological Survey, in order that the true aspect of the question may be clearly seen,

The area over which these rocks are distributed is not confined to the province of Quebec. They are also recognized in the province of Newfoundland along the western portion of the island as well as in the states of New York and Vermont to the south. The literature on the subject is abundant and extends from the first quarter of the century to the present day.

The study of these rocks, which presented so many points of difference from the established formations, was greatly complicated by the presence of certain bands of conglomerate associated with the limestones and slates, in which fossils were found, both in the paste and the pebbles, of quite different horizons; in the arrangement of which it was not always found practicable to separate the fossils of the two series, owing to the great similarity of the matrix in the two cases. The elucidation of the structure was also hindered by the presence of numerous faults which occur throughout the area, and, through the agency of which, strata widely different in age have been brought into close proximity; so that in some cases the older series now rests upon the newer, both conforming in strike and dip, and in the absence of fossils their true relations are sometimes difficult to determine. Further complications also arose from the attempt to reconcile the crystalline schists and associated rocks of the mountain area, which present features strongly resembling certain portions of the Archæan, with the slates, sandstones and limestones of the sedimentary series which they were supposed to represent.

In the earlier days of their study all these various groups of strata were considered as belonging to a generally ascending series, so that a great part of the

crystalline members of the whole series of formations was regarded as more recent than much of the fossiliferous portion. About the year 1870, however, Dr. T. S. Hunt, then on the staff of the Canadian Survey, advanced the theory that these crystalline rocks were older than the fossiliferous strata and that they were probably referable to the Huronian system. This view was gradually adopted, and has since been proved to be correct, since these rocks undoubtedly underlie the lowest Cambrian. The use of the term "Quebec Group," therefore, which was adopted to include all these divisions, under the supposition that they all represented fossiliferous sediments, is now misleading, and if employed should be confined to the peculiar series of fossiliferous limestones, slates, conglomerates, etc., which are well recognized. As, however, all these have now been studied and assigned to their proper position in the geological scale, the use of the term, except in the way of reference, may now be discontinued.

The first paper in which these rocks are discussed in their development about the city of Quebec is found in the Transactions of the Geological Society of London, December, 1827, by Dr. J. Bigsby; who in the earlier years of the century did a very considerable amount of geological exploration in various parts of the Canadian field, both on the fossiliferous and the crystalline rocks. The slate, conglomerate and limestone series about Quebec city was described and the presence of the contained fossils recognized; but from the existence of small deposits of carbonaceous matter, which are found in some of the strata around Lévis and in the vicinity, in the slaty rocks, and which apparently belong to the variety of coaly matter now called Anthraxolite, Bigsby considered that the rocks of this series might represent or be the equivalents of the Carboniferous limestone of the English geologists.

In 1845, Capt. Bayfield, in a paper published in the *Geological Journal*, claimed that the Trenton limestone, which appears on the north side of the St. Lawrence, above Quebec city, must, from its stratigraphical position beneath the greywacke and slate series, be an older formation; and this view was held to be supported by the presence of fossils in certain bands of conglomerate which appeared to be an integral portion of this latter series. These fossils were in pebbles, supposed to be derived from beds of the Trenton limestone, which rests upon the Laurentian gneiss in the area to the north of Quebec city; so that on this evidence, if correctly interpreted, the slate and conglomerate portion would be more recent than the Trenton. In the report for 1843, Sir W. E. Logan stated that the rocks of the Point Lévis series came out from beneath the limestone of the St. Lawrence and belonged to an apparently older horizon, but in a footnote to this report, it is also stated that the bulk of the evidence points to their superior position, which would make them the equivalents of the Hudson River and Lorraine formations.

In the report for 1844, while discussing the general character of the slates, limestone and conglomerates along the south side of the St. Lawrence to the east of Cape Chat and towards the extremity of Gaspé, Logan expressed the opinion that, from the run of the strata along this part of the coast, it is not improbable that certain portions of the strata, to the west of that point, may belong to a lower formation; since along this part of the river below Quebec they come to the shore in an oblique direction from the mainland, and may therefore represent older horizons. As for those beds which contain the coaly matter, it is also stated that the rock containing it is supposed to be the equivalent of the Hudson River group of the New York geologists.

In the report for 1847–48, it is stated that the red

slates and sandstones (now regarded as Sillery), which are developed in portions of the Eastern Townships in association with Trenton limestones, are the equivalents of certain dolomitic bands, as well as of the chloritic and quartzose rocks of the Green Mountain range; and that the whole of these Green Mountain rocks, including the auriferous quartz veins, belong to the Hudson River group, with the possible addition of the Shawangunk conglomerates. As for their extension, it is also said that these Hudson River strata have a continuous run from Lake Champlain along the south bank of the St. Lawrence to Cape Rozier.

This view as to the Hudson River age of these deposits along the east side of the river was maintained for some years; and as regards the various widely different rocks which make up the crystalline series of the mountain range in their extension through the province of Quebec, it was held that these represented the same series of strata, the marked difference in their appearance and composition being entirely due to metamorphism, so that shales became slates and sandstones were altered into quartzites and talcose strata, while the red slates and green sandstones became converted into chloritic, epidotic and ferriferous slates and less schistose forms of rock. The whole were held to belong to the Lower Silurian series of deposits, followed upward by others which were of Upper Silurian age and contained fossils of that division.

The red and green slates seen along the north side of the St. Lawrence above Quebec city were also supposed to represent the Oneida division of the New York series, and to rest upon the supposed Trenton rocks of the city and of the Ste. Foye road.

In 1855 Hunt, in discussing the structure and age of these rocks, claimed that the red and green slates and sandstones of the Sillery division, which had been so

named by Logan, were the equivalents of the Shawangunk or Oneida conglomerates of the New York geologists, and lay between the Richelieu shales and Medina sandstone. He also regarded the peculiar rocks of the mountain region as the equivalents of these, their metamorphic and crystalline character being the result of chemical action, so that the fossils could no longer be recognized. The rocks thus metamorphosed were also stated to belong to the Hudson River group and to the Sillery division, and he added that the changes which these sedimentary beds had undergone were often remarkable, some of them passing into chloritic, micaceous and talcose schists, while others took the form of felspathic, hornblendic and epidotic rocks.

In 1855 Prof. James Hall presented his report on the graptolites of Point Lévis, and in this the age of the strata in which these fossils were found was held to be that of the Hudson River formation. Up to 1857, in which year this report was published, there was therefore a great unanimity of opinion as to the comparatively recent age of the several divisions of these strata, though of necessity there were many complex explanations in order to account satisfactorily for the marked differences in character between the various groups, more especially as regarded the crystalline division. The first change of opinion as to their age is due to the researches of E. Billings, who, from an examination of certain fossils collected from the Lévis rocks in 1856–57, found among these certain forms, characteristic of the Calciferous and Chazy formations as developed in the Ottawa valley, where these strata are undisturbed. In consequence of this discovery Billings came to the conclusion that a great portion of these strata were referable to the base rather than to the summit of the Lower Silurian, as had so long been supposed, and that the Lévis and Sillery rocks were in reality older than the Trenton limestone.

These views were first published in the *Canadian Naturalist* for December, 1860, and in the *American Journal of Science* for March, 1861, where the opinion was expressed that "this series of rocks, to which the term 'Quebec Group' was now first applied, represents a great development of strata about the horizon of the Chazy and Calciferous, brought to the surface by an overturn anticlinal fold, with a crack and dislocation running along the summit, by which the Quebec Group was brought to overlap the Hudson River formation."

In this connection it may be mentioned that the new views thus expressed by the Canadian Survey were confirmatory of those advanced by Emmons years before, who had maintained that the strata of the group were beneath the Birds-eye limestone.

The discovery of these fossils and their satisfactory determination as Calciferous by Billings, led naturally to renewed explorations among the rocks of this area. The presence of several great faults was recognized and their relations to the various groups were determined. The series of slates and sandstones, limestones and conglomerates of the Quebec and Lévis area was divided into two principal groups, of which the supposed lower portion included the limestone, greyish slates and conglomerates, which was styled the Lévis division, while the great bulk of the red and green slates with the sandstone was placed at the top of the series and styled Sillery. These were all held to be newer than the Potsdam formation.

Exception was taken to these views of Logan by Prof. Jules Marcou, who, after an examination of the rocks in this locality, as well as of certain strata in the vicinity of Phillipsburgh, which were also regarded by Billings as about the same horizon, came to the conclusion that the strata of the 'Quebec Group' of Logan were of the age of the middle portion of the Taconic and far below the Potsdam sandstone.

Marcou regarded the presence of the Calciferous types of fossils as illustrations of the "Theory of Colonies" (Barrande's), and held that these forms received their full development at a later period. These peculiar colonies of fossils were supposed to occur in lenticular masses of limestone, enclosed in the slate. Their presence was recognized by Marcou both at Lévis and Phillipsburgh, and the associated slates, limestones and conglomerates were by him considered to be a little higher in the series than the Georgia slates, which were supposed to represent the lowest part of the Taconic.

The controversy between Logan and Marcou at length drew from Billings a statement, after carefully working out all the facts connected with the fossil contents of the different divisions, to the effect that the fossiliferous Quebec Group was apparently on the same horizon as the Llandeilo of England and Australia, and the equivalent of the Calciferous and Chazy of the American scale of formations; and he also showed from the evidence that their position was in reality at the base of the Lower Silurian, instead of at the summit, where they had so long been placed by some; and not, on the other hand, beneath the Potsdam, as was maintained by Marcou. He regarded the strata of the group as a peculiar development, the upper limit of which could scarcely be newer than the Black River formation or older than the middle of the Calciferous.

The views of the structure of this group, as given in the Geology of Canada, 1863, may be briefly summed up as follows: The Quebec Group was divided into two portions stratigraphically, viz., the Lévis and the Sillery, of which the latter was regarded as the upper member; and into two divisions lithologically, viz., a fossiliferous sedimentary and a crystalline metamorphic, the latter of which was held to represent the former in a different condition, the Sutton Mountain rocks being supposed to represent, in part at least, the Sillery formation.

In Newfoundland similar rocks to those seen at Phillipsburgh and Lévis are recognized, and the sequence of strata in that province is supposed to be nearly the same as in Quebec. The red sand-rock division, or the Georgia group, was styled the Potsdam formation, and this, along the Strait of Belle-isle, was established as the base of the whole series. These rocks were overlain by the Calciferous, which was represented by rocks regarded as the equivalents of the Phillipsburgh limestones, and these in turn were supposed to be succeeded by the slates and sandstone of the Sillery, which was still regarded as constituting the upper member of the group.

In 1866 the Quebec Group was divided into three parts, a new term, the Lauzon, being added, which comprised the greater portion of the red, green and purple slates in which fossils were rarely found, and which was held to be intermediate between the Lévis and Sillery. This arrangement was, however, soon discarded and the rocks of the group were included under the two original heads.

In 1866–69, Richardson, after a study of the red and green slates, sandstones and conglomerates of the country to the south of the St. Lawrence, and between that river and the mountain chain of crystalline rocks, assumed that the division styled the Sillery was separable into three portions and should be referred to the Potsdam formation as representing its upper part. In 1870, however, Hunt, after a study of the crystalline rocks of New Brunswick and of their relations to the overlying Cambrian, and by a comparison of these with the rocks of the mountain area in the province of Quebec, became convinced that the latter should be separated from the fossiliferous formations and assigned to a much lower position, being in fact the equivalent of the Huronian. This change of view on the part of Hunt naturally met with much dissent from those who had been so long at work in this field. It, however, gradually acquired weight, and after a careful study of the

problem for some years by Dr. Selwyn, then the Director of the Canadian Survey, this opinion was adopted and was officially announced in the publications of the department for 1877–78, where the whole series was divided into three parts, viz.: 1st, Lower Silurian; 2nd, a volcanic group, probably lower Cambrian; and 3rd, the crystalline schist group, probably Huronian, embracing the rocks of the Sutton Mountain anticlinal, etc.

This change of view placed the study of these complicated rocks on an entirely new basis. The careful separation of the fossils found in the pebbles of the limestone conglomerates from those which occur in the paste of the rock, served to simplify the difficulty arising from the mixing of widely separated types, since in the earlier days of their study this discrimination was not always attended to, and hence arose the difficulty of reconciling fossils of widely different horizons, said to be obtained from the same layer.

The study of the entire series was taken up in detail by the writer in 1885, and since that date the structure of the entire area east of the St. Lawrence and extending to the American boundary, has been mapped, so that several of the most difficult geological problems have now been satisfactorily solved.

The conclusions arrived at after so many years of constant work in this field may be briefly stated. The results of these investigations involve not only the stratigraphical relations of the several fossiliferous divisions of the Quebec Group, and the definite placing of the schists and associated rocks at their base, but the determination also of the age and relations of the great intrusive masses which are so conspicuous throughout the area east of the St. Lawrence, and which are found both to the east and west of the anticlinal axis of the crystalline schists which compose the greater part of the Sutton Mountain range.

1st. As regards the crystalline schists, formerly regarded

as Upper Silurian and then as a metamorphic portion of the Sillery division of the Lower Silurian, included in the Quebec Group, it has been very conclusively shown on stratigraphical grounds that these are directly overlain by the lowest beds of the Cambrian, which in their extension to the south of the province into the state of Vermont, have been found to contain primordial fossils. These were obtained from certain of the quartzite beds several years ago by Prof. C. D. Walcott, now Director of the United States Geological Survey. But little attempt has as yet been made to ascertain the presence of these fossils in the similar beds in their extension through Quebec.

