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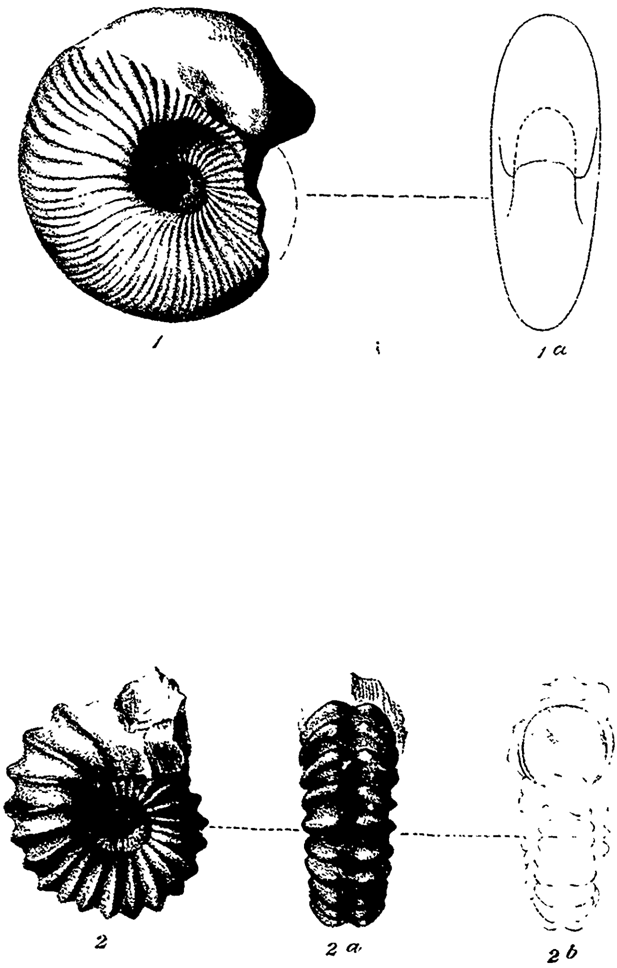

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AMMONITES FROM Q.C. ISLANDS.

THE

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Descriptions of two new species of Ammonites from the Cretaceous rocks of the Queen Charlotte Islands.*

By J. F. Whiteaves.

Through the courtesy ot Dr. C. F. Newcombe, of Victoria, V. I., and by kind permission of the council and members of the Natural History Society of British Columbia, the whole of their collection of the fossils of the Cretaceous rocks of that province has recently been sent to the writer for examination and study. Among these fossils there are two small Ammonites which appear to be undescribed, both of which are labelled as having been collected at Skidegate Inlet, Q. C. I., and presented to the society by Mr. James Deans. Both are clearly referable to the family of Stephanoceratidæ of Neumayr, as amended or re-defined by Zittel. One is an imperfect specimen of a small species of *Olcostephanus*, nearly related to *O. Jeannotti* (the *Ammonites Jeannotti* of d'Orbigny [1]) of the Neocomian of France and Switzerland. The other is a more perfect but apparently not quite full-grown specimen of a species of *Hoplites*, of the type of *H. sinuosus* (the *Ammonites sinuosus* of d'Orbigny [2])

[1] Paléont. Franc., Terr. Cret., vol. i, p. 188, pl. 56, figs. 3-5.
[2] Ib., p. 204, pl. 60, figs. 1-3.

*Communicated by permission of the Director of the Geological Survey Department.

of the French Neocomian. The exact characters of the sutural line are unfortunately not well shown in either of these specimens. The two species represented may be provisionally described as follows, with the proviso that the diagnoses of each are, of course, subject to such modifications or amplifications as may be made necessary by the discovery of more perfect specimens.

OLCOSTEPHANUS (ASTIERIA) DEANSII. (Sp. nov.)

Plate VII, figs. 1 and 1 *a*.

Shell small, compressed at the sides and narrowly rounded at the periphery: umbilicus occupying rather less than one-third of the entire diameter. Volutions three or four, increasing rapidly in size, especially in the dorso-lateral direction, and rather closely embracing, about two-thirds of the sides of the inner ones being covered, the outer one a little higher than broad: aperture elliptical in outline but deeply emarginate by the encroachment of the preceding volution.

Surface marked by numerous, closely arranged, small but distinct, though not very prominent, flexuous, transverse ribs, which bifurcate about the middle of the sides and then pass uninterruptedly over the periphery.

The sutural lines are so crowded together and confused that, although fairly well preserved in places, it is scarcely possible to follow the details of any single one. The siphonal saddle, however, is small, a little higher than broad, with a minutely trifurcate apex, and an appressed spur on each side below. The first lateral saddle is large, ramose and unequally bipartite or obscurely tripartite at its summit. The siphonal lobe is large and symmetrical, with three branchlets on each side, two of which are lateral and one terminal, but the lowest of the two pairs of lateral branchlets is much the smallest of the three pairs.

The only specimen collected is considerably eroded near the aperture, as represented in fig. 1, but in the uneroded portion the maximum diameter is about forty millimetres, and the greatest breadth fourteen.

The writer has much pleasure in associating with this species the name of its discoverer, Mr. James Deans of Victoria, V. I., who accompanied Mr. James Richardson in his exploration of the Queen Charlotte Islands, in 1872, and who has since presented some unusually perfect specimens of the fossils of the Cretaceous rocks of those islands to the museum of the Geological Survey Department at Ottawa.

O Deansii appears to belong to the small group of Ammonites of which *Olcostephanus Astieri* is the type, and for which M. Pavlow has recently (1891) proposed the generic or subgeneric name *Astieria*[1] According to M. Pavlow, the Olcostephani of the group of *O. Astieri* form a natural group, a genus (*Astieria*) if one prefers to consider the Olcostephani as a family, or a subgenus if one would rather regard *Olcostephanus* as a genus.

The shape and surface ornamentation of *O. Deansii* are very similar to those of *O. Jeannotti.* But in *O. Jeannotti* the ribs bifurcate at the umbilical margin, and are represented as so prominent as to everywhere break the general contour if the shell is viewed laterally. The siphonal saddles of *O. Jeannotti*, too, are described as broad, and the figures show that they are much broader than high. In *O. Deansii*, on the other hand, the ribs bifurcate half way way across the sides, at a considerable distance from the umbilical margin, and are not sufficiently prominent to interrupt the continuity of the outline of the shell in a full side view. The siphonal saddles of *O. Deansii*, also, are narrow and, as already stated, a little higher than broad.

The genus *Olcostephanus*, which was founded by Neumayr in 1875, is abundantly represented in the Upper Jurassic and Lower and Middle Cretaceous rocks of Europe. The only other species that has been definitely recorded from the Canadian Cretaceous is *O. Loganianus* (nobis), from Skidegate Inlet, whose characters are still very imperfectly known. As stated elsewhere,[2] however, it is most probable that the so-called *Haploceras Cumshewaense* (nobis), from

[1] Bull. Soc. Imp. Naturalistes de Moscou, Année 1891, N. Ser., vol. v, p. 491.
[2] Trans. Royal Soc. Canada, vol. x, sect. iv, p. 114.