On the eastern side of the anticlinal lower Cambrian strata are also found, but this area is affected by heavy faults, so that the thickness of the Cambrian formations is greatly reduced, while the fossiliferous strata are quite well developed. These rocks in the old scheme were placed in the Upper Silurian system.

2nd. The complicated series of the stratified fossiliferous sediments of the Quebec Group proper has been resolved into several well defined divisions. The lowest of these include the red and green slates, with certain bands of coarse conglomerate and hard sandstone, which appear at intervals along the south shore of the St. Lawrence, between Quebec and Gaspé, and, though the greater part of these is poor in organic remains, portions are found which contain forms which place them on the horizon of the upper Cambrian, while certain other portions, from their stratigraphically lower position, apparently represent the lower part of the Newfoundland section and may be the equivalents of the Georgia slates, which there underlie the Sillery and Lévis formations.

Portions of the Sillery are conspicuous for the great development of a coarse conglomerate, holding pebbles of slate, limestone and quartzite, often of large size. In the

limestone pebbles an abundant fauna of trilobites has been found, which indicates that these have been derived from the beds of the Georgia series, though their source does not readily appear. As the whole series has, however, been so faulted and overturned, it is presumable that the lower members have been thrust upward and removed by denudation. The gap in the sequence of formations along the lower St. Lawrence may thus be explained, though it is possible that a more careful search among some of the oldest or lowest beds will yet result in the discovery of strata holding a true lower Cambrian fauna from which these pebbles have been derived. Certain beds below the upper Sillery have already yielded very ancient types of graptolites, as well as Cambrian forms of trilobites.

3rd. The Sillery has been conclusively shown by the examination of a number of sections, both near the St. Lawrence River, as well as at points inland, to represent the lower part of the group, and there is a marked break between these beds of red and green shale and sandstone, which are the extension downward of the Lévis beds and the lower series of hard slates and quartzose strata. It is at the base of the former portion that the coarse conglomerates, in the limestone pebbles of which the primordial fossils are found, occur, so that these lower beds must represent a lower or older portion of the Cambrian.

As a result of the recent work in this area, therefore, the Sillery formation is now transferred from its supposed position above the Lévis to the lower part of the series; and there appears to be a gradual upward passage from the slates and conglomerates of this portion to the slates and limestones of the Lévis, the fossils in which are of a more recent aspect and quite distinct as a whole in character from those found in the lower division.

The study of the Lévis beds, and a careful discrimination of the fossils found in the pebbles of the associated

conglomerates from those found in the associated slates and limestones, shew that these are of the horizon of the Calciferous formation of the Ottawa district, and that the upper part of the Sillery would therefore be the equivalent of the Potsdam sandstone, which in that area has been conclusively proved to be the lower part of the Calciferous formation. The Lévis graduates upward into the Chazy, as certain beds near the top of the series contain fossils which bear a close resemblance to those obtained from the true Chazy beds elsewhere.

The peculiar development of strata which compose the hill on which the city of Quebec is built, has also been a fruitful source of controversy. They were for many years supposed to be a portion of the Lévis division, though differing in many respects from the typical strata of that formation as developed on the south side of the river, both in physical characters and in the nature of the contained fossils. They were subsequently regarded by some observers as the equivalents of the Utica and Hudson River formations. A careful study of the fauna of the city rocks has, however, very conclusively disproved both of these views, in so far at least as the greater portion of the strata are concerned. The fossils, of which large collections have been made, show that these are more closely related to the base of the Trenton formation, and that they represent a peculiar development about the horizon on the Black River or near the top of the Chazy. They are separated from the Utica and Lorraine on the north by a fault which skirts the north flank of the city along the valley of the St. Charles River, and from the Sillery formation by another fault which passes to the south of the city, in front of the Citadel, and which comes to the north shore of the St. Lawrence about two miles above the city.

The strata in the city itself are, however, thrown into a series of folds; and from the presence of certain fossils at

a few points it would appear that, along the crests of some of these the underlying Lévis beds are disclosed. The areas of such underlying strata must, however, be comparatively small.

A development of black shales and limestones is seen along the upper part of the north side of the Island of Orleans. These are separated from the slates of the Lévis by a fault, which appears to be the continuation of that seen along the north side of the city of Quebec. The strata of the Lévis division here appear to rest conformably upon the rocks of this series, but there is a difference in the physical aspect of the two series as well as in the character of the contained fossils in the two divisions. The northern, and apparently underlying portion, is undoubtedly the same as that seen in the city of Quebec, the age of which has been stated to be that of the lower Trenton. This group of rocks appears at a number of places along the south side of the lower St. Lawrence in such close relations to the overlying Sillery as to have led to the conclusion on the part of some observers that it really occupied a lower stratigraphical position. The presence of several faults between the strata of the two series is plain, and the fossils obtained from the apparently underlying beds show conclusively that the underlying member is really the higher in the geological scale. These beds also apparently belong to the lower part of the Trenton.

To the north of the St. Lawrence, below the city of Quebec, these peculiar developments of strata do not appear. The Trenton along the south flank of the hill range of the Laurentian rests directly upon the crystalline rocks of that system. The lower beds of the Trenton here consist of a thin development of arkose strata resembling very closely a quartzite, but the upper portion of this has been found to contain the characteristic fossils of the formation. These quartzose beds appear

in the bed of the Ste. Anne River, above the Montmorency Fall, as well as in patches on the face of the gneiss at the fall itself.

The Trenton, at the foot of the Falls, is overlain by the Utica shales, and these pass upward into the Lorraine, which extends out into the north channel of the St. Lawrence. All these formations are clearly defined by their characteristic fossils.

On apparently the same horizon with the Quebec city rocks are certain other areas, which for many years have been in dispute as to their true horizon. Among these may be mentioned the areas of black slate and limestone near Farnham, which on presumed stratigraphical grounds were, in the Geology of Canada, 1863, regarded as beneath the Potsdam. An examination of the fossil contents by Billings, however, showed that they were higher in the scale; and subsequent investigations in this direction have proved them to be the equivalents of the Quebec city series. Along the east side of the Sutton Mountain anticlinal also are other areas of slates with limestones, which for a long time yielded no organic remains, and these were, from their supposed relations to Upper Silurian rocks in their vicinity, regarded as of that age. These also, on the evidence of fossils, principally graptolites, are now assigned to their proper place at the base of the Trenton.

The areas of these rocks are very considerable, both on the east and west side of the main anticlinal. Interesting developments of this group of black slates and limestones are also found in close association with the crystalline schists near Melbourne and Danville, where, through a peculiar series of folds and overturns, these rocks, which have recently been found to contain lower Trenton fossils, are apparently beneath the crystalline series. Like the Farnham rocks, these were also formerly regarded as older than the Potsdam and supposed to be in

their true place beneath the crystalline rocks of the Sutton Mountain anticlinal axis, at that time regarded as the metamorphic development of the Sillery. The series of foldings to which these mountain rocks have been subjected has resulted in enclosing not only certain areas of the Sillery strata but also of the Trenton as well.

The rocks of Phillipsburg, about which there has long been much dispute, have recently been carefully studied by the aid of their contained fossils as well as from their stratigraphical relations, and satisfactory conclusions as to their structure and true position have been reached. They have been paralleled with the Lévis formation, both on the evidence of their contained fossils as well as their general features. Along the shores of the Missisquoi Bay they are separated by a fault from the beds of the lower Trenton, the conditions of the two series being apparently similar to those seen on the north side of the island of Orleans. The lowest beds of the Phillipsburg series are apparently the transition beds between the Calciferous and the Potsdam sandstone formations. There is then a gradually ascending series through somewhat crystalline strata into the fossiliferous beds of the Calciferous till the overlying shales of the Chazy are reached, a short distance west of the railway at St. Armand station. These Chazy shales are associated with limestone beds which hold fossils; and occupy a synclinal which extends north-easterly to Bedford and on to Stanbridge. While these are separated on the west from the Trenton strata by a fault, they, on the east, pass upward gradually into the Farnham beds of the lower Trenton, the whole series in this direction lying in a broad synclinal basin. The succession, therefore, from the base of the Phillipsburg series appears to be quite regular, though the fossils are not exactly identical with those found in the typical Calciferous and Chazy which they are held to represent. They are evidently distinct

from the Georgia sandrock of the vicinity and have a considerably higher position in the geological scale.

The term Potsdam formation in the discussion of these rocks must be carefully distinguished from the Potsdam sandstone since the indiscriminate use of the terms has led to a certain amount of confusion in the interpretation of these geological problems.

In the earlier reports of the Geological Survey the term Potsdam was held to include all between the Calciferous and the Huronian as then understood, the sandstone forming the upper member. Since that time, however, the intervening or Cambrian system has been studied, and the formations which compose it have been clearly recognized between the sandstone and the Huronian, and these have yielded a great variety of fossils of Primordial types. These include the rocks of the Georgia formation, which extends into Quebec near St. Armand station from the state of Vermont, but these rocks of the Georgia division are distinct from the Potsdam sandstone formation which has been clearly shown to be simply an extension downward of the Calciferous, and has, therefore, now been included in the Cambro-Silurian system as its lowest member. The Cambrian rocks are developed along the flanks of the Sutton anticlinal, and these underlie the Sillery proper or upper portion of that division, which on the understanding that the Lévis formation is the equivalent of the Calciferous naturally falls into the place of the Potsdam sandstone as a peculiar local development.

There is yet another portion of the old Quebec Group which calls for a word of explanation, viz., the series of diorites, diabases and serpentines, which occur along the east side of the Sutton mountain range; and which, under the old hypothesis, were regarded as, in large part, the altered equivalents of the sandy portions of the Sillery formation. A careful study of these masses over

a large area has clearly shown that in their original form the greater part of these are igneous rocks and that in point of time they are among the newest of our rock formations. Thus while they are often found closely associated with strata that extend downward as low as the pre-Cambrian, they are also seen in connection with Silurian and Devonian strata and have altered these to a very considerable extent. They may, in part, therefore, be considered as newer than Upper Silurian, or in fact than the lower part of the Devonian, since the fossiliferous strata of these formations have been altered by their action.

The recent age of these rock masses will probably apply to the greater portion of the igneous rocks lying to the east side of the Sutton Mountain anticlinal which extends from the Vermont boundary for at least 150 miles to the north-east. It also applies presumably to a number of isolated mountains which rise from the generally level country of the St. Lawrence plain.

There are, however, quite extensive areas of altered igneous rocks in connection with the crystalline schists of the mountain range. Some of these undoubtedly underlie the lowest Cambrian strata of quartzites and slates, and must, therefore, be older than these. The serpentines are, however, closely associated with the diabase mountains east of the anticlinal, and, therefore, belong to the newer period of igneous action. They are apparently altered diabase or olivine rocks. These diabase mountains sometimes form areas of considerable extent and are always conspicuous features in the landscape.

The igneous rocks of the Gaspé peninsula are of two kinds. Some of the masses are undoubtedly comparatively new, while others, as in the case of the Shick-Shock range, consist of hornblende, epidote, chlorite and serpentine, portions of which are apparently older than the slates of the Cambrian system, which occur along their northern flank.

In the case of the granite masses which are found at a number of points throughout the Eastern Townships, the same association of these with strata of widely different horizons is seen; since in some places the granites are surrounded by pre-Cambrian rocks, while in other cases the slates of the Cambrian and of the Cambro-Silurian are in contact. Near the line of junction these slates are frequently converted into schists and contain crystals of staurolite and chiastolite. That there was a period of great disturbance subsequent to the Silurian time is evident from the fact that at several points in this area the Silurian and Devonian strata are folded up, overturned and altered; so that these newer sediments are now beneath those of Cambro-Silurian age, while the corals which are found in the Devonian slates are drawn out into flat masses, and the slates themselves are sometimes altered to schists, which in hand specimens can with difficulty be distinguished from those of the pre-Cambrian areas.

Some Common Birds in their Relation to Agriculture.[1]

By F. E. L. Beal, B.S.

Continued from No. 6, page 309.

THE REDWINGED BLACKBIRD.

(Agelaius phœniceus.)

The redwinged, or swamp, blackbird is found all over the United States and the region immediately to the north. While common in most of its range, its distribution is more or less local, mainly on account of its partiality for swamps. Its nest is built near standing

[1] Reprinted from Farmers' Bulletin No. 54, U.S. Department of Agriculture, 1897.

water, in tall grass, rushes, or bushes. Owing to this peculiarity the bird may be absent from large tracts of country which afford no swamps or marshes suitable for nesting. It usually breeds in large colonies, though single families consisting of a male with several wives, may sometimes be found in a small slough, where each of the females builds her nest and rears her own little brood, while her liege lord displays his brilliant colors and struts in the sunshine. In the Upper Mississippi Valley it finds the conditions most favorable, for the countless prairie sloughs and the margins of the numerous shallow lakes form nesting sites for thousands of red-wings; and there are bred the immense flocks which sometimes do so much damage to the grain fields of the West. After the breeding season is over, the birds collect in flocks to migrate, and remain thus associated throughout the winter.

Many complaints have been made against the redwing, and several States have at times placed a bounty upon its head. It is said to cause great damage to grain in the West, especially in the Upper Mississippi Valley; and the rice growers of the South say that it eats rice. No complaints have been received from the north-eastern portion of the country, where the bird is much less abundant than in the West and South.

An examination of 725 stomachs showed that vegetable matter forms 74 per cent. of the food, while the animal matter, mainly insects, forms but 26 per cent. A little more than 10 per cent. consists of beetles, mostly harmful species. Weevils, or snout beetles, amount to 4 per cent. of the year's food, but in June reach 25 per cent. As weevils are among the most harmful insects known, their destruction should condone for at least some of the sins of which the bird has been accused. Grasshoppers constitute nearly 5 per cent. of the food, while the rest of the animal matter is made up of various insects, a few snails,

and crustaceans. Several dragon flies were found, but these were probably picked up dead, for they are too active to be taken alive, unless by one of the flycatchers. So far as the insect food as a whole is concerned, the redwing may be considered entirely beneficial.

The interest in the vegetable food of this bird centres around the grain. Only three kinds, corn, wheat and oats were found in appreciable quantities in the stomachs, and they aggregate but little more than 13 per cent. of the whole food, oats forming nearly half of this amount. In view of the many complaints that the redwing eats grain, this record is surprisingly small. The crow blackbird has been found to eat more than three times as much. In the case of the crow, corn forms one-fifth of the food, so that the redwinged blackbird, whose diet is made up of only a trifle more than one-eighth of grain, is really one of the least destructive species; but the most important item of this bird's food is weed seed, which forms practically the whole food in winter and about 57 per cent. of the whole year's fare. The principal weed seeds eaten are those of ragweed, barn grass, smartweed, and about a dozen others. That these seeds are preferred is shown by the fact that the birds begin to eat them in August, when grain is still readily accessible, and continue feeding on them even after insects become plentiful in April. The redwing eats very little fruit and does practically no harm in the garden or orchard.

While it is impossible to dispute the mass of testimony which has accumulated concerning its grain-eating propensity, the stomach examinations show that the habit must be local rather than general. As the area of cultivation increases and the breeding grounds are curtailed, the species is likely to become reduced in numbers and consequently less harmful. Nearly seven-eighths of the redwing's food is made up of weed seed or of insects injurious to agriculture, indicating unmistakably

that the bird should be protected. except, perhaps, in a few places where it is too abundant.

THE MEADOW LARK, OR OLD FIELD LARK.

(Sturnella magna.)

The meadow lark is a common and well-known bird occurring from the Atlantic Coast to the Great Plains, where it gives way to a closely related subspecies, which extends thence westward to the Pacific. It winters from our southern border as far north as the District of Columbia, Southern Illinois, and occasionally Iowa. Although it is a bird of the plains, finding its most congenial haunts in the prairies of the West, it does not disdain the meadows and mowing lands of New England. It nests on the ground and is so terrestrial in its habits that it seldom perches on trees, preferring a fence rail or a telegraph pole. When undisturbed, it may be seen walking about with a peculiar dainty step, stopping every few moments to look about and give its tail a nervous flirt or to sound a note or two of its clear whistle.

The meadow lark is almost wholly beneficial, although a few complaints have been made that it pulls sprouting grain, and one farmer claims that it eats clover seed. As a rule, however, it is looked upon with favor and is not disturbed.

In the 238 stomachs examined, animal food (practically all insects) constituted 73 per cent. of the contents and vegetable matter 27 per cent. As would naturally be supposed, the insects were ground species, such as beetles, bugs, grasshoppers, and caterpillars, with a few flies, wasps and spiders. A number of the stomachs were taken from birds that had been killed when the ground was covered with snow, but still they contained a large percentage of insects, showing the bird's skill in finding proper food under adverse circumstances.

Of the various insects eaten, crickets and grasshoppers are the most important, constituting 29 per cent. of the entire year's food and 69 per cent. of the food in August. It is scarcely necessary to enlarge upon this point, but it can readily be seen what an effect a number of these birds must have on a field of grass in the height of the grasshopper season. Of the 238 stomachs collected at all seasons of the year, 178, or more than two-thirds, contained remains of grasshoppers, and one was filled with fragments of 37 of these insects. This seems to show conclusively that grasshoppers are preferred and are eaten whenever they can be procured. The great number taken in August is especially noticeable. This is essentially the grasshopper month, *i.e.*, the month when grasshoppers reach their maximum abundance; and the stomach examination has shown that a large number of birds resort to this diet in August, no matter what may be the food during the rest of the year.

Next to grasshoppers, beetles make up the most important item of the meadow lark's food, amounting to nearly 21 per cent., of which about one-third are predaceous ground beetles. The others are all harmful species, and when it is considered that the bird feeds exclusively on the ground, it seems remarkable that so few useful ground beetles are eaten. Many of them have a disgusting odor, and possibly this may occasionally save them from destruction by birds, especially when other food is abundant. Caterpillars, too, form a very constant element, and in May constitute over 28 per cent. of the whole food. May is the month when the dreaded cutworm begins its deadly career, and then the bird does some of its best work. Most of these caterpillars are ground feeders, and are overlooked by birds which habitually frequent trees; but the meadow lark finds them and devours them by thousands. The remainder of the insect food is made up of a few ants, wasps, and spiders, with a few bugs, including some chinch bugs.

The vegetable food consists of grain, weed, and other hard seeds. Grain in general amounts to 14, and weed and other seeds to 12 per cent. The grain, principally corn, is mostly eaten in winter and early spring, and must be therefore simply waste kernels; only a trifle is consumed in summer and autumn, when it is most plentiful. No trace of sprouting grain was discovered. Clover seed was found in only six stomachs, and but little in each. Seeds of weeds, principally ragweed, barn grass, and smartweed, are eaten from November to April, inclusive, but during the rest of the year are replaced by insects.

Briefly stated, more than half of the meadow lark's food consists of harmful insects; its vegetable food is composed either of noxious weeds or waste grain, and the remainder is made up of useful beetles or neutral insects and spiders. A strong point in the bird's favor is that, although naturally an insect eater, it is able to subsist on vegetable food, and consequently is not forced to migrate in cold weather any farther than is necessary to find ground free from snow. This explains why it remains for the most part in the United States during winter, and moves northward as soon as the snow disappears from its usual haunts.

There is one danger to which the meadow lark is exposed. As its flesh is highly esteemed, the bird is often shot for the table, but it is entitled to all possible protection, and to slaughter it for game is the least profitable way to utilize a valuable species.

THE BALTIMORE ORIOLE.

(Icterus galbula.)

Brilliancy of plumage, sweetness of song, and food habits to which no exception can be taken are some of the striking characteristics of the Baltimore oriole. In summer this species is found throughout the northern

half of the United States east of the Great Plains, and is welcomed and loved in every country home in that broad land. In the Northern States it arrives rather late, and is usually first seen, or heard, foraging amidst the early bloom of the apple trees, where it searches for caterpillars or feeds daintily on the surplus blossoms. Its nest commands hardly less admiration than the beauty of its plumage or the excellence of its song. Hanging from the tip of the outermost bough of a stately elm, it is almost inaccessible, and so strongly fastened as to bid defiance to the elements.

By watching an oriole which has a nest one may see it searching among the smaller branches of some neighboring tree, carefully examining each leaf for caterpillars, and occasionally trilling a few notes to its mate. Observation both in the field and laboratory shows that caterpillars constitute the largest item of its fare. In 113 stomachs they formed 34 per cent. of the food, and are eaten in varying quantities during all the months in which the bird remains in this country, although the fewest are eaten in July, when a little fruit is also taken. The other insects consist of beetles, bugs, ants, wasps, grasshoppers, and some spiders. The beetles are principally click beetles, the larvæ of which are among the most destructive insects known; and the bugs include plant and bark lice, both very harmful, but so small and obscure as to be passed over unnoticed by most birds. Ants are eaten mostly in spring, grasshoppers in July and August, and wasps and spiders with considerable regularity throughout the season.

Vegetable matter amounts to only a little more than 16 per cent. of the food during the bird's stay in the United States, so that the possibility of the oriole doing much damage to crops is very limited. The bird has been accused of eating peas to a considerable extent, but remains of peas were found in only two stomachs. One

writer says that it damages grapes, but none were found. In fact, a few blackberries and cherries comprised the only cultivated fruit detected in the stomachs, the remainder of the vegetable food being wild fruit and a few miscellaneous seeds.

THE CROW BLACKBIRD, OR GRACKLE.

(Quiscalus quiscula.)

The crow blackbird or one of its subspecies is a familiar object in all of the States east of the Rocky Mountains. It is a resident throughout the year as far north as Southern Illinois, and in summer extends its range into British America. In the Mississippi Valley it is one of the most abundant birds, preferring to nest in the artificial groves and windbreaks near farms instead of the natural "timber" which it formerly used. It breeds also in parks and near buildings, often in considerable colonies. Farther east, in New England, it is only locally abundant. though frequently seen in migration. After July it becomes very rare, or entirely disappears, owing to the fact that it collects in large flocks and retires to some quiet place where food is abundant and where it can remain undisturbed during the molting season, but in the latter days of August and throughout September it usually reappears in immense numbers before moving southward.

It is evident that a bird so large and so abundant may exercise an important influence upon the agricultural welfare of the country it inhabits. The crow blackbird has been accused of many sins, such as stealing grain and fruit and robbing the nests of other birds; but the farmers do not undertake any war of extermination against it, and, for the most part, allow it to nest about the premises undisturbed. An examination of 2,258 stomachs showed that nearly one-third of its food consists of insects, of which the greater part are injurious. The bird also eats a few snails, crayfishes, salamanders, small fish, and occa-

sionally a mouse. The stomach contents do not indicate that it robs other birds' nests to any great extent, as remains of birds and birds' eggs amount to less than one-half of 1 per cent.

It is, however, on account of its vegetable food that the grackle is most likely to be accused of doing damage. Grain is eaten during the whole year, and during only a short time in summer is other food attractive enough to induce the bird to alter its diet. The grain taken in the winter and spring months probably consists of waste kernels gathered from the stubble. The stomachs do not indicate that the bird pulls sprouting grain; but the wheat eaten in July and August, and the corn eaten in the fall, are probably taken from fields of standing grain. The total grain consumed during the year constitutes 45 per cent. of the whole food, but it is safe to say that at least half is waste grain, and consequently of no value. Although the crow blackbird eats a few cherries and blackberries in their season, and some wild fruit in the fall, it apparently does no damage in this way.

Large flocks of crow blackbirds no doubt do considerable injury to grain crops, and there seems to be no remedy except the destruction of the birds, which is in itself expensive. During the breeding season, however, the species does much good by eating insects and by feeding them to its young, which are reared almost entirely upon this food. The bird does the greatest amount of good in spring, when it follows the plow in search of large grub worms, of which it is so fond that it sometimes literally crams its stomach full of them. The farmer must decide for himself whether or not these birds cause more damage than can be repaid by insect destruction; but when they destroy an entire crop it is no consolation to know that they have already eaten a multitude of insects which, if left alone, would have accomplished the same result.

THE SPARROWS.[1]

Sparrows are not obtrusive birds, either in plumage, song or action. There are some forty species, with nearly as many subspecies, in North America, but their differences, both in plumage and habits, are in most cases too obscure to be readily recognized, and not more than half a dozen forms are generally known in any one locality. All the species are more or less migratory, but so widely are they distributed that there is probably no part of the country where some can not be found throughout the year.

While sparrows are noted seed eaters, they do not by any means confine themselves to a vegetable diet. During the summer, and especially in the breeding season, they eat many insects, and probably feed their young largely upon the same food. An examination of the stomachs of three species—the song sparrow *(Melospiza)*, chipping sparrow *(Spizella socialis)*, and field sparrow *(Spizella pusilla)*—shows that about one-third of the food consists of insects, comprising many injurious beetles, such as snout-beetles or weevils, and leaf-beetles. Many grasshoppers are eaten, and in the case of the chipping sparrow these insects form one-eighth of the food. Grasshoppers would seem to be rather large morsels, but the bird probably confines itself to the smaller species; indeed, this is indicated by the fact that the greatest amount (over 36 per cent.) is eaten in June, when the larger species are still young and the small species most numerous. Besides the insects already mentioned, many wasps and bugs are taken. Predaceous and parasitic Hymenoptera and predaceous beetles, all useful insects, are eaten only to a slight extent, so that as a whole the sparrows' insect diet may be considered beneficial.

[1] The sparrows here mentioned are all native species. For a full account of the English sparrow, including its introduction, habits, and depredations, see Bull. No. 1 of the Division of Ornithology, published in 1889.

Their vegetable food is limited almost exclusively to hard seeds. This might seem to indicate that the birds feed to some extent upon grain, but the stomachs examined show only one kind—oats—and but little of that. The great bulk of the food is made up of grass and weed seed, which form almost the entire diet during winter, and the amount consumed is immense.

Anyone acquainted with the agricultural region of the Upper Mississippi Valley can not have failed to notice the enormous growth of weeds in every waste spot where the original sward has been disturbed. By the roadside, on the borders of cultivated fields, or in abandoned fields, wherever they can obtain a foothold, masses of rank weeds spring up, and often form impenetrable thickets which afford food and shelter for immense numbers of birds and enable them to withstand the great cold and the most terrible blizzards. A person visiting one of these weed patches on a sunny morning in January, when the thermometer is 20° or more below zero, will be struck with the life and animation of the busy little inhabitants. Instead of sitting forlorn and half frozen, they may be seen flitting from branch to branch, twittering and fluttering, and showing every evidence of enjoyment and perfect comfort. If one of them be killed and examined, it will be found in excellent condition—in fact, a veritable ball of fat.