Cumshewa Inlet, belongs to that section of the genus *Olcostephanus* for which M. Pavlow has since proposed the subgenus *Virgatites.*[1]

HOPLITES HAIDAQUENSIS. (Sp. nov.)

Plate VII, figs. 2, 2 *a* & 2 *b*.

Shell small, strongly costate and widely umbilicated, the umbilicus, as measured from suture to suture, occupying about one-third of the entire diameter. Volutions about three, though the nucleus is not preserved in the only specimen collected, increasing rather rapidly in size and slightly embracing: the outer one moderately convex, a little broader than high, the outline of a transverse section being subpentagonal if made through one of the ribs, or not far from circular if in the centre of one of the grooves between them: aperture nearly circular but shallowly emarginate by the encroachment of the preceding volution.

Surface marked by large and prominent, simple and nearly straight, transverse ribs, which are separated by rather broad concave grooves. The ribs, which are equal in length, are most elevated on the outer or peripheral portion of the last volution, and in the median line of the periphery there is a single angular notch on each rib which scarcely interrupts the continuity of the rib.

Sutural line not clearly defined, but apparently not very complicated nor much branched. The first and second lateral saddles appear to be much broader than high, and doubly incised rather than ramose at the summits. The first lateral lobe seems to be trifurcate above and unusually small, though apparently much larger than any of the others except the siphonal lobe.

Maximum diameter of the only specimen collected, twenty nine millimetres: greatest breadth of the same, twelve mm.

The specific name suggested for this little Ammonite is a modification of the word Hai-da-kwe-a, which Dr. G. M.

[1] Op. cit., p. 471

Dawson quotes as the Indian name for the Queen Charlotte Islands, in his report on these islands, published in the Report of Progress of the Geological Survey of Canada for 1878-79.[1] The shell itself appears to belong to the sub-group Dentati-regulares of the Dentati. of Pictet's classification of the Ammonites in the "Paléontologie Suisse,"[2] and to that section of the genus *Hoplites* which Zittel calls the group of *Ammonites interruptus.*[3] In many of its characters it is very similar to *Hoplites sinuosus*, but it seems to have fewer and more distant ribs than that species and a different sutural line. Thus the type and only known specimen of *H. Haidaquensis* has twenty-two ribs on the outer volution, while that of *H. sinuosis*, which is almost exactly the same size, is said to have thirty-four. The sutural line of *H. Haidaquensis* seems to be more like that of *H. crassicostatus*, as figured by d'Orbigny,[4] in which the first and second lateral saddles are represented as broader than high, whereas the corresponding saddles of *H. sinuosus* are represented as higher than broad.

The genus *Hoplites* also was proposed by Neumayr in 1875, and is regarded as eminently characteristic of the Cretaceous epoch. *H. Haidaquensis* and *H. Canadensis* (nobis),[5] from the Clearwater shales and Peace River sandstones of the district of Athabasca, are typical and characteristic Canadian species of this genus. *H. McConnelli*[6] (nobis), from the Clearwater shales of the Athabasca, appears to be rather an aberrant member of that section of the genus which Zittel calls the "group of *Ammonites cryptoceras.*" It is also most probable that the fossil from Comox, Vancouver Island, which Meek doubtfully referred to his genus *Placenticeras*, under the name *P. Vancouverense*,[7] is also referable to *Hoplites.*

[1] P. 104 B.
[2] Prem. partie, p. 328.
[3] Handb. der Palæont., vol. ii, p. 476.
[4] Paléont. Franç., Ter. Cret., vol. i. atlas. pl. 59. fig. 3.
[5] Trans. Royal Soc. Canada, vol. x, sect. iv, p. 118, pl. xi, figs. 3-5.
[6] Ib., p, 117, pl. xi, figs. 2, 2 *a* & *b*.
[7] Bull. Geol. and Geog. Surv. Terr., vol. i. No. 4, p. 370, pl. vi, figs. 1, 1 *a-c*.

With the permission of Mr. Deans, the types of the two species described in this paper have been presented to the museum of the Geological Survey by the members of the Natural History Society of British Columbia.

EXPLANATION OF PLATE VII.

OLCOSTEPHANUS (ASTIERIA) DEANSII.

Fig. 1.—Side view of the only specimen collected.
1*a*.—Outline of the same, from another point of view, to show the proportionate breadth of the shell and probable shape of its aperture.

HOPLITES HAIDAQUENSIS.

Fig. 2.—Side view of the only specimen collected.
2*a*.—Another view of the same, to show the characters of the peripheral region, near the aperture.
2*b*.—Front view of the same, in outline, to show the shape of the aperture, etc. All the figures of natural size.

NOTES ON THE DEPLETION OF THE FUR-SEAL IN THE SOUTHERN SEAS.[1]

By FREDERICK REVANS CHAPMAN.

In a communication which I addressed to Prof. T. J. Parker, F.R.S., on September 24th, 1891, I gave such facts as I then had at command on the subject of the practical extinction of the fur-seal of New Zealand. I am now in a position to add considerably to this, and to supplement it with information respecting the fate of this animal in the Australian seas. If more were needed, I think that it might be obtained by further research, but this would be difficult and would take much time, and as I have no reason

[1] Mr. Chapman's paper, here printed, was written by him in response to enquiries on my part respecting the fur-seal and methods of sealing in the Australasian region. These enquiries were in the first place addressed to Prof. T. J. Parker, F.R.S., of the University of Otago, Dunedin, N. Z. Prof. Parker referred to Mr. Chapman as likely to be well informed on the subject, and obtained from him a memorandum which was printed as an appendix to the Report of the British Behring Sea Commission. At a later date, and too late for inclusion in the report mentioned, Mr. Chapman favored me with the present more detailed paper, embodying the result of much enquiry on his part. This paper, it is

to think that it would support any conclusions differing from those toward which the evidence now collected tends, I think it as well to communicate what I have.

All early writers on New Zealand, Tasmania (Van Diemen's Land) and the southern part of Australia agree in describing the fur-seal as very plentiful in these regions.

Captain Cook (1770), after circumnavigating the North Island of New Zealand, passed down the east coast of the South or Middle Island. When in latitude 46° 31′, off this coast, he remarks: "This day we saw some whales and seals, as we had done several times after having passed the strait" (Cook Strait); "but we saw no seal while we were upon the coast of Eahienomawe" (North Island). On his second voyage (1773) he visited the west coast of what subsequently became the Province of Otago. He refers to the seals here as follows: "A gentleman killed a seal, one of the many which were upon a rock." And next day writes: "We touched at the seal rock and killed three seals." And again, in the same vicinity: "Rowing out to the outermost isles, where we saw many seals, fourteen of which we killed and brought away with us; and might have got many more would the surf have permitted us to land with safety." A few days later he writes: "We could only land in one place, where we killed ten."