The snowbird (*Junco hyemalis*) and tree sparrow (*Spizella monticola*) are perhaps the most numerous of all the sparrows. The latter fairly swarms all over the Northern States in winter, arriving from the north early in October and leaving in April. Examination of many stomachs shows that in winter the tree sparrow feeds entirely upon the seeds of weeds; and probably each bird consumes about one-fourth of an ounce a day. In an article contributed to the New York *Tribune* in 1881 the writer estimated the amount of weed seed annually destroyed by

these birds in the State of Iowa. Upon the basis of one-fourth of an ounce of seed eaten daily by each bird, and supposing that the birds averaged ten to each square mile, and that they remain in their winter range two hundred days, we shall have a total of 1,750,000 pounds, or 875 tons, of weed seeds consumed by this one species in a single season. Large as these figures may seem, they certainly fall far short of the reality. The estimate of ten birds to a square mile is much within the truth, for the tree sparrow is certainly more abundant than this in winter in Massachusetts, where the food supply is less than in the Western States, and I have known places in Iowa where several thousand could be seen within the space of a few acres. This estimate, moreover, is for a single species, while, as a matter of fact, there are at least half a dozen birds (not all sparrows) that habitually feed on these seeds during winter.

Farther south the tree sparrow is replaced in winter by the white-throated sparrow, the white-crowned sparrow, the fox sparrow, the song sparrow, the field sparrow and several others; so that all over the country there are a vast number of these seed eaters at work during the colder months reducing next year's crop of worse than useless plants.

In treating of the value of birds, it has been customary to consider them mainly as insect destroyers; but the foregoing illustration seems to show that seed eaters have a useful function, which has never been fully appreciated.

THE ROSE-BREASTED GROSBEAK.

(Zamelodia ludoviciana.)

The beautiful rose-breasted grosbeak breeds in the northern half of the United States east of the Missouri River, but spends its winters beyond our boundaries. Unfortunately, it is not abundant in New England, and

nowhere as plentiful as it should be. It frequents groves and orchards rather than gardens or dooryards, but probably the beauty of the male is the greatest obstacle to its increase; the fully adult bird is pure black and white, with a broad patch of brilliant rose color upon the breast and under each wing. On account of this attractive plumage the birds are highly prized for ladies' hats; and consequently have been shot in season and out till the wonder is not that there are so few, but that they remain at all.

When the Colorado potato beetle first swept over the land, and naturalists and farmers were anxious to discover whether or not there were any enemies which would prey upon the pest, the grosbeak was almost the only bird seen to eat the beetles. Further observation confirmed the fact, and there can be no reasonable doubt that where the bird is abundant it has contributed very much to the abatement of the pest which has been noted during the last decade. But this is not the only good which the bird does, for many other noxious insects besides the potato beetle are also eaten.

The vegetable food of the grosbeak consists of buds and blossoms of forest trees, and seeds, but the only damage of which it has been accused is the stealing of green peas. The writer has observed it eating peas and has examined the stomachs of several that had been killed in the very act. The stomachs contained a few peas and enough potato beetles, old and young, as well as other harmful insects, to pay for all the peas the birds would be likely to eat in a whole season. The garden where this took place adjoined a small potato field which earlier in the season had been so badly infested with the beetles that the vines were completely riddled. The grosbeaks visited the field every day, and finally brought their fledged young. The young birds stood in a row on the topmost rail of the fence and were fed with the beetles which their parents

gathered. When a careful inspection was made a few days later, not a beetle, old or young, could be found; the birds had swept them from the field and saved the potatoes.

It is not easy to advise measures either for increasing the numbers of this bird or inducing it to take up its residence on the farm. Naturally it inhabits thin, open woods or groves, and the change from such places to orchards would be simple—in fact, has already been made in some parts of Pennsylvania and Ohio. In New England the bird is somewhat rare, and perhaps the best that can be done here or elsewhere is to see that it is thoroughly protected.

THE SWALLOWS.

There are seven common species of swallows within the limits of the United States, four of which have, to some extent, abandoned their primitive nesting habits and attached themselves to the abodes of men. As a group, swallows are gregarious and social in an eminent degree. Some species build nests in large colonies, occasionally numbering thousands; in the case of others only two or three pairs are found together; while still others nest habitually in single pairs.

Their habits are too familiar to require any extended description. Their industry and tirelessness are wonderful, and during the day it is rare to see swallows at rest except just before their departure for the South, when they assemble upon telegraph wires or upon the roofs of buildings, apparently making plans for the journey.

A noticeable characteristic of several of the species is their attachment to man. In the eastern part of the country the barn swallow (*Chelidon erythrogastra*) now builds exclusively under roofs, having entirely abandoned the rock caves and cliffs in which it formerly nested. More recently the cliff swallow (*Petrochelidon lunifrons*) has found a better nesting site under the eaves of build-

ings than was afforded by the overhanging cliffs of earth or stone which it once used, and to which it still resorts occasionally in the East, and habitually in the unsettled West. The martin (*Progne subis*) and white-bellied swallow (*Tachycineta bicolor*) nest either in houses supplied for the purpose, in abandoned nests of woodpeckers, or in natural crannies in rocks. The other species have not yet abandoned their primitive habitats, but possibly may do so as the country becomes more thickly settled.

Field observation will convince any ordinarily attentive person that the food of swallows must consist of the smaller insects captured in mid-air, or perhaps in some cases picked from the tops of tall grass or weeds. This observation is borne out by an examination of stomachs, which shows that the food consists of many small species of beetles which are much on the wing; many species of Diptera (mosquitoes and their allies), with large quantities of flying ants and a few insects of similar kinds. Most of them are either injurious or annoying, and the numbers destroyed by swallows are not only beyond calculation, but almost beyond imagination.

The white-bellied swallow eats a considerable number of berries of the bayberry, or wax myrtle. During migrations and in winter it has a habit of roosting in these shrubs, and it probably obtains the fruit at that time.

It is a mistake to tear down the nests of a colony of cliff swallows from the eaves of a barn, for so far from disfiguring a building, the nests make a picturesque addition, and their presence should be encouraged by every device. It is said that cliff and barn swallows can be induced to build their nests in a particular locality, otherwise suitable, by providing a quantity of mud to be used as mortar. Barn swallows may also be encouraged by cutting a small hole in a gable of the barn, while martins and white-bellied swallows will be grateful for boxes like those for the bluebird, but placed in some higher situation.

THE CEDAR BIRD.

(Ampelis cedrorum.)

The cedar waxwing, or cherry bird, inhabits the whole of the United States, but it is much less common in the West. Although the great bulk of the species retires southward in winter, the bird is occasionally found in every State during the colder months, especially if wild berries are abundant. Its proverbial fondness for cherries has given rise to its popular name, and much complaint has been made on account of the fruit eaten. Observation has shown, however, that its depredations are confined to trees on which the fruit ripens earliest, while later varieties are completely untouched. This is probably owing to the fact that when wild fruits ripen they are preferred to cherries, and really constitute the bulk of the cedar bird's diet.

In 152 stomachs examined animal matter formed only 13 and vegetable 87 per cent., showing that the bird is not wholly a fruit eater. With the exception of a few snails, all the animal food consisted of insects, mainly beetles—and all but one more or less noxious, the famous elm leaf-beetle being among the number. Bark or scale lice were found in several stomachs, while the remainder of the animal food was made up of grasshoppers, bugs and the like. Three nestlings were found to have been fed almost entirely on insects.

Of the 87 per cent. of vegetable food, 74 consisted entirely of wild fruit or seeds and 13 of cultivated fruit, but a large part of the latter was made up of blackberries and raspberries, and it is very doubtful whether they represented cultivated varieties. Cherry stealing is the chief complaint against this bird, but of the 152 stomachs only 9, all taken in June and July, contained any remains of cultivated cherries, and these aggregate but 5 per cent. of the year's food. As 41 stomachs were collected in

those months, it is evident that the birds do not live to any great extent on cultivated cherries.

Although the cherry bird is not a great insect destroyer it does some good work in this way, since it probably rears its young mostly upon insect food. On the other hand, it does not devour nearly as much cultivated fruit as has been asserted, and most, if not all, of the damage can be prevented. The bird should therefore be considered a useful species, and as such should be accorded all possible protection.

THE CATBIRD.

(Galeoscoptes carolinensis.)

The catbird, like the thrasher, is a lover of swamps, and delights to make its home in a tangle of wild grapevines, greenbriers and shrubs, where it is safe from attack and can find its favorite food in abundance. It is found throughout the United States west to the Rocky Mountains; occurs also in Washington, Idaho and Utah, and extends northward into British America. It winters in the Southern States, Cuba, Mexico and Central America.

The catbird always attracts attention, and the intruder upon its haunts soon understands that he is not welcome. There is no mistaking the meaning of the sneering voice with which he is saluted, and there is little doubt that this gave rise to the popular prejudice against the bird; but the feeling has been increased by the fact that the species is sometimes a serious annoyance to fruit growers. All such reports, however, seem to come from the prairie country of the West. In New England, according to the writer's experience, the catbird is seldom seen about gardens or orchards; the reason may possibly be found in the fact that on the prairies fruit-bearing shrubs which afford so large a part of this bird's food are conspicuously absent. With the settlement of this region comes an extensive

planting of orchards, vineyards and small fruit gardens, which furnish shelter and nesting sites for the catbird, as well as for other species, with a consequent large increase in their numbers, but without providing the native fruits upon which they have been accustomed to feed. Under these circumstances, what is more natnral than for the birds to turn to cultivated fruits for their supplies? The remedy is obvious; cultivated fruits can be protected by the simple expedient of planting wild species or others which are preferred by the birds. Some experiments with catbirds in captivity showed that the Russian mulberry was preferred to any cultivated fruit that could be offered.

The stomachs of 213 catbirds were examined and found to contain 44 per cent. of animal (insect) and 56 per cent. of vegetable food.[1] Ants, beetles, caterpillars and grasshoppers constitute three-fourths of the animal food, the remainder being made up of bugs, miscellaneous insects and spiders. One-third of the vegetable food consists of cultivated fruits, or those which may be cultivated, such as strawberries, raspberries and blackberries; but while we debit the bird with the whole of this, it is probable—and in the eastern and well-wooded part of the country almost certain—that a large part was obtained from wild vines. The rest of the vegetable matter is mostly wild fruit, such as cherries, dogwood, sour gum, elder berries, greenbrier, spice berries, black alder, sumac and poison ivy.

Although the catbird sometimes does considerable harm by destroying small fruit, the bird can not be considered injurious. On the contrary, in most parts of the country it does far more good than harm, and the evil it does can be reduced appreciably by the methods already pointed out.

[1] The investigation of the food of the catbird, brown thrasher, and house wren was made by Mr. Sylvester D. Judd and published in the Yearbook of the Department of Agriculture for 1895, pp. 405-408.

THE BROWN THRASHER.

(Harporhynchus rufus.)

The brown thrasher breeds throughout the United States east of the Great Plains, and winters in the South Atlantic and Gulf States. It occasionally visits the garden or orchard, but nests in swamps or in groves standing upon low ground. While it generally prefers a thickly grown retreat, it sometimes builds in a pile of brush at a distance from trees. On account of its more retiring habits it is not so conspicuous as the robin, although it may be equally abundant. Few birds can excel the thrasher in sweetness of song, but it is so shy that its notes are not heard often enough to be appreciated. Its favorite time for singing is the early morning, when, perched on the top of some tall bush or low tree, it gives an exhibition of vocal powers which would do credit to a mockingbird. Indeed, in the South, where the latter bird is abundant, the thrasher is known as the sandy mocker.

The food of the brown thrasher consists of both fruit and insects. An examination of 121 stomachs showed 36 per cent. of vegetable and 64 of animal food, practically all insects, and mostly taken in spring before fruit is ripe. Half the insects were beetles, and the remainder chiefly grasshoppers, caterpillars, bugs and spiders. A few predaceous beetles were eaten, but, on the whole, its work as an insect destroyer may be considered beneficial.

Eight per cent. of the food is made up of fruits like raspberries and currants which are or may be cultivated, but the raspberries at least are as likely to belong to wild as to cultivated varieties. Grain, made up mostly of scattered kernels of oats and corn, is merely a trifle, amounting to only 3 per cent., and though some of the corn may be taken from newly planted fields, it is amply paid for by the May beetles, which are eaten at the same time. The rest of the food consists of wild fruit or seeds. Taken all in all, the brown thrasher is a useful bird, and

probably does just as good work in its secluded retreats as it would about the garden, for the swamps and groves are no doubt the breeding grounds of many insects that migrate thence to attack the farmers' crops.

THE HOUSE WREN.

(Troglodytes aëdon.)

The diminutive house wren frequents barns and gardens, and particularly old orchards in which the trees are partially decayed. He makes his nest in a hollow branch where perhaps a woodpecker had a domicile the year before, but he is a pugnacious character, and if he happens to fancy one of the boxes that have been put up for the bluebirds, he does not hesitate to take it. He is usually received with favor, and is not slow to avail himself of boxes, gourds, tin cans, or empty jars placed for his accommodation.

As regards food habits, the house wren is entirely beneficial. Practically, he can be said to live upon animal food alone, for an examination of 52 stomachs showed that 98 per cent. of the stomach contents was made up of insects or their allies, and only 2 per cent. was vegetable, including bits of grass and similar matter, evidently taken by accident with the insects. Half of this food consisted of grasshoppers and beetles; the remainder of caterpillars, bugs and spiders. As the house wren is a prolific breeder, frequently rearing from twelve to sixteen young in a season, a family of these birds must cause considerable reduction in the number of insects in a garden. Wrens are industrious foragers, searching every tree, shrub, or vine for caterpillars, examining every post and rail of the fence and every cranny in the wall for insects or spiders. They do not, as a rule, fly far afield, but work industriously in the immediate vicinity of their nests. In this way they become valuable aids in the garden or orchard, and by providing suitable nesting boxes they may be

induced to take up residence where their services will do most good. Their eccentricities in the selection of a home are well known. Almost anything, from an old cigar box to a tomato can, an old teapot, a worn-out boot, or a horse's skull, is acceptable, provided it be placed well up from the ground and out of reach of cats and other prowlers.