The great navigator and others who followed him killed seals only for food. This, too, had been the practice of the Maoris. Mention of seals is constantly found in traditions relating to the southern portion of the South Island (east coast). Mr. T. Sarata, a Maori member of Parliament, tells

believed, will be of general interest, as it relates to a chapter of history and exploration of which few records have seen the light.

It must be remembered, in reading Mr. Chapman's paper, that the pursuit of fur-seals in the Southern Hemisphere has been entirely confined to the killing of these animals on shore, at their breeding-stations. "Pelagic sealing," as now carried on in the North Pacific, has never been practised in the South; where vessels have been employed merely as the means of reaching the otherwise inaccessible resorts of the seals. Thus Mr. Chapman's observations, in so far as they bear on the question of the preservation of the fur-seal of the North Pacific, go to show the extreme importance of protecting the littoral breeding resorts of the animals from all disturbances.—G. M. DAWSON.

me that his ancestors, living about Otago Heads, used annually to make expeditions to Cape Saunders to catch young seals after the breeding season. I also find seals' bones in ancient Maori middens in sufficient numbers to indicate that the animal was once a staple of food here. The natives had neither methods nor motives which could result in the extermination of seals; indeed the parts of the coast where these were and still are most plentiful, were and yet remain uninhabited.

Such records as we have of the transactions on the coasts of South Island in the early part of the century tell us that sealing was the first industry; the sealers preceded the whalers, as the whalers preceded the "flax"[1] traders, and these in turn were succeeded by the colonists. Of the sealers and their doings we have little actual record in the colony which has since sprung up, but what we know we learn mainly from the older colony of New South Wales and from the books of travellers. More may doubtless be learned from England and North America, whence came a large number of the sealing vessels. As it is, the information has to be sought from scattered sources. It will be readily understood how slight is the acquaintance of the colonists with seals and their history, when it is considered that in the South Island, which the seals formerly inhabited, the west coast is almost unoccupied along a great part of its extent; while on the east coast, which is fairly populated, the seals became almost extinct prior to the permanent settlement of the country. The west coast is only inhabited as far north as lat. 44°.

As early as 1846, *i. e.*, six years after the foundation of the colony, when Major Heaphy and Mr. Brunner, the explorers sent by the New Zealand Company, passed down the coast by land, they found a few seals, which were regarded with curiosity, on the Steeples at Cape Foulwind. Local tradition referred to the already almost mythical times of the sealers and their doings here. The explorers,

[1] *Phormium tenax.*

referring to the Maoris at the nephrite cutting village, Kararoa, say: "Of these only the old man and woman had ever seen a white man. They remembered the sealers." Even at that date, however, it was worth while to visit the "rookeries" occasionally. Two years before the exploring party went down, 150 sealskins had be . obtained at the Steeples. Another point had not been visited for ten years, and it is mentioned that fifteen years earlier a sealing vessel had been lost, and those of her crew who escaped had been murdered by Maoris.

I am unable to give the northward limit of the seals. They were extremely plentiful in Bass Strait, in lat. 38°, and on this island at least as far north as Cape Foulwind, lat. 42°. While not unknown in the North Island, they were evidently rare there. Mention is made in a book of a vessel coming from the Fiji Islands with sealskins, but, if this is not a mistake, I suspect that this locality was given out to mislead competitors, the vessel having really come from some previously unvisited spot in the vicinity of New Zealand, which it was thought undesirable to make known.

Some idea of the number of seals in suitable localities will be gathered from a few facts which may be mentioned.

New Sonth Wales was colonized in 1788, and very soon after, whalers and sealers began to frequent the neighboring seas. In that year Messrs. Enderby's ship, the *Emilia,* rounded Cape Horn, and first carried the sperm whale fishery into the Pacific Ocean. As early as 1793 an American sealer, on his way to his own cruising grounds, called at Sydney and expressed surprise that they had no small craft on the coast, as he had observed a plentiful harvest of seals as he came along.

The insu'arity of Van Diemen's Land was discovered by Messrs. Bass and Flinders in 1798. In the vicinty of Bass Strait they met the sealing vessel *Nautilus,* which obtained 9,000 seals on that cruise. Seals of several species in enormous numbers were seen. Mr. Flinders likens the scene to a crowded farmyard, and Mr. Bass "had to fight his way up the cliffs of the island against the seals." The American sealers getting scent of the business, with customary energy, poured into these seas and joined in the scramble. The captains of American vessels being disinclined to respect the local customs regulations, gave a good deal of trouble, and were accused of disturbing the seal fisheries. They probably secured a share of the skins of which no record would appear in Colonial or British customs returns.

In 1802 Captain Campbell, on an island off King's Island, in Bass Strait, killed in ten weeks (from 10th March to 27th May) 600 sea elephants and 4,300 seals. In the same year two French vessels came there seal hunting, but were warned off by Governor King. Van Diemen's Land, now named Tasmania, was settled in 1803, and at a very early date escaped convicts and lawless, runaway sealers began to infest the islands of Bass Strait, ostensibly, and sometimes actually, engaged in sealing. Regular shore gangs were formed which occupied the islands of the strait in sets of ten or twelve. They were tendered by small vessels, which brought provisions and carried away sea-elephant oil and sealskins in abundance. They employed Tasmanian native women to swim out to the rocks, imitate the motion of the seals, and thus take and slaughter them. Before long some of this class, as well as others of better repute, began to find their way to New Zealand. As early as 1792 Messrs. Enderby sent a sealing party to Dusky Sound, by the *Britannia*, and procured 4,500 skins. Jorgen Jorgenson, afterwards known in history for his revolt in Iceland, was upon the coast of New Zealand in 1804. He went down in charge of a small vessel from Port Jackson. "We killed," he says, "several thousand of these harmless animals, and it was quite astonishing with what eagerness the sailors entered into the pursuit, knocking down the animals with their clubs, stripping them of their skins and pegging them out to dry or salting them down in casks, with the greatest zeal and perseverance. At that time these skins were sold in London at a guinea each. We filled our small vessel and returned to Sydney."

The following entries of sealskins are recorded at Sydney. The *Sydney Gazette*, October 14, 1803, notes the arrival of the sealer *Endeavour*, Captain Oliphant, with 2,200 sealskins from New Zealand, six months out. The *Endeavour* brought into Sydney from March 9, 1803, to May 28, 1804, 9,514 sealskins, worth 20 shillings each, and the schooner *Surprise*, from March 11, 1809, to September 15 of the same year, 15,480. During the years 1803 and 1804 upwards of 36,000 sealskins were obtained from the islands of Bass Strait, the slaughter being carried on without regard for sex or season. Some of the above figures probably overlap, as my information does not always state where the seals came from, and it is evident that there are long gaps without information.

The *Scorpion*, 14 guns, left England in 1803 with letters of marque. She captured two French whalers with full cargoes. Whether she got sealskins from them I do not know, but she entered Sydney early in 1804, after a visit to New Zealand, with 4,759 sealskins. Her master, Captain Dagg, leaves his name in Dagg's Sound, on the west coast of Otago. The sealer *Sydney Cove* landed a party at the South Cape (Stewart Island) in 1806. These men were murdered by the natives, save one who married a chief's daughter and got to Sydney in 1820. In 1813 the schooner *Governor Bligh*, Captain Snow, brought to Port Jackson 14,000 sealskins, after a sixteen months' cruise about New Zealand. She also brought back ten men who had been landed there by a vessel which was to return for them, but was never heard of. This occurred again the same year, when the brig *Perseverance* brought away four men similarly left four years before at Solander Island, in Foveaux Strait. Her take is not mentioned. The fact of these crews being left shows that there were parties constantly at work. The figures are perhaps somewhat confused, but they probably altogether understate the results. They sufficiently show at least that there were then rich hunting grounds on the coasts of Australia, Tasmania and New Zealand.

J. S. Polock, in his work "Travels and Adventures in New Zealand."[1] says: "Some fifteen years back seals were very prolific [plentiful] on the southerly parts of the country, many shore parties procuring 100,000 skins in a season. So few are now procurable that a single vessel employed solely in this trade would make a losing speculation. The favourite grounds frequented by these animals was the whole of the west coast of the Island of Victoria (Middle or South Island), from Cape Farewell to the South Cape, including the rocks called the Traps, the Snare Islands, Antipodes Islands, Bounty Rocks, Auckland Isles and the Chatham Groups. All these places were infested by the various phocæ, which have since been annually cut up." This writer, though his figures are astonishing, is recognized as one of the safest authorities on subjects relating to the early days of New Zealand. Dumont D'Urville, in 1830, notices the great decline of the seals in recent years.

Sealing was, in the early years of the century and probably up to 1830 or even later, pursued with declining success in Foveaux Strait, on the coast of Stewart Island. Mr. East, in his evidence before a select committee of the House of Commons in 1844, says: 'The seals, what few there are, are in the southern part of the island, near the settlements of the Middle Island. Formerly they abounded, but they have been attacked so by the Australian colonists in times past that they have nearly left."

Old narratives, sometimes founded on fact, sometimes mythical, tell strange tales of those wild days. Tommy Chaseland, a noted sealer and afterwards a famous headman of the later whaling days, was the son of an Australian woman and a white man. He navigated his open sealing boat from the Chatham Islands to New Zealand in the stormiest of seas, and lives in the memory of a few of the oldest inhabitants as the hero of numerous bold adventures. Probably the cold seas of the north teem with bold spirits of this kind.

On all these southern and eastern coasts, however, a seal

[1] London, 1838, vol. i, p. 316.

is now so rare an apparition as not to be recorded once in ten years. In the sounds of Western Otago, then the most prolific sealing ground, they are still occasionally found, being known to breed on a few very inaccessible rocks in that uninhabited region. Fifteen years ago Captain Fairchild, of the Government steamer *Hinemoa*, himself an old northern sealer, showed me his charts on which were marked several of these "rookeries," but depletion has progressed since, partly through the operations of the Maoris, who occasionally pass round the coast in whaleboats from Foveaux Strait, and partly from the fact that the coast is now much more visited and disturbed than formerly.

Though the information which I have got together is of a fragmentary character, it sufficiently shows that sealing was an active pursuit in the southern part of New Zealand, and that numerous sealing vessels obtained full cargoes there, while for nearly half a century the few surviving seals have been pressed nearer and nearer to the point of extermination without being systematically pursued. The islands lying off the coast of New Zealand, however, have proved, relatively at least to their extent, vastly richer in seals than the mainland. Six groups of small islands lie to the south of the latitude of New Zealand.[1] The Snares were discovered by Vancouver late in the eighteenth century. They lie sixth-three miles from Stewart Island. Seals are still found there in small numbers, and were, I have no doubt, once numerous, but the group is so very small that their extermination must have been an easy matter. The Auckland Islands, in lat. 50° S., are about as long as the Isle of Wight, but much cut up by inlets, and with a precipitous southern and western coast, with numerous sea caves capable of sheltering seal "rookeries." They were discovered in 1810 by John Benton, a whaling captain hailing from Sydney, connected with the house of Enderby. They were found to be crowded with seals, and for many years afforded

[1] For further interesting particulars respecting these islands, see a paper by Mr. Chapman entitled "The Outlying Islands South of New Zealand," Trans. New Zealand Inst.," 1890, p. 491.

a good sealing ground. After a while they seem to have been abandoned for long intervals and revisited with varying success. An attempt was made to colonize them in 1850, which failed after two years. During this period sealing was not pursued. It is impossible to ascertain with any degree of accuracy what number of skins they have supplied, but this much is known that even as lately as 1885, when a party of shipwrecked sailors was found on these desolate islands, they were rescued by a party of white and half-caste sealers, who took them to the sealing grounds. One of them published in the Melbourne *Argus* an interesting series of articles, which showed that numerous "rookeries" were still full, and were systematically visited by these poachers, who were lowered over the high cliffs by their companions by means of ropes. Though I visited this coast a few years later, on a bright, sunny day, with a calm sea, I can imagine no more desolate or dangerous scene, nor a safer refuge from everything but human ingenuity. The fruits of this illicit sealing were gathered by a member of Parliament, and a still higher personage was not free from suspicion. For many years a close time had been proclaimed by the New Zealand Government, which, however, does not possess means adequate to the suppression of this illicit sealing. A short season was opened a few years since, when sealing expeditions were fitted out and all available seals, irrespective of age or sex, were slaughtered, in the hope that the closing of Behring Sea would cause a great rise in prices. As, however, the prices were very low, and the sealers settled disputes with the owner of the vessel by stealing the skins, the result was disappointing. I believe about a thousand skins were obtained at the various islands, chiefly at this group.

Sea-lions, which are said to be quite useless, are very numerous at the Auckland Islands.

Campbell Island, lat. 53°, was discovered by Hazelburg, in a whaling vessel fitted out by the Campbells of Sydney, in 1819. It is a bold, round island of small size, some hundreds of miles from any other land. It has in times past yielded large quantities of seals. Numerous vessels visited it soon after its discovery, and shore parties lived there for considerable periods. Portions of wrecks and graves of sailors attest these facts. An American poaching vessel which came out to visit it during the close season, ten years ago, met with disappointing results and lost a boat's crew there. Recent cruises have yielded a few seals in this field.