It does not seem possible to have too many wrens, and every effort should be made to protect them and to encourage their nesting about the house.

THE ROBIN.

(Merula migratoria.)

The robin is found throughout the United States east of the Great Plains, and is represented farther west by a slightly different subspecies. It extends far north through Canada, and is found even in Alaska. Although the great bulk of the species leaves the Northern States in winter, a few individuals remain in sheltered swamps, where wild berries furnish an abundant supply of food.

The robin builds its nest in orchards and gardens, and occasionally takes advantage of a nook about the house, or under the shelter of the roof of a shed or outbuilding. Its food habits have sometimes caused apprehension to the fruit grower, for it is fond of cherries and other small fruits, particularly the early varieties. For this reason many complaints have been lodged against it, and some persons have gone so far as to condemn the bird. The robin is, however, too valuable to be exterminated, and choice fruit can be readily protected from its depredations

An examination of 330 stomachs shows that over 42 per cent. of its food is animal matter, principally insects, while the remainder is made up largely of small fruits or berries. Over 19 per cent. consists of beetles, about one-third of which are useful ground beetles, taken mostly in spring and fall, when other insects are scarce. Grasshoppers make up about one-tenth of the whole food, but in August

comprise over 30 per cent. Caterpillars form about 6 per cent., while the rest of the animal food, about 7 per cent., is made up of various insects, with a few spiders, snails and angle-worms. All the grasshoppers, caterpillars and bugs, with a large portion of the beetles, are injurious, and it is safe to say that noxious insects comprise more than one-third of the robin's food.

Vegetable food forms nearly 58 per cent. of the stomach contents, over 47 being wild fruits and only a little more than 4 per cent. being possibly cultivated varieties. Cultivated fruit amounting to about 25 per cent. was found in the stomachs in June and July, but only a trifle in August. Wild fruit, on the contrary, is eaten in every month, and constitutes a staple food during half the year. No less than forty-one species were identified in the stomachs; of these, the most important were four species of dogwood, three of wild cherries, three of wild grapes, four of greenbrier, two of holly, two of elder; and cranberries, huckleberries, blueberries, barberries, service berries, hackberries and persimmons, with four species of sumac, and various other seeds not strictly fruit.

The depredations of the robin seem to be confined to the smaller and earlier fruits, and few, if any, complaints have been made against it on the score of eating apples, peaches, pears, grapes, or even late cherries. By the time these are ripe the forests and hedges are teeming with wild fruits, which the bird evidently finds more to its taste. The cherry, unfortunately, ripens so early that it is almost the only fruit accessible at a time when the bird's appetite has been sharpened by a long-continued diet of insects, earthworms and dried berries, and it is no wonder that at first the rich juicy morsels are greedily eaten. In view of the fact that the robin takes ten times as much wild as cultivated fruit, it seems unwise to destroy the birds to save so little. Nor is this necessary, for by a little care both may be preserved. Where much

fruit is grown, it is no great loss to give up one tree to the birds; and in some cases the crop can be protected by scarecrows. Where wild fruit is not abundant, a few fruit-bearing shrubs and vines judiciously planted will serve for ornament and provide food for the birds. The Russian mulberry is a vigorous grower and a profuse bearer, ripening at the same time as the cherry, and, so far as observation has gone, most birds seem to prefer its fruit to any other. It is believed that a number of these trees planted around the garden or orchard would fully protect the more valuable fruits.

Many persons have written about the delicate discrimination of birds for choice fruit, asserting that only the finest and costliest varieties are selected. This is contrary to all careful scientific observation. Birds, unlike human beings, seem to prefer fruit like the mulberry, that is sweetly insipid, or that has some astringent or bitter quality like the chokecherry or holly. The so-called black alder *(Ilex verticillata)*, which is a species of holly, has bright scarlet berries, as bitter as quinine, that ripen late in October, and remain on the bushes through November, and though frost grapes, the fruit of the Virginia creeper, and several species of dogwood are abundant at the same time, the birds eat the berries of the holly to a considerable extent, as shown by the seeds found in the stomachs. It is moreover a remarkable fact that the wild fruits upon which the birds feed largely are those which man neither gathers for his own use nor adopts for cultivation.

THE BLUEBIRD.

(Sialia sialis.)

The common and familiar bluebird is an inhabitant of all the States east of the Rocky Mountains, from the Gulf of Mexico northward into Canada. It winters as far north as Southern Illinois, in the Mississippi Valley, and Pennsylvania in the east; in spring it is one of the

first migrants to arrive in the Northern States, and is always welcomed as an indication of the final breaking up of winter. It frequents orchards and gardens, where it builds its nest in hollow trees, or takes advantage of a nesting box provided by the enterprising farmer's boy.

So far as known, this bird has not been accused of stealing fruit or of preying upon any crops. An examination of 205 stomachs showed that 76 per cent. of the food consists of insects and their allies, while the other 24 per cent. is made up of various vegetable substances, found mostly in stomachs taken in winter. Beetles constitute 28 per cent. of the whole food, grasshoppers 22, caterpillars 11, and various insects, including quite a number of spiders, comprise the remainder of the insect diet. All these are more or less harmful, except a few predaceous beetles, which amount to 8 per cent., but in view of the large consumption of grasshoppers and caterpillars, we can at least condone this offence, if such it may be called. The destruction of grasshoppers is very noticeable in the months of August and September, when these insects form more than 60 per cent. of the diet.

It is evident that in the selection of its food the bluebird is governed more by abundance than by choice. Predaceous beetles are eaten in spring, as they are among the first insects to appear; but in early summer caterpillars form an important part of the diet and are replaced a little later by grasshoppers. Beetles are eaten at all times, except when grasshoppers are more easily obtained.

So far as its vegetable food is concerned, the bluebird is positively harmless. The only trace of any useful product in the stomachs consisted of a few blackberry seeds, and even these more probably belonged to wild than cultivated varieties. Following is a list of the various seeds which were found: Blackberry, chokeberry, juniperberry, pokeberry, partridgeberry, greenbriar, Virginia creeper, bittersweet, holly-strawberry bush, false spike-

nard, wild sarsaparilla, sumac (everal species), rose haws, sorrel, ragweed, grass and asparagus. The list shows how little the bluebird depends upon the farm or garden to supply its needs, and indicates that by encouraging the growth of some of these plants, many of which are highly ornamental, the bird can be induced to make its home on the premises.

Bluebirds are so well known that it seems unnecessary to urge anything more in their favor; but in view of the fact that large numbers were destroyed during the storm of 1895, more than ordinary vigilance should be exercised in protecting them until they have regained their normal abundance.

Book Notices.

High School Botany.[1]—In any new edition of a text-book one naturally seeks to discover (1) what extensions have been made, and (2) how far the errors and objectionable features of earlier editions may have been corrected.

The first part of the book before us, embracing 226 pages, is devoted to the general principles of Morphology and Physiology, with a discussion of type forms of the lower groups of plants, ranging from a fern to Chara. The principles of classification are also dealt with, and the three concluding pages are devoted to directions for the collection of plants and the formation of herbaria. In this portion of the book no extension or alteration has been made; it remains as in the previous revised edition of 1887.

The second part, dealing with the Flora of Canada, has been extended from 162 to 271 pages, and now "includes most of the wild plants of Manitoba and the prairie region generally, as well as those of the older provinces." We observe also, the introduction of a separate and much better glossary, and an alphabetical list of common cultivated plants, which are designated by both common and scientific names. It is in this portion of the book that we note the only extensions and

[1] The Elements of Structural Botany, with special reference to the study of Canadian Plants. H. B. Spotten, M.A., F.L.S. W. J. Gage & Co., Toronto, new edition, pp. 237 and 308, 1897.

improvements. Such a manual tends to meet a long-felt want among Canadian botanists, and will serve a most useful purpose.

As a text book for the use of schools, however, interest centres chiefly in the first portion of the book. For purposes of elementary education, where controversial questions have no place, the value of such a text-book is to be measured very largely by the directness and accuracy with which recognised facts are stated. To continue the presentation of views which have been recognised as erroneous for many years, imposes upon those who are engaged in teaching the higher aspects of the subject the difficult task of undoing the teaching of the schools. Thus on pages 208-209 we are informed that Dicotyledons are either angiospermous or gymnospermous, a statement which wholly destroys the educational value of the classification employed, since it introduces an absolutely incorrect idea of relationship.

An appendix gives a "Selection from Examination Papers," the obvious purport of which appears to be to give the prospective student some notion of the ground covered in the university work. A revised edition of a text-book might be supposed to include such an item in the up-to-date changes. It is, therefore, a matter of some surprise to find that these selections are the same as those which appeared in 1887, and in one case at least they represent work of a character which has been unknown for the last fourteen years. It is to be regretted that the author could not see his way to fully justify the use of the term *revised*.

D. P. P.

VEGETABLE PHYSIOLOGY.[1] —In the form of a small pamphlet of 32 pages, Dr. Arthur has brought together directions for a number of experiments illustrative of the most prominent functions of the plant as employed by him in connection with his classes at Purdue University. No attempt is made to introduce the student to an elaborate course in plant physiology, the directions being adapted rather to the needs of an elementary course. By suggestion, rather than detailed direction, the student is led to exercise his own powers of observation, develop originality, and realize that there is a much larger field for inquiry beyond.

D. P. P.

BOTANICAL TEXT-BOOK.[2] —The rapidity with which new text-books of Botany are being produced at the present time is not always a matter for congratulation either in the interests of the student, the teacher or the science, since, in the majority of cases, they either perpetuate erroneous ideas or show little, if any, special adaptation to the

[1] Laboratory Exercises in Vegetable Physiology by Dr. J. C. Arthur. Kinney and Herbert, Lafayette, Ind., 32 p., 1897.

[2] Elementary Botany, Percy Groom, M.A., F.L.S. Geo. Bell & Sons, London, 252 pp., 275 ill., 1898.

object in view; there is, therefore, no proper justification for their appearance.

When, however, a book offers an illustration in exception to this statement, it is especially welcome, and such an instance is to be met with in the book under consideration. The author has approached his task from the double standpoint of an experienced botanist trained in modern methods, and of one who has had large acquaintance with the requirements of secondary school work, through his experience as an examiner.

The work is divided into three parts:—I. General Morphology, II. Classification of the Angiosperms, III. Physiology. No attempt whatever is made to go beyond the limits of the seed plants, and for the class of students for whom the book is written, this is a wise limitation. While the many topics dealt with are necessarily treated somewhat briefly, the statements are accurate, concise and lucid. The pupil is led on by suggestion, and is certain to have a good grounding when the by no means difficult subject matter is fully mastered. Great aid to a clear understanding of the various problems discussed, is given by the numerous very excellent illustrations which, it is to be noted, are not of the stereotyped class, but possess a desirable degree of freshness.

The material selected for study is of a character readily available, and nothing has been introduced which calls for the use of more than a simple pocket lens. A feature which will commend the book to many is the avoidance of technical terms, the undue use of which in elementary works, has often proved a most serious stumbling block to those who otherwise might have been attracted to the study. All such burdensome details as the forms and margins of leaves are relegated to an appendix which provides an admirably arranged dictionary where special terms are grouped under general headings.

The work is thoroughly modern in its presentation of the subjects and is exceptionally free from objectionable features. It will doubtless serve an admirable purpose in elementary schools as the basis of more advanced work. D. P. P.

INDEX.

NOTE.—The pages marked with an asterisk * (267–325) are to be found in the Number for April, 1897, coming immediately after page 328.