Macquarrie Island, which lies outside the jurisdiction of New Zealand, in lat. 55°, is now the home of countless great king penguins and of numerous sea-elephants. This was the most remarkable sealing ground in this part of the world. It is 650 miles from the Bluff Harbour and 800 from Tasmania, to which it is politically attached and the Government of which now prohibits the destruction of its native animals and birds. It is not known who discovered it, as the discovery by some Sydney sealing vessel, which occurred about 1811, was evidently kept a secret at first. I suspect that the entry of sealskins from Figi already mentioned was part of the process of keeping the secret. It is said that this small island, not more than twenty-five miles long and less than half that width, yielded to the discoverers no less than 80,000 seals. There is evidence that the pursuit was continued in later years, until dogs brought there by shore parties, destroyed the young seals and exterminated the race. This was facilitated by the fact that there are no considerable cliffs, the herbage everywhere dipping nearly to the sea. I may mention that Professor Scott of the Otago University, who visited the island in 1880, found that the fur seal was then absolutely unknown there; and though shore parties have worked there pretty nearly ever since boiling down sea-elephants, and several kinds of seals are seen, the fur-seal has never reappeared. This appears to support the statement made to me by Captain Fairchild that the fur-seal of these seas returns to breed at its own station and that it is useless to try and shift it to another.

It is to be observed that no land lies south of Macquarrie Island in this region until the ice-bound antarctic land discovered by Ross is reached. A spot marked as Emerald Island on the maps has no existence, nor has Royal Company Island, south of Tasmania. Vessels, however, on the homeward voyage are occasionally driven to Dougherty Island, between New Zealand and Cape Horn, and there it is asserted seals are seen in large numbers. Presumably the seals go south to the ice in summer, as they are not then seen at the various islands. The penguins, however, must go south in winter, as they are seen at the islands in enormous numbers in summer and are absent in winter. The extremely limited extent of the land below the ice line no doubt contributed to the ultimate destruction of the seals of Macquarrie Island.

Antipodes Island, discovered by Pendleton in 1800, a solitary mountainous island surrounded by steep cliffs and only three miles in length and breadth, was also the home of numerous seals. It is known that it was formerly visited by sealers. A man who spent six months there some years since, obtained no seals. Captain Fairchild has never seen seals there, but the recent open season led to its being visited with some result.

Bounty Islands, discovered by Captain Bligh on the outward voyage of the *Bounty* in 1788, form a small group of rocky islands quite without herbage or water and covered with enormous numbers of sea-birds. This group was a famous sealing ground. A sealing party remained here five months in charge of the once famous Maori chief Duaterra, about 1807. Their stay in this desolate spot was unduly prolonged and two Europeans and one Tahitian died of the privations to which they were subjected. They, however, took 8,000 skins. It is evident that numerous other parties of whose doings there is no record visited this place, which even during the late open season seems to have yielded some hundreds of seals, though the total area of rocky surface is not much more than 100 acres. I saw no seals when I visited these rocks a few years since, but the enormous numbers of penguins swimming in the sea and sitting on the rocks—computed at a low estimate at several millions—attests the presence of a plentiful food supply.

A seventh group is the Chathams, discovered at the end of the last century by Lieut. Broughton. This group, which is situated in the latitude of New Zealand (43°), was inhabited by numerous natives of a primitive Polynesian race called Moriori, thirty of whom survive. About 1835 it was conquered by the Maoris, who now number 300, and to whom are added an equal number of Europeans. It has from the first been a sealing ground. Several shore parties lived here at various periods, and the outlying rocks are still visited by a small number of seals. Of the doings of sealers here I have found it impossible as yet to get records, but it was recognized as a new field. These islands have a good climate and soil, and were, until recently, for many years the headquarters of the now abandoned sperm whale fishery.

When the Europeans commenced to hunt seals on the coast of New Zealand they also found whales in immense numbers. The coasts swarmed with black or inshore whales, and the deeper waters, even near the land, abounded in sperm whales. The great sea now known as the Tasman Sea, between Australia and New Zealand, was called the Middle Ground, and was throughout its extent a whaling ground. It was found worth while to equip whaling vessels both from Sydney and from England. In addition to these were many from America and France and some from other countries. The very first whaling fleet which sailed from Sydney brought in a large catch, and reported the amazing fact that they had sighted 15,000 whales. Mr. Wm. Chapman, who visited New Zealand with the Governor of Norfolk Island, in 1793, describes the number of whales off the north of New Zealand, where he saw several whale-ships successfully cruising. The crew easily killed a whale, apparently for pastime. The whale fisheries were continued with activity until after 1840, but from that date a great decline in results is noticed.

As points of analogy occur between whaling and sealing in the Southern Hemisphere, it will not be out of place to add a few words on the whaling industry, the last ship connected with which withdrew from the waters a year or two since. Some statistics have been preserved as to the whaling operations north of Banks Peninsula for a few years. They are imperfect, as they relate to the transactions of one firm only, but they give some idea of the magnitude and the course of the trade. Each whale yields five or six tuns of oil.

Year.	Whales caught.	Oil in tuns.
1829	(?)	120
1830	do.	143
1831	do.	152
1832	do.	115
1833	do.	284
1834	do.	424
1835	69	502
1836	70	410
1837	75	360
1838	156	725
1839	134	642
1840	90	429
1841	57	285
1842	35	163
1843	30	151

The foregoing was entirely the work of shore stations on a few hundred miles of coast. The figures do not take into account the catch of ships, even in the same localities. Thus, in 1834, one vessel, the *Columbia*, took 200 tuns in the harbour of Otakson (Otago). In 1835 four or five vessels fished in this harbour. During 1841, 1842 and 1843 nineteen vessels, principally French, entered the harbour. But all this was exceeded by the operations in Cook Strait and in parts of the North Island. The Bay of Islands became, like Honolulu in later times, the rendezvous of a great fleet of whaling vessels. The fragmentary statistics which have come to hand amply show this; yet the vessels only entered the harbours at certain seasons, and many of them wholly avoided harbours, as, once there, they had no law to prevent the desertion of seamen.

The French made some sort of protest against the destructiveness of shore stations, but there was no recognized sovereignty save a shadowy dependence on New South Wales, and there was no law of any kind prior to 1840. It is to the operation of shore parties, destroying and disturbing the cow whales in the breeding grounds, that I attribute the extinction of the whales. The sperm whale, which lives more constantly in the deep sea, lasted longer and lingers still. At this once famous whaling station one whale —possibly two—has been killed in the last twenty years. The boats have rotted on the beach; it is not worth the while of the Maori owners to look after them. With the the town of Dunedin in the bay, numbering 45,000 inhabitants, and a trade of some millions annually, the survival of the whales could not be expected.

I cannot but attribute the depletion of the seals to the same cause. They are very timid, and as is the case with all timid creatures disturbance on the breeding grounds is fatal to the maintenance of the race. Disturbance in this case has taken the form of reckless slaughter. There could be no hope of preserving the seals on the east coast, which is now settled and is rapidly becoming well peopled. On the wild west coast they could only be preserved by stringent laws judiciously administered. There are reasons which lead me to conclude that once or twice in recent years, when left undisturbed for a time, they have increased in certain places. The comparatively large number obtained in 1891 caused some surprise to experts, and this fact may be taken as some evidence of increase. Such an increase can, however, only lead to partial restoration of the seal fisheries on the uninhabited west coast and on the islands which are probably useless for other purposes, if great care is used to make the protection effective.

Dunedin, N. Z., March 22, 1893.

Some Notes on the Rideau Canal, the Sources of its Water Supply, and its Early History.

By A. T. Drummond.

A somewhat careful investigation into the nature of the country bordering on the Rideau Canal, as well as of the lakes on its course and of its water powers—all in connection with a line of railway now being surveyed—has led to my ascertaining some facts of interest which I desire to here mention. It has further occurred to me that here also might be a fitting place for a short resumé of the facts—almost unknown now in this country—connected with the inception and construction of the canal. These facts I have abbreviated from the extensive manuscript notes—taken from the Dominion archives and other sources, as well as from personal recollection—of Mr. Andrew Drummond of Ottawa, whose association and close family connection with two of the leading builders of the canal and personal acquaintance, formed in 1832, with others who planned its construction, enables him to speak with not only some interest, but even some authority.

The canal may be divided into the river and the lake divisions, the former comprising the Rideau River which was the original outlet to the Ottawa of the Upper and Lower Rideau Lakes lying beyond Smith's Falls. The lake division, besides these two lakes, includes Mud, Clear, Indian, Opinicon, Sand, Whitefish and Cranberry Lakes, to which may be added the long artificial lake, known as the "drowned lands," created between Washburn and Kingston Mills, by the erection of the Kingston Mill's dam. The waters of Upper Rideau Lake form the summit level of the canal system, and are admitted by the locks on either side of the lake to the Ottawa River slope or to the St. Lawrence River slope as the traffic on the canal requires. The immense importance of keeping a sufficient supply of water in this lake is so obvious that every means should be taken to husband the waters of its feeders, Clear, Wolfe and Sand Lakes, which empty into it at Westport. The forest country around these outer lakes should be kept, as far as possible, in its virgin state by protecting it from forest fires and absolutely withdrawing it from settlement, in order to hold back within these forests the accumulations from the melted snow and the rain which otherwise will be too quickly drained off into the lakes. Were Upper Rideau Lake allowed in midsummer to fall seriously in level at the locks, the whole canal would be rendered practically useless.

The depth of water in the different lakes, according to old navigators and fishermen, is not very great. The lakes on the St. Lawrence slope do not, it is said by them, exceed 100 feet in depth. My own soundings in the upper half of of Lower Rideau Lake at points where our fisherman indicated were the greatest depths, gave 114 feet as the maximum, but in the Rocky Narrows nearer Oliver's Ferry on the same lake, the lead has, it is asserted, found the bottom at about 200 feet.

The waters of these in land lakes are in similar depths considerably colder than those of Lake Ontario. On the 6th July, 1893, at noon, under the conditions of strong sun, with a few light clouds and a comparative calm, the thermometer readings, at one half a mile from Grindstone Island, in Lower Rideau Lake, gave the following temperatures of the water:

1 inch below surface	77° F.
2½ feet " "	74° F.
102 " " "	47·5° F.

Half an hour later, at another locality, a quarter of a mile farther fromthe island, and with more clouds in the sky, the record indicated:

1 inch below surface	76° F.
2 feet " "	74·5° F.
96 " " "	45° F.

In the Ontario waters, at this period, with their temperature raised by constant accessions from Lake Erie, which not only lies further south but is also very shallow, the mercury in the main channel opposite Kingston stood at 62·25° in 11 fathoms in one locality, and at 53° in 17 fathoms in another.

In Cataraqui Bay, where the waters of the canal join Lake Ontario, there is what old navigators call "a tide" of ten inches to one foot, caused evidently by the frequent westerly winds on Lake Ontario forcing the water to a higher level in the gradually contracted area forming the bay. Capt. Fleming, of the steamer *James Swift*, informs me that it comes and goes, and is so well known that when his boat happens to ground, through missing the channel, he simply waits for the "tide" to again float it. During a continuous calm of two or more days the rise and fall cease.

It is an interesting fact that the summit levels of the different systems of lakes which are the sources of the water supply of the Rideau Canal lie chiefly in the townships of Bedford and Loughborough, and within a very moderate distance of Lake Ontario. The headwaters of the Loughborough Lake system are within seven miles of Kingston; Knowlton, the uppermost of those lakes which find an outlet on the canal at Mud Lake, is within thirteen miles of the same place; whilst Bobb's Lake (a corruption, perhaps, of Robb's Lake), the most important of the higher levels of the River Tay system, whose waters eventually reach the Ottawa, is also situated within twenty-five miles of Kingston. The low, broad ridge of gneiss which connects the Laurentian rocks of New York State with the main range in Canada, forms the watershed here of the streams falling into the Ottawa, on the one hand, and the St. Lawrence and Lake Ontario, on the other. The strata are, however, thrown up into very numerous subordinate ridges, which lie here in directions generally north-east and south-west, and somewhat parallel to each other. These ridges, prolonged far to the south-west towards Kingston, have led to the formation and extension of lake basins in that direction. Those who planned the Rideau Canal, notably Col. By, showed their engineering skill in taking advantage of the number and different levels of these lake basins to procure an adequate supply of water for navigation on the summit level as well as on both slopes, causing the waters sometimes, as in the Loughborough Lake and the Devil's Lake systems, to almost double on themselves.

This great water system, including in it fifty-three lakes which are from one to fifteen miles long, has another peculiarity, that these lakes lie, with only four unimportant exceptions, on the west and north-west side of the canal. Between Kingston Mills and the mouth of the Tay the canal lies, as it were, on the side of a gentle slope from the south-west, the lakes thus on that side discharging into it, whilst those on the other find their outlet chiefly through the Gananoque River to the St. Lawrence.

We are apt to regard the townships of Storrington, Loughborough and Bedford and the east half of the township of Hinchinbrooke, all in the county of Frontenac, as unattractive for settlement, and to assume that when the pine and spruce are removed from their forests there will be nothing left in this somewhat rugged country but the possibility of minerals. It is consoling, however, to think that all the lakes which, walled in by heights of verdure-clad gneiss, picturesquely stud these townships in every direction, are the great reservoirs from which chiefly is drawn the supply of water needed to keep the Rideau Canal navigable as well in its course to Ottawa as in its course to Kingston. Had the great forces of nature not placed these Laurentian ridges in positions to form lake basins between them, and left the country rugged and unattractive, so that the virgin forests might largely remain and in their depths hold back the waters from being too quickly drained away, it would be hopeless to maintain uninterrnpted navigation on the canal.