ABSTRACT FOR THE MONTH OF DECEMBER, 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	19.17	26 6	8 8	17.8	30.0100	30 248	29.869	.379	.0978	89 5	16.5	S	13.42	9.0	10	4	00	....	4.3	0.33	1
2	10.78	18.6	3.6	15.0	30.4410	30.525	30.217	.308	.0583	81.7	6.2	S.W.	16 92	0 2	1	0	91	....	0.0	0.00	2
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4	15 93	25.7	6.9	18 8	30.0565	30.393	29.621	.772	.0892	96.5	15.0	S.W.	8.25	10 0	10	10	00	....	3 8	0.28	4
SUNDAY..... 5	.....	36.0	20 8	15.2	.....	.....	....	.....	.....	....	....	S.	24 63	...	..	..	4	0.34	0.0	0.34	5 .....SUNDAY
6	11 08	17.0	7.3	9.7	30.1877	30.237	30.075	.162	.0588	81.8	6 5	N.	13 25	1.0	7	0	89	....	....	....	6
7	23.65	29 3	10.4	18.9	30.1050	30.153	30.066	.087	.1225	93.5	22.2	E	10 08	8.3	10	0	00	....	4.0	0.37	7
8	28.68	31.6	24.0	7.6	30 1638	30.181	30.146	.035	.1487	93.2	26.8	S.E	8 04	9.7	10	7	00	....	0.1	0.01	8
9	33.83	38.3	25.0	13.3	30.1612	30 181	30.153	.028	.1763	89.5	31.2	S.E.	16.96	6 3	10	0	00	....	...	....	9
10	42.67	46.2	35.8	10.4	29 9878	30.126	29.856	.270	2397	87 3	39.2	S.	23.75	9 2	10	7	00	....	....	...	10
11	41.68	47.7	34.4	13.3	29 7332	29.862	29 585	.277	.2515	94 5	40.0	S.	15.92	10.0	10	10	00	0.56	.....	0.56	11
SUNDAY.....12	.....	33.8	27.0	6.8	.....	.....	.....	....	.....	....	....	N.W.	9.38	....	..	..	00	0.01	1.0	0 10	12 .....SUNDAY
13	28.60	31.3	25.6	5.7	30.2482	30.342	30.120	.222	.1283	81.5	23.8	S.W.	9.25	4.7	10	0	59	....	....	....	13
14	31.27	34.7	24.5	10.2	30.1118	30.311	29.862	.449	.1598	90.3	29.0	N.E.	13.17	9.8	10	9	00	0.77	....	0.77	14
15	34.45	35.7	33.2	2.5	29.6405	29.752	29.554	.198	.1922	96.5	33.3	S.W.	20.33	9.0	10	4	00	1.06	....	1.06	15
16	36.22	39.3	33.0	6.3	29.8713	29 958	29 812	.146	.1900	88.7	33.0	S.W.	20.44	9.3	10	6	00	0.02	....	0.02	16
17	30.70	38.6	27.1	11.5	30.0312	30.187	29.776	.411	.1358	79.5	25.2	S.W.	15.63	8.2	10	3	7	....	2.9	0.30	17
18	12.48	29.0	3.1	25.9	30.1437	30.372	29.935	.437	.0635	81.0	7.7	S.W.	29.46	0 7	4	0	89	....	0.1	0.01	18
SUNDAY.....19	.....	6.7	—2.8	9.5	.....	.....	.....	.....	.....	....	....	S.W.	15.38	....	..	..	91	....	....	....	19 .....SUNDAY
20	5.48	9.9	—0.8	10 7	30.2395	30.498	29.918	.580	.0518	92 5	3 7	N.	8.21	7 0	10	0	00	....	1.8	0 12	20
21	11.90	16.8	9.1	7.7	29 8501	29.898	29.811	087	.0670	89.8	9.5	S.W.	13.46	3.7	10	2	27	....	2.0	0.15	21
22	9.58	12.5	4.3	8.2	29.8117	29.901	29 700	.201	.0645	95.5	8 7	S.	6.79	5.5	10	0	9	....	0.5	0.03	22
23	12.03	13.8	9.3	4.5	29 5837	29 642	29.511	.131	.0698	93.0	10.5	N	8.13	10.0	10	10	00	....	5.3	0.40	23
24	—1.10	10.8	—7.1	17.9	30.1050	30 316	29.796	.530	.0373	89 7	—3 2	S.W.	29.43	5.3	10	0	10	....	0 5	0.03	24
25	1.63	17.8	—11.1	28.9	30.0907	30.354	29 842	.512	.0437	87.0	—1.5	S. E.	19.83	5 3	10	0	00	....	....	....	25
SUNDAY.....26	.....	30.3	8.5	21.8	.....	.....	.....	.....	.....	....	....	S.	11 25	...	..	..	1	....	1.3	0.10	26.....SUNDAY
27	16.02	28.3	4.0	24.3	29.9610	30 220	29.778	.442	.0785	82.3	11 8	S.W.	19.50	3.5	10	0	88	....	0.0	0.00	27
28	1.52	5.1	—2.7	7.8	30 4052	30.448	30.335	.113	.0402	87.2	—1.5	S.W.	17.54	0.0	4	0	89	....	....	....	28
29	10 77	22.3	—1.8	24 1	30.0867	30.380	29.714	.666	.0630	91.0	8.7	E.	12.42	7.8	10	0	1	....	0.8	0.07	29
30	31.42	35.9	23.7	12 2	29.5485	29 640	29 458	.182	.1595	89.8	28.8	S.	19.09	9.5	10	7	5	....	9.7	0.78	30
31	23 20	30.3	17.2	13.1	29 7423	29.808	29.624	.184	.1102	87.0	20.0	N.	19.88	8 5	10	1	00	....	1.1	0.03	31
Means.....	20.07	26.57	13.27	13.30	30.0319	30.1676	29.8751	.2925	.1105	88.55	17.22	S. 23¼° W.	15.46	6.55	9.1	3.0	22.1	2.76	39 2	5.91	....Sums.
23 Years means for and including this month	18.95	26.07	11.76	14.31	30.0352	.....	.....	.2946	.1001	82.87			s 16.53	6.87	.	..	¶29.46	1.34	23.53	3.61	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	1155	400	837	1428	1604	5799	205	75	
Duration in hrs..	94	33	67	93	107	327	16	7	
Mean velocity....	12.29	12.12	12.49	15.35	14 99	17.73	12.81	10.71	

Greatest mileage in one hour was 49, on the 24th.

Greatest velo city in gusts 54 miles per hour on the 24th.

Resultant mileage, 5682.

Resultant direction, S. 23¼ W.

Total mileage, 11,503.

* 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. s 11 years only.

The greatest heat was 47.7° on the 11th; the greatest cold was —11.1° on the 25th, giving a range of temperature of 58.8 degrees.

Warmest day was the 10th. Coldest day was the 24th. Highest barometer reading was 30.583 on the 3rd. Lowest barometer was 29.330 on the 5th, giving a range of 1.253 inches. Maximum relative humidity was 100 on the 4th. Minimum relative humidity was 62 on the 25th.

Rain fell on 6 days.

Snow fell on 19 days.

Rain or snow fell on 23 days.

Hoar Frost on the 4th.

Lunar halo on the 6th and 13th. Lunar corona on the 2nd and 3rd.

Fog on 9 days.

Meteorological Abstract for the Year 1897.

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

C. H. McLEOD, *Superintendent.*

Month.	Thermometer.					* Barometer.				† Mean pressure of vapour.	‡ Mean relative humidity.	Mean dew point.	Wind.		Sky clouded per cent.	Per cent. possible bright sunshine	Inches of rain.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain *and* snow fell.	No. of days on which rain *or* snow fell.	Month.
	Mean.	¶ Deviation from 23 years means.	Max.	Min.	Mean daily range.	Mean.	Max.	Min.	Mean daily range.				Resultant direction.	Mean velocity in miles per hour.										
January	13.54	+ 1.62	47.5	— 23.5	13.84	30.0269	30.720	29.321	.308	.0512	85.0	10.0	S. 67½° W.	17.7	59	42.6	0.41	4	26.1	15	3.03	2	18	January
February	18.12	+ 2.65	37.7	— 5.3	11.88	30.0864	30.587	29.514	.221	.0896	82.1	13.5	S. 81½° W.	16.0	51	51 2	0.48	4	16 5	16	2.12	3	16	February
March	26.60	+ 2.42	46.2	— 9.7	13.43	29.9922	30.857	29.676	.361	.1237	80.1	21.0	S. 68½° W.	15 6	60	41 6	1.80	12	23.7	14	4.05	6	20	March
April	41 71	+ 1.57	74.3	10.9	16.88	30.0268	30.548	29.444	.222	.2070	74.5	33.9	S. 56½° W.	16.5	57	45.4	3.02	18	1.9	2	3.27	1	19	April
May	53.11	— 1.56	72.1	33.8	16.99	29.9192	30.395	29.475	.179	.2934	72.6	43.6	S. 67½° W.	14 7	61	43.9	3.74	22	....	..	3.74	..	22	May
June	61.21	— 3.63	81.6	41 5	16.12	29.8765	30.215	29.604	.133	.3877	71.4	51.2	S. 77° W.	13 6	54	49.3	3.76	20	...	..	3.76	..	20	June
July	70.96	+ 2.13	93.0	54.5	16.01	29 9064	30.343	29.599	.117	.5933	78.5	63.3	S. 18½° E.	10.7	54	56.5	4.42	19	...	..	4.42	..	19	July
August	63.94	— 2.65	82.0	44.9	14.82	29.9057	30.190	29.514	.128	.4633	77.1	56.4	S. 47½° W.	12 5	49	55.5	1.95	21	..	..	1.95	..	21	August
September	57.50	— 0.69	86.8	35.5	16.88	30.1072	30.421	29.640	.173	.3687	73.4	49.0	S. 63½° W.	14.6	37	59 2	1.15	18	....	..	1.15	..	18	September
October	49.29	+ 3.96	77.8	26.0	18.21	30.0666	30.644	29.525	.247	.2690	71.8	40.4	S. 54½° W.	14.7	38	57.3	0.65	9	....	..	0.65	..	9	October
November	30.62	— 1.83	54.2	8.5	11.84	29.9928	30.588	29.100	.279	.1562	83.7	26.3	S. 35½° W.	16.9	69	27.9	2.66	11	18.9	11	5.03	4	18	November
December	20.07	+ 1.12	47.7	— 11.1	13.30	30.0319	30.583	29.330	.293	.1105	88.6	17.2	S. 23½° W.	15.5	66	22.1	2.76	6	39.2	19	5.91	2	23	December
Sums for 1897	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	26.80	164	126.3	77	39 08	18	223	Sums for 1897
Means for 1897	42.26	+ 0.418	....	....	15.02	29.9949	....	....	.2218	.2624	78.23	35.48	S. 57° W.	14 90	54.6	46.04	....	....	....	..	3.27	..	..	Means for 1897
Means for 23 years ending Dec. 31. 1897.	41.84	....	.. .	....	...	29.9802	....	....	....	.2525	75.02	....	....	*a* 15.11	60 4	§45.77	28.17	134	118.0	78	39.74	16	201	Means for 23 years ending Dec. 31, 1897.

* Barometer readings reduced to 32° Fah. and to sea level. † Inches of mercury. ‡ Saturation 100. § For 16 years only. ¶ "+" indicates that the temperature has been *higher*: "—" that it has been *lower* than the average for 23 years inclusive of 1897. The monthly means are derived from readings taken every 4th hour, beginning with 3 h. 0 m. Eastern Standard time. The anemometer and wind vane are on the summit of Mount Royal, 57 feet above the ground and 810 feet above the sea level. *a* For 11 years only.

The greatest heat was 93.0° on July 5; the greatest cold was 23.5° below zero on January 25. The extreme range of temperature was therefore 116.5°. Greatest range of the thermometer in one day was 50.8° on January 18; least range was 2.5° on December 15. The warmest day was July 5, when the mean temperature was 82 6°. The coldest day was January 19, when the mean temperature was 12.7° below zero. The highest barometer reading was 30.857 on March 7, lowest barometer reading was 29.076 on March 25, giving a range of 1.781 inches for the year. The lowest relative humidity was 27 on May 6. The greatest mileage of wind recorded in one hour was 56 miles on January 26, and the greatest velocity in gusts was at the rate of 66 miles per hour on January 26. The total mileage of wind was 130,585. The resultant direction of the wind for the year was S. 57° W., and the resultant mileage 48,320. Auroras were observed on 11 nights; fog on 30 days; thunder storms on 19 days; lunar halos on 10 nights; lunar coronas on 34 nights; mock suns on 1 day. The sleighing of the winter commenced in the city on December 1. The first appreciable snowfallot the autumn was on November 9. Earthquakes were recorded on March 23rd, March 26th, and May 27th. all moderately severe.

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

ABSTRACT FOR THE MONTH OF JANUARY, 1898.