The more that consideration is given to the subject, the more reasonable does it seem to be to regard these Laurentian ridges as having long preceded the ice age, and to view the lakes, scattered over this archæan area here in such apparent, picturesque confusion, as in reality occupying still older lake basins whose position and general direction was due to the presence of the ridges, and through which guided in their course by the lie of the ridges, the glaciers during the ice age flowed. These ancient ridges have suffered from the decomposing forces of perhaps centuries of the growth and decay upon their surfaces of plant life, of the extremes of heat in summer and cold in winter, and of the wearing effect of storms and floods, and possibly may have felt the force of even former ice periods, and their worn shapes must not be altogether attributed to post-pliocene times.

On its western and northwestern sides the canal is fed by seven systems of lakes. Two of these, the River Tay and Black Lake systems, supply Lower Rideau Lake, and eventually through the Rideau River, reach the River Ottawa. One system, the Wolfe Lake system, joins Upper Rideau Lake, the summit lake, and is therefore tributary to both the St. Lawrence and the Ottawa slope. The other four systems furnish the supply of water for the St. Lawrence slope, and also are through the outlet, in reality now a great waste weir, at Morton, the actual headwaters of the Gananoque River. On the easterly side of the canal, three or four small lakes form sources of supply, but of these only Irish, Otter and Bass Lakes have any importance.

The comparative freedom from water courses is a singular feature of the country bordering on the Rideau River after it leaves the lake systems. With the exception of the River Goodwood (or Jock), Irish Creek and the south branch of the Rideau River, not one of which has pretensions to being more than a creek, the Rideau has practically no tributaries in this length of about 70 miles.

Considerable confusion appears to exist on the maps as to the locality, name and outlet of many of the lakes in Frontenac county, and it is therefore desirable to briefly refer to the lakes forming each system, my authority being one of the original charts on file in the Department of Railways and Canals at Ottawa, which Mr. F. A. Wise, the superintending engineer has kindly allowed me to consult.

River Tay System.—Long, Eagle and Elbow Lakes in the townships of Hinchinbrooke and Olden, are at the headwaters of this system. In Bedford, it is joined by Bobs, (probably, originally, Robb's), Crown or Crow) and Green Lakes. Entering South Sherbrooke as the River Tay, it has, added to it, the waters of Farrens and Silver Lakes, and then widens into Christie's Lake. Grant's Creek connects it near Perth with Pike, Second and Third Lakes and near its outlet into Lower Rideau Lake, it receives the waters of Otty Lake.

Black Lake System.—Black Lake in North Burgess and a small lake beyond it in North Crosby, constitute an independent system which is also tributary to Lower Rideau Lake.

Wolfe Lake System.—Clear Lake (No. 2) in Bedford forms the summit, but Wolfe Lake and Sand Lake, the latter wholly in North Crosby, are the principal reservoirs and supply Upper Rideau Lake at Westport.

Devil's Lake System.—Knowlton, Mud, Otter and Desert Lakes in the township of Loughborough are at the headwaters of this system. Desert Lake is joined from Bedford by the waters of Carter (or Garter), Canoe and Elbow (No. 2) Lakes and the system then expands into Birch Lake which also receives the outflow from Long Salmon Lake in the township of Loughborough. Mud (No. 2) and Devil Lakes in Bedford are further expansions of the system, which, after including Loon Lake in North Crosby, eventually reaches the Canal system at Mud Lake proper.

Buck Lake System.—Draper is the largest of a small group of lakes in the township of Loughborough at the source of this system. These along with Clear Lake (No. 3) and four smaller sheets of water are tributary to Buck Lake, which lies partly in Bedford, and whence the waters flow by the Mississagua River to Mosquito Lake in South Crosby, from which they reach Mud and Indian Lake on the Canal route.

Rock Lake System.—This system takes its rise in the township of Loughborough but its larger sheets of water, Expedition, Upper Rock and Rock Lakes, are in Storrington. It is tributary to the Canal system at Opinicon Lake.

Loughborough Lake System.—This system is tributary to the Canal near Brewer's Mills, and includes Troy, Little Cranberry and Dog Lakes, all in Storrington, and Loughborough Lake which is situated partly in the township of Loughborough and partly in Storrington, and is the largest of the Rideau Canal feeders.

As, originally, Cranberry Lake—then known as Cranberry Marsh—appears to have had a connection with Whitefish Lake, the waters of this system may, in times of flood, have been also tributary to the Gananoque River and have reached the St. Lawrence at Gananoque as well as Lake Ontario at Kingston.

The duplication of names should be avoided by the Government renaming some of these lakes, the scanty population and small interests presently involved, readily admitting of this being done. Other defects in nomenclature also need pressing attention.

EARLY HISTORY OF THE CANAL.

At the close of the war between France and Great Britain which resulted in French Canada becoming a British Crown Colony, the Ottawa valley had a few settlements as far up the river as Carillon on the north side, but the south side was still an almost unbroken wilderness. In 1783, the British Government, in pursuance of its policy of settling the United Empire Loyalists from the United States, and the disbanded soldiers, upon free grant lands in Canada, sent Lieutenants French and Jones to explore the country, on either side of the River Ottawa. Lieutenant French proceeded up the river as far as the Rideau Falls and then diverging inland, followed the Rideau River to the Rideau Lakes. Coursing his way through the net-work of lakes met with beyond this, he at length reached the Gananoque River, down which he went to the St. Lawrence. Lieutenant Jones pushed through the country bordering the River Ottawa, along its northern banks, until he reached the Chaudiere Falls, where he crossed to the other side and returned to Montreal by the south bank. Both officers found a large amount of land available for settlement. No special official action appears, however, to have been taken, at the time, on these reports, and the course of settlement for years afterwards continued rather to be directed to the valley of the St. Lawrence.

The construction of a canal to connect the River Ottawa with Lake Ontario formed the subject of discussion from time to time after this, but it was not until the breaking out of the war between the United States and Great Britain, in June, 1812, that the urgent necessity for such a canal became apparent both to the British Government and to the Canadian leaders. The transportation of arms and supplies from Quebec and Montreal to the upper lakes by way of the St. Lawrence River involved great exposure to the enemy along the extended frontier of New York State. The expense arising from the Government's endeavor to avoid this exposure was enormous. The transportation of a 24-pounder cannon from Quebec to Kingston alone cost nearly one thousand dollars. The earliest official document dealing practically with the subject of a canal appeared on the 29th December, 1814, in the shape of a letter from Sir George Prevost, in command in Upper Canada, to Lieut.-Gen. Sir Gordon Drummond, at Kingston, enclosing some plans and reports, and asking for opinions thereon and for further information. Sir Gordon's reply, transmitting reports from three of the local officers, gave his own opinion that the difficulties would be immense and the expense enormous.