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	9.63	17.2	—0 7	17.9	29.6602	29 898	29.505	.393	.0612	88 7	7.0	S.W.	26.00	7.0	10	0	03	....	10.6	0.94	1
SUNDAY.....2	.....	13.7	—9 6	23.3	.....	.....	.....	.....	.....	....	...	S.W.	23.38	...	..	..	76	....	0.3	0.03	2 .....SUNDAY
3	4.55	19.3	—0.8	20.1	29.9078	30.288	29.537	.751	.0500	86 5	.2	S.W.	25.29	3 3	10	0	79	....	1.6	0.13	3
4	—4.50	0.8	—10.7	11 5	30.2388	30 383	30.013	.370	.0328	92.3	—6.2	S.W.	10 63	5.0	10	0	59	....	0 5	0.04	4
5	10.55	22.3	—1.2	23.5	30.03'5	30.099	29 976	.123	.0078	91.0	8.5	S.W.	15 25	9 3	10	5	00	....	1.3	0.11	5
6	30 90	33.4	27.9	5.5	29.8937	30 109	29 654	.455	.1520	87.3	27 8	S	17.54	10.0	10	10	00	....	2.4	0.20	6
7	29.93	34 7	21.0	13 7	29.8205	29.935	29.665	.270	.1437	85.0	26.2	S.W.	16 92	7.8	10	0	29	....	0.5	0.06	7
8	30.58	37.3	20.7	16 6	29 4763	29.784	29.246	.538	.1487	86 8	27.3	S.W.	27 54	9.5	10	7	00	0.00	0.6	0.05	8
SUNDAY.....9	.....	29.2	12.7	16.5	.....	.....	.....	....	.....	....	...	W.	16 96	....	..	..	91	....	...	....	9 .....SUNDAY
10	20.32	25.9	9.4	19.5	30 0382	30 221	29.931	.270	.1013	89.8	18.0	S.W.	15.67	0 8	3	0	68	....	.	.	10
11	3.45	10.9	—0.3	11.2	30.2093	30 316	30.007	.3 9	0425	84.0	—0.7	N	13 17	2 3	10	0	89	....	0.0	0.00	11
12	19.47	29.0	1.5	27.5	29 6860	29.928	29 440	.488	.1030	95.5	18.3	S	12.33	10.0	10	10	00	0.35	0.8	0 46	12
13	17.08	29.2	7.0	22.2	29 9035	30 171	20 520	.651	.0365	86.5	14 0	N.	14.42	3.3	10	0	83	0.18	....	0.18	13
14	15.50	22.4	6.2	16 2	30.2145	30.276	30.167	.109	.0832	88.2	12.7	S.W.	12 88	7.5	10	5	32	....	0.0	0.00	14
15	18.00	24.5	12.5	12.0	29.8673	30.108	29.630	.418	.0943	95 0	17.0	N.	8.83	10.0	10	10	00	....	8.5	0.63	15
SUNDAY.....16	....	22.5	4.3	18.2	.....	.....	.....	.....	.....	....	....	N.W.	11.13	....	..	..	83	....	0 0	0.00	16 .....SUNDAY
17	1.98	5.9	—3.7	9.6	30 4103	30 464	30 299	.165	.0425	91 2	—0.4	S	8.04	1.7	10	0	68	....	...	....	17
18	17.45	23.8	2.7	21.1	30.4088	30 481	30.361	.113	.0901	90 2	15.2	S.W.	17.53	5.5	10	0	10	....	0.6	0.04	18
19	22.63	27.9	14.1	13.8	30.4118	30.513	30.275	.238	.1108	90 7	20.2	S.	13.08	2 0	10	0	63	....	....	....	19
20	21.40	30.8	11.6	19.2	29.8455	30.201	29 528	.673	.1113	93 3	19 8	N.	14.83	8 3	10	0	00	0.01	10 4	0 08	20
21	20.75	27.3	19.1	8.2	30 0543	30.288	29.724	564	.1007	89.8	18 5	N.	12.00	10.0	10	10	00	....	0.9	0.09	21
22	16.18	20.2	13.4	6.8	30 2540	30.345	30 031	.264	.0848	93 7	14.8	N.	8.25	10.0	10	10	00	....	0.3	0.02	22
SUNDAY.....23	.....	29.0	13.0	16.0	.....	.....	.....	.....	.....	....	....	N.	18.58	....	.	..	00	....	16.9	1.67	23.....SUNDAY
24	13.93	17.3	11.6	5.7	30 0230	30 214	29.739	.475	.0715	87.2	11.0	S.W.	16.38	3.3	10	0	73	....	0 4	0 04	24
25	12 85	18.5	6.5	12.0	30.0375	30.231	29.676	.555	.0710	90 5	10 7	S.W.	13.46	4.2	10	0	49	....	....	.	25
26	16.77	22.3	8.5	13 8	29.6405	29 779	29 524	.255	.0790	84 7	13.3	N.	17 21	6 3	10	3	54	....	2.2	0.21	26
27	1.30	16.1	2.0	14.1	29.8710	29 979	29.830	.149	.0412	89 7	—0 7	S.W.	12 00	0.2	1	0	94	....	....	.....	27
28	—5.45	0 3	—8.5	8.8	30 0672	30 138	29.989	.149	.0305	89.7	—7.5	S.W.	8.79	0.0	0	0	94	....	....	...	28
29	—4.68	3.9	—11.9	15 8	30.0157	30 217	29 973	.244	.0313	83 2	—6.8	N.	14.03	3.3	10	0	77	....	....	....	29
SUNDAY.....30	.....	—8.5	—20 9	12 4	.....	.....	.....	.....	.....	...	....	N.	9.04	...	..	..	93	....	....	....	30.....SUNDAY
31	—4.20	8.3	—20.7	29.0	29.9213	30.073	29.776	.297	.0362	93.2	—5.7	N.	17.88	8 3	10	0	00	....	3 9	0.38	31
Means.....	12.94	19.95	4.22	15.73	29 9978	30.1711	29.8136	3575	.0796	89.57	10.52	S. 76½ W.	15 13	5.73	9 0	2.7	44.0	0.57	62 7	6.17	....Sums.
24 Years means for and including this month	12.06	20.35	4.34	16.09	30.0557	.....	.....	.325	.0732	82.62			s 16.14	6.30	.	.	¶34 99	0.79	30.83	3.63	24 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	3320	309	28	21	1815	4393	529	844	
Duration in hrs..	250	18	2	2	136	251	33	48	4
Mean velocity....	13.28	17.17	14.00	10.50	13 35	17 50	16.03	17.58	

Greatest mileage in one hour was 47, on the 8th.

Greatest velocity in gusts 54 miles per hour on the 8th.

Resultant mileage, 4055.
Resultant direction, S. 76½ W.
Total mileage, 11,259.
Average velocity 15.13 m. p. h.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 17 years only. s 12 years only.

The greatest heat was 37.8° on the 8th; the greatest cold was —20.9° on the 30th, giving a range of temperature of 58.2 degrees.

Warmest day was the 6th. Coldest day was the 30th. Highest barometer reading was 30.513 on the 19th. Lowest barometer was 29.246 on the 8th, giving a range of 1.267 inches. Maximum relative humidity was 100 on the 30th. Minimum relative humidity was 68 on the 8th.

Rain fell on 4 days.

Snow fell on 21 days.

Rain or snow fell on 22 days.

Lunar halo on 4 nights. Lunar coronas on 5 nights.

Fog on 4 days.

Mock moons on the 8th.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1898.

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	7 70	10.7	3.5	7.2	29.6925	29.829	29.593	.236	.0577	93 7	6.2	N	25.08	10.0	10	10	00	....	4.5	0.43	1
	—8.98	3.5	—15.3	18.8	30.0448	30.082	29 948	.134	0262	90 8	—10.7	S.W.	14.71	5.5	10	0	51	....	0.0	0.00	2
3	—2 32	2.0	—10.7	12.7	30.2110	30 303	30 066	.237	.0322	81.8	—6.7	S	18.42	5 3	10	2	52	....	0.1	0.01	3
4	11 95	16.8	2 0	14.8	30 4353	30 496	30.374	.122	.0583	78.5	6.5	S.	18.29	6.5	10	2	58	....	0.0	0.00	4
5	25.73	32.5	13.0	19 5	30.1018	30 294	30.005	.289	.1298	89.7	23.2	S.	21.04	9 2	10	5	00	....	2.5	0.25	5
																					6 .....SUNDAY
SUNDAY.....6	.....	32.5	3.8	28.7	.....	.....	.. ..	.....	.....	....	....	S.	9.38	..	..	..	89	....	0.0	0.00	
7	16.82	25 1	6.0	19.1	30.3435	30.364	30.320	044	.0842	88 7	14 2	S.	8.42	6.2	10	0	33	....	...	....	7
8	20.15	26.8	12.8	14.0	30.3148	30 356	30 280	.076	.1008	91.3	18.3	N.	5.42	4.7	10	0	25	....	....	...	8
9	21.18	29.8	10.8	19.0	30 2870	30.362	30.171	.191	.1103	93 8	19 8	S.	6.25	6.8	10	0	28	0.08	...	0 08	9
10	36.43	40.7	29 5	11 2	30.2375	30.333	30.129	.204	.1968	91.2	34.2	S.W.	13.67	8 3	10	0	19	0.00	....	0.00	10
11	37.03	40.3	33.3	7.0	30 1417	30.296	30.000	.296	.1397	85.8	33.2	S.	21.79	8 0	10	5	33	...	....	....	11
12	36 62	39.5	33.6	5.9	29 8753	29.986	29 781	.205	.2060	94 5	35 2	S.W	24.96	8 3	10	0	00	0.47	0.1	0 48	12
SUNDAY.....13	....	34.7	23.7	11.0	.....	.....	.....	....	.....	....	...	S.W.	10 50	...	..	..	99	....	....	....	13 ....SUNDAY
14	29.22	36.7	17.7	19.0	29 7877	29 956	29.672	.284	.1342	82 7	24 5	S	19 92	7.5	10	0	00	....	0.6	0.06	14
15	26.65	30.9	22.0	8.9	29 6685	29 847	29 434	.413	.1203	82.5	22.5	N.	14 67	8.8	10	7	37	....	1.6	0.13	15
16	11.72	22.0	7.6	14.4	29 5108	29.804	29.338	.466	.0673	91 2	9.8	N.W.	30.92	10.0	10	10	00	....	12.3	1.23	16
17	0.97	8.7	—7.7	16.4	30 1537	30 261	29 972	.289	.0383	83 0	—2.8	S.W.	29.83	0 0	10	0	99	...	....	...	17
18	13 70	17.8	5.2	12.6	30.2165	30.270	30 164	.106	.0742	90 8	11.7	N.	7.79	10 0	10	10	00	....	0.0	0.00	18
19	19.25	25.8	11.9	13 9	30.4428	30 473	30 375	.093	.0937	88 3	16 5	N.	9 17	1.8	10	0	97	...	0 0	0.00	19
SUNDAY. 20	.....	19.8	15.9	3.9	.....	.....	.....	.....	.....	....	....	N.	27 13	..		..	00	....	10 5	1.30	20 ....SUNDAY
21	20.85	24.5	16.0	8.5	30 0428	30.164	29 960	.204	.1045	93.2	19.2	N.	31 67	10.0	10	10	00	....	6.5	0.93	21
22	23.82	26.9	20 4	6.5	29.9455	29.999	29.899	.100	.1207	93 5	22.3	N.	23 29	9.7	10	8	03	....	2.2	0 22	22
23	27.07	32.2	25.0	5.2	29.8790	29.950	29 830	.120	.1387	93.8	25.5	N.	12 67	10.0	10	10	00	...	2.0	0.20	23
24	28.40	33.5	24.8	8.7	29.8590	29.902	29 838	.064	.1360	86 7	24.8	S.W.	10 92	8 0	10	2	19	....	0.9	0.09	24
25	25 35	29.4	22.0	7.4	29 9695	30.022	29 940	.082	.1157	84.8	21 5	S.W.	5 29	7.3	10	2	05	....	0.5	0.04	25
26	26.05	31.5	21 0	10.5	30 0058	30.037	29 968	.069	.1257	87.3	23.2	W.	9 38	9.2	10	5	00	....	1 4	0.14	26
SUNDAY.....27	.....	31.8	23.2	8 6	.....	.....	.....	.....	.....	....	...	S W.	17.83	.....	..	.	35	....	0 5	0.05	27..... ...SUNDAY
28	20 08	24.6	14.4	10 2	29.9048	29.931	29.866	.065	0907	83.0	16 2	S.W.	24.21	2 3	10	0	81	...	0.1	0 01	28
29	.....	....	....	....	.....	.....	.....	.....	.....	....	....	....	....	...	.	..	..	....	....	.....	29
30	.....	....	....	....	.....	.....	.....	.....	.....	....	....	....	....	....	..	..	..	....	....	...	30
31	.....	....	....	....	.....	.....	.....	. ....	.....	....	....	....	....	....	..	..	..	....	....	....	31
Means.....	19.81	26 03	13.76	12.27	30 0447	30.1382	29.9551	.1831	.1063	88.36	17 01	S. 64° W.	16.88	7.23	9 6	3.7	30 7	0.55	46 3	5.65	....Sums.
24 Years means for and including this month	15.64	23.71	7.30	16.41	30.0304	.....	.....	.309	.0837	80.28	....	....	s 18.14	5.93		.	¶41.53	0.74	23 37	3 04	24 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	3791	56			3226	3491	218	559	
Duration in hrs..	200	2			222	192	22	28	6
Mean velocity....	18.96	28.00			14 53	18.18	9.91	19.97	

Greatest mileage in one hour was 43, on the 17th and 21st.

Greatest velocity in gusts 60 miles per hour on the 1st.

Resultant mileage, 3370.

Resultant direction, S. 64° W.

Total mileage, 11,341.

Average velocity 16.88 m. p. h.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 17 years only. s 12 years only.

The greatest heat was 40°.7 on the 10th; the greatest cold was —15°.3 on the 2nd, giving a range of temperature of 56.0 degrees.

Warmest day was the 11th. Coldest day was the 2nd. Highest barometer reading was 30.496 on the 4th. Lowest barometer was 29.338 on the 16th, giving a range of 1.158 inches. Maximum relative humidity was 100 on the 6th. Minimum relative humidity was 71 on the 4th and 14th.

Rain fell on 3 days.

Snow fell on 21 days.

Rain or snow fell on 23 days.

Lunar halo on 4 nights. Lunar coronas on 3 nights.

Hoar frost on 2 days.

Fog on 3 days.

Mock moons on the 24th.

ABSTRACT FOR THE MONTH OF MARCH, 1898.

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

DAY	THERMOMETER.				BAROMETER.				†Mean pressure of vapor.	‡Mean relative humidity.	Dew Point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	§Max.	§Min.	Range.				General direction.	Mean velocity in miles per hour	Mean.	Max.	Min.					
1	22.32	29.3	13.1	16.2	29.9725	29 994	29.951	.043	.0930	77.7	16.7	S	12.62	0.5	3	0	82	....	..	.....	1
2	21.03	28.5	14.2	14.3	30.1013	30.148	30 057	.031	.0923	81 3	16.3	W.	8.83	0.0	0	0	92	....	....	...	2
3	20.77	28.4	13.0	15.4	30 2295	30.285	30 164	.121	.0883	78.8	15.5	N.	10.08	0 0	0	0	96	....	....	....	3
4	24 65	34.0	12 9	21.1	30 1992	30.281	30.104	.177	.1132	82 8	20.5	S	8.79	3.5	9	0	96	....	....	....	4
5	26.95	32.8	21.8	11 0	30.1492	30 231	30.091	.140	.1103	75 2	20.5	S W.	20.42	0.0	0	0	97	....	....	....	5
SUNDAY.....6	.....	35.7	22.0	13.7	.....	....		.....	.....	....	....	S.W.	28.75	....	..	..	97	....	....	..	6.....SUNDAY
7	32.85	40 3	23.0	17.3	30.4140	30.454	30.382	072	.1465	78 5	26.7	S.	16.42	1.2	3	0	84	....	...	....	7
8	33.08	41.3	24.4	16.9	30.3115	30 393	30 244	.139	.1468	77 7	26.8	S.	5.63	1.0	3	0	76	....	....	....	8
9	37.90	43.7	28.4	15.3	30.2550	30.247	30.191	.056	.1682	73 5	30 2	S.	12 38	4.2	8	0	54	....	....	....	9
10	41.53	47.1	36.0	11 1	30.2417	30.281	30.214	067	.1930	73.3	31.5	S.	13.00	2 8	9	0	28	....	..	....	10
11	44.12	48.7	38.4	10.3	30 1157	30 223	29.952	.271	.2205	76.2	36.8	S.	21.03	6 3	10	0	78	0.01	....	0.01	11
12	42.18	45.8	39.7	6.1	29.8790	29.923	29.854	.069	.2513	93 5	40.3	S.	20.59	10.0	10	10	00	0.54	....	0 54	12
SUNDAY.....13	.. .	46.5	35.6	10.9	.....	.....	.....	....	.....	....	...	S.	30 54	....	..	..	00	0.33	....	0.33	13.....SUNDAY
14	31.70	35.3	26.5	8.8	30 0100	30.216	29.797	.419	.1322	73.7	24.3	S. W.	36 71	0.8	5	0	99	....	....	....	14
15	25.83	31.3	18.9	12.4	29 3798	30.426	30 337	.089	.1082	75.8	19.5	N.	10.75	0.0	0	0	90	....	....	...	15
16	34 95	39.3	25.9	13.4	30.1077	30.220	29.871	.349	.1537	77.2	28.5	S	22.46	5.3	10	0	34	....	0 9	0.09	16
17	39. 5	45.2	35.4	9.8	29 8372	30 065	29.689	.376	.1784	73 3	31.5	W.	26.79	3.7	10	0	88	0.22	....	0.22	17
18	36 27	39.8	31.0	8.8	30.1943	30.271	30 088	.183	.1370	63 7	25.5	W.	11.33	4.7	10	0	72	...	....	....	18
19	...90	49.0	32.5	17.5	29.7207	29.988	29.482	.506	.2305	87 3	37 2	S.E.	15.88	10.0	10	10	00	0.28	....	0.28	19
SUNDAY.....20	..	51.1	30.6	20.5	.....	.....	.....	.....	.....	....	....	W.	22 31	. ..		..	54	0 00	0 0	0 00	20.....SUNDAY
21	28.38	33.2	24.2	9.0	30 2445	30.277	30 222	055	.1038	69 8	20.3	N.	7.42	3.8	10	0	52	....	...	....	21
22	33.68	41.6	22 3	19.3	29.9833	30.263	29.645	.615	.1367	69 8	24.5	S.E	19 71	8.0	10	0	00	0 00	....	0 00	22
23	33 38	42.9	25.4	15.5	29.7702	30.036	29 423	.673	.1488	74.7	26 0	S.E.	20 13	4.3	10	0	75	0.17	....	0.17	23
24	29.18	38.1	18.8	19.3	30.1682	30.204	30 124	.080	.1145	69 8	21.0	S E.	5 03	0 0	0	0	94	....	....	....	24
25	36 35	43.8	29.9	13.9	30 4413	30.574	30.268	.306	.1543	71.8	23 0	W.	6 92	0.7	2	0	94	....	....	....	25
26	42.47	53.5	31.0	22.5	30 6048	30.648	30.582	.066	.1745	64.7	31.0	S.E.	16 38	3.0	9	0	58	....	....	....	26
SUNDAY.....27	....	58.3	34.5	21.8	.....	.....	.....	.....	.....	....	....	S E	18.08	....	..	..	83	....	....	....	27.....SUNDAY
28	46 08	49.3	41.8	5.5	30.2472	30 316	30.181	.135	.2607	83.8	41.2	S.E.	27.42	10 0	10	10	00	0.37	....	0 37	28
29	40.48	4.7	34.8	9.9	30 2122	30.266	30.194	.072	.2298	90.3	37.7	S.	23 38	8.0	10	0	00	0.63	...	0.63	29
30	35.93	42 4	30 0	12.4	30.1882	30.269	30.115	.154	.1385	65.3	25.7	S.W.	15.71	4.3	10	0	86	....	....	...	30
31	33 97	44.9	28 5	16.4	30.0723	30.192	30.002	.190	.1110	56.3	20.3	N.W.	14.17	5.7	10	0	58	....	....	...	31
Means.....	33.95	41 41	27.37	14.04	30.1492	30.2495	30.0453	.2042	.1536	75.40	26 69	S. 18° W.	17 31	3 77	6.7	1.1	61.5	2.55	0 9	2.64	....Sums.
24 Years means for and including this month	24 59	31.75	17.15	14.60	29.9759	.....	....	.265	.1108	76.43	....	....	S 17.83	5.89	-	..	¶47.32	1.10	22 64	3.38	24 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	437		188	2855	3831	3067	2274	232	
Duration in hrs..	47		12	160	234	136	125	15	15
Mean velocity....	9.30		15 67	17.84	16 37	22.55	18.19	15.47	

Greatest mileage in one hour was 55, on the 13th.

Greatest velocity in gusts 60 miles per hour on the 13th.

Resultant mileage, 7,865.
Resultant direction, S. 18° W.
Total mileage, 12,884.
Average velocity 17.32 m. p. h.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 17 years only. ₰ 12 years only.

The greatest heat was 58°.3 on the 27th; the greatest cold was 12°.9 on the 4th, giving a range of temperature of 45.4 degrees.

Warmest day was the 28th. Coldest day was the 2nd. Highest barometer reading was 30.648 on the 26th. Lowest barometer was 29.391 on the 13th, giving a range of 1.257 inches. Maximum relative humidity was 98 on the 12th, 13th and 29th. Minimum relative humidity was 45 on the 26th.

Rain fell on 10 days.

Snow fell on 2 days.

Rain or snow fell on 11 days.

Auroras were observed on 3 nights.

Lunar halo on 3 nights. Lunar coronas on 9 nights.

Fog on 7 days.

ABSTRACT FOR THE MONTH OF APRIL, 1898.

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

DAY	THERMOMETER.				BAROMETER.				†Mean pressure of vapor.	‡Mean relative humidity.	Dew Point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min.	Range.	Mean.	§Max.	§Min.	Range.				General direction.	Mean velocity in miles per hour	Mean.	Max.	Min.					
1	27.02	34.6	19.0	15.6	30.0400	30.103	29.992	.111	.0870	58.2	14.8	W.	20.46	0.2	1	0	96	....	0.3	0.03	1
2	27.80	37.5	20.1	17.4	29.9122	30.041	29.803	.238	.1067	68.8	19.2	W.	12.54	3.7	7	0	51	....	....	.....	2
SUNDAY.....3	.....	23.5	14.1	9.4	.....	.....	.....	.....	.....	....	....	W.	11.83	....	..	..	65	....	0 9	0.08	3.....SUNDAY
4	22.63	30.8	16.4	14.4	30.0362	30.114	29.999	.115	.0927	73.5	15.8	N.	10.42	7.5	10	0	15	....	0.4	0.03	4
5	25.08	30.6	17.7	12.9	30.0648	30.132	29.975	.157	.1007	75.3	18.5	S.W.	6.75	6.0	10	0	45	....	0.1	0.01	5
6	30.67	35.8	22.5	13.3	29.8897	29.960	29.817	.143	.1230	71.8	22.7	S.W.	13.92	6.3	10	0	56	....	....	....	6
7	39.28	47.5	30.8	16.7	29.9212	29.967	29.826	.141	.1318	56.0	24.3	W.	18.00	5.2	10	0	90	....	....	....	7
8	43.35	54.2	34.7	19.5	30.0258	30.110	29.992	.118	.1238	44.2	22.8	W.	11.88	2.5	10	0	87	....	....	....	8
9	45.60	56.7	33.0	23.7	30.0925	30.153	30 043	.110	.1650	54.3	29.8	S.W.	8.96	1.0	4	0	95	....	....	....	9
SUNDAY.....10	.....	61.5	35.2	26.3	.....	.....	.....	....	.....	....	....	N.	7.79	....	..	..	96	....	....	....	10 .....SUNDAY
11	50.73	62.2	36.5	25.7	30.1725	30.208	30 145	.063	.1765	45.0	31.3	E.	3.79	0.2	1	0	97	....	...	....	11
12	53.70	63.8	43.3	20.5	30.1513	30.237	30.058	.179	.1928	46.5	33.2	E.	6.08	0.3	2	0	92	....	....	....	12
13	53.83	66.6	40.8	25.8	29.8975	30.052	29.747	.305	.2203	54.5	37.0	N.	11.96	2.3	7	0	77	....	...	....	13
14	51.30	62.2	41.2	21.0	29.6727	29.756	29.603	.153	.2037	55.5	34.8	N.	21.08	4.5	9	0	28	....	.. .	....	14
15	47.25	55.7	38.4	17.3	29.6478	29.678	29.622	.056	.2100	63.7	35.0	N.	21.04	8.3	10	0	2	0.00	....	0.00	15
16	48.55	58.6	38.6	20.0	29.6027	29.638	29.552	.086	.2463	72.7	39.8	N.	10.84	6.2	10	0	61	....	....	....	16
SUNDAY. 17	.....	63.0	34.8	28.2	.....	.....	.....	.....	.....	....	....	S.W.	14.58	....	..	..	65	....	....	....	17.....SUNDAY
18	42.18	50.3	34.3	16.0	30.0722	30.203	29.925	.278	.1352	50.2	25.0	N.W.	17.75	3.5	10	0	97	....	....	....	18
19	46.52	55.3	37.2	18.1	30 0655	30.211	29.888	.323	.1563	50.8	27.8	S.E.	13.21	5.3	10	0	63	0.03	....	0.03	19
20	39.65	44.4	36.2	8.2	29.6963	29.764	29.646	.118	.2288	93.3	37.8	S.E.	12.88	10.0	10	10	00	0.70	....	0.70	20
21	43.22	49.5	38.3	11.2	29.6815	29.864	29 598	.266	.2357	84.7	38.8	S.W.	12.67	9.5	10	7	37	0 20	....	0.20	21
22	47.22	57.7	36.0	21.7	29.9323	29.989	29.892	.097	.2148	67.3	36.3	S.W.	21.54	4.7	10	0	74	....	....	....	22
23	49.89	59.8	43.0	16.8	29.9025	29.937	29.880	.057	.2570	72.7	41.0	S.E.	7.88	5.8	10	0	60	....	...	....	23
SUNDAY.....24	.....	54.2	41.5	12.7	.....	.....	.....	.....	.....	...	....	N.	20.21	....	..	..	00	....	....	....	24.....SUNDAY
25	46.72	55.3	39.8	15.5	30.0203	30.150	29.913	.237	.1942	61.5	33.7	N.	23.50	5 3	8	2	50	....	....	....	25
26	46.12	55.3	36.0	19.3	30.2397	30.290	30.189	.101	.1703	56.0	30.5	N.	14.38	2.0	6	0	74	....	....	...	26
27	47.02	58.0	33.3	24.7	30 2790	30.370	30.211	.159	.1725	55.3	30.8	N.	9.00	1.2	3	0	96	....	....	...	27
28	48.98	59.8	35.0	24.8	30.0677	30.225	29.891	.334	.1432	42.5	26.2	N.W.	16.75	3.3	8	0	72	....	....	....	28
29	40.63	47.1	36.5	10.6	29.8070	29.863	29.754	.109	.2087	81.5	35.5	N	16.67	9.5	10	7	00	0.07	....	0.07	29
30	48.70	56.7	39.0	17.7	29.9498	30.091	29.875	.216	.2280	67.7	37.8	N.W.	18.63	7.7	10	0	17	0.00	....	0.00	30
Means.....	42.84	51.61	33.44	18.17	29.9554	30.0425	29.8783	.1642	.1740	62.44	30 01	N. 44° W.	13.89	4.69	7.9	1.0	58.6	1.00	1.7	1.15	....Sums.
24 Years means for and including this month	40.25	48.80	32.46	16.34	29.9604	.....	.....	.202	.1729	66.97	....	....	s 16.46	5.74	..	..	¶51.52	1.64	5.63	2.21	24 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	3904	225	283	519	177	2049	1504	1337	
Duration in hrs..	255	27	44	40	20	141	101	85	7
Mean velocity....	15.31	8.33	6.43	12.98	8.85	14.53	14.89	15.73	

Greatest mileage in one hour was 30, on the 25th.

Greatest velocity in gusts 42 miles per hour on the 25th.

Resultant mileage, 4,315.
Resultant direction, N. 44° W.
Total mileage, 9,998.
Average velocity 13.89 m. p. h.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 17 years only. s 12 years only.

The greatest heat was 66°.6 on the 13th; the greatest cold was 14°.1 on the 3rd, giving a range of temperature of 52.5 degrees.

Warmest day was the 13th. Coldest day was the 3rd. Highest barometer reading was 30.370 on the 27th. Lowest barometer was 29.552 on the 16th giving a range of 0·818 inches. Maximum relative humidity was 97 on the 20th. Minimum relative humidity was 30 on the 28th.

Rain fell on 6 days.

Snow fell on 4 days.

Rain or snow fell on 10 days.

Auroras were observed on 2 nights.

Lunar halo on 1 night. Lunar coronas on 5 nights. Solar halo on 1 day.