On the restoration of peace, however, Sir Gordon Drummond was instructed by Lord Bathurst, under date of 10th October, 1815, to get "estimates of the expense of the Lachine Canal, and of the Ottawa and Rideau being made navigable, in order that His Majesty's Government may decide as to the propriety of undertaking these works, either separately or simultaneously." Accordingly Lieut. Jebb was, early in 1816, directed to ascend the Cataraqui River to the chain of lakes and thence continue down the Rideau River to the Ottawa, and to return by the same route, reporting on the land available for military settlements and on the navigation for batteaux. His report recommended certain dams to be constructed and certain channels on the Rideau River to be cleared of obstructions. It was immediately subsequent to this that the military settlements of Perth and Richmond were laid out, but not until 1819 that construction of canals was actively undertaken, by the Imperial Government. In this year the Grenville Canal was begun by the Royal Staff Corps, although not completed until 1833. In 1821 the Carillon Canal was similarly commenced by the Staff Corps and completed in 1834; whilst the Lachine Canal was undertaken by the Lower Province, with some aid from the Imperial Government, and finished in 1824.

In 1821 the interest of the people of the Upper Province was thoroughly aroused, and a commission, under the presidency of Hon John Macaulay of Kingston, was appointed to consider the improvement of the internal navigation of the Province. The commission reported on the Rideau Canal on the 5th October, 1825, giving three estimates of cost; that for a canal 5 feet deep, and with locks 80 feet long by 15 wide, being £145,802 stg. This report was apparently at once transmitted to the British Government, which in the same year sent out a commission, composed of Sir J. C. Smyth, Sir G. Hoste and Major Harris, C.E., to enquire into the cost of construction of a canal on the same scale as the Lachine Canal, which had been made 5 feet deep, and with locks 108 feet long by 20 feet wide. This commission in its report estimated the cost at £169,000 stg., and on this report being received by the Home Government the construction of the Rideau Canal was determined on.

On 30th May, 1826, Lieut.-Col. By, R.E., arrived at Quebec from England, with instructions from Gen. Mann, inspector of fortifications, to superintend the building of the canal on the lines laid down by the Imperial commission. Foreseeing the possibilities of steam on the great river systems of Canada, and its importance on the canal as a motive power instead of horses, as contemplated by the commission, he, on the 13th July, 1826, urged Gen. Mann to adapt the work to the use of steam power, including the enlargement of the locks to admit vessels of 130 feet in length. This was vigorously opposed by Sir J. C. Smyth, with the result that Col. By was directed to commence construction on the original lines.

About the middle of September, 1826, Col. By and his assistant, Lieut. Pooley, reached Hull, and shortly afterwards inaugnrated the work by laying out the entrance of the canal at "Sleigh Bay," its present location under the shadow of the eastern block of the parliamentary buildings. The importance of the occasion was signalized by the arrival, a few days afterwards, of the Governor, Earl Dalhousie, who formally approved of the location selected.

The first steps taken in actual construction consisted in the building of a bridge across the Ottawa River fronting the Chaudière Falls, on the site of the present iron bridge, in order to get in material and supplies, the erection of barracks for the men and magazines for stores, and the construction of a road from the Chaudière Falls to Long Island, on the Rideau River. These works were completed by the close of 1827, excepting the bridge, which was not opened until a year later. In the construction of these works we first meet with the names of the men who built the more important structures of the canal—the Hon. Thos. McKay of Bytown, John Redpath of Montreal, and Robert Drummond of Kingston.

In 1827 the chief contracts were given out—Mr. Pennyfather taking the excavation for the first eight locks at the Ottawa River end, Mr. McKay the construction of these eight locks, as well as those at Hartwell's and Hogsback, Mr. Redpath the great works at Jones Falls, Messrs. Fenelon & Henderson the earth excavation and grading from the entrance locks to Dow's Swamp and thence to Hogsback, whilst Mr. Robert Drummond had the Kingston Mills locks and the extensive dykes and dam near there.

On the 26th October, 1827, Col. By, with the experience of more than a year to guide him, as well as a personal acquaintance with the details of the work, made up for the Ordnance Department in London his own estimate of the cost of the canal. It reached the sum of £463,899 stg. This vast increase over the estimate of the commission of 1826 created an intense stir in the department, and resulted in orders being sent out to Col. By for the immediate stoppage of all work wherever practicable, and in the appointment of a commission, composed of Sir Jas. Kempt, Col. Edw. Fanshaw and Col. Lewis, to investigate the character of the work and the cause of the extraordinary expenditure. This committee, on the 28th June, 1828, reported, on the whole very favorable to Col. By, and recommended the canal to have a depth of 5 feet at the lowest water and the locks to be of a size to admit a steamer 108 feet long and 30 feet wide. On this report the size of the locks was fixed at 134 feet by 33 feet, and the work pressed on with Col. By's accustomed vigor.

After much difficulty and repeated failures at the works at Hogsback and Dow's Swamp, near Bytown, and great loss of life at some points, particularly Kingston Mills, where about 500 laborers died from malaria, necessitating the raising of the dams in order to flood the extensive swamps of the Cataraqui River, the Canal was ready for opening in August, 1831. Another delay however took place. Mr. Merrick, of Merrickville, cut off the water at that point by a dam in order to make repairs to his mills. This act raised very serious legal questions which were not settled before the winter set in. In consequence, it was not until the 29th May, 1832, that the first steamboat the "*Pumper*" with Col. By and his family on board, passed through from Ottawa to Kingston, and the Canal was formally opened to traffic.

On the 8th January, 1831, in writing to Col. Glegg, for the information of the Commander of the Forces, Col. By mentions that his estimate of the cost of the work as presented to the Imperial Commission in June, 1828, was

£693,449 stg. All of the official papers connected with the Canal do not appear to have been printed as parliamentary returns, but the last estimate published brought up the cost to nearly £800,000 stg.

As the city of Ottawa owes its inception to the construction of the Rideau Canal, it is interesting here to note that the first settler at Hull was Philemon Wright. the founder of the Wright family there, who on the 3rd January, 1806, obtained a crown patent covering lot 2 in the 3rd range including the water privileges at the Chaudiere Falls on that side of the river. The original locatee of the corresponding lot and water privilege on the Ontario side was Robert Randall, whose rights were however in 1820, bought at sheriff's sale by Lieutenant Le Breton, from whom, and from the large exposed areas here of level, Trenton limestone, the locality acquired the name of "Le Breton Flats." In 1820, Earl Dalhousie bought for the government, the Fraser property, lying between the Sparks and Besserer properties on the one side, and the Ottawa River on the other, and on instructions from him in the end of September, 1826, Col. By, laid out in town lots the upper part of this, and Dr. A. J. Christie became apparently, the first locatee of a lot upon the site. In 1827, the swamp then covering a considerable area east of the Canal entrance, was drained, divided into lots, and became known as Lower Town, to distinguish it from the part surveyed during the previous year which was called Upper Town. The name of Bytown—in honor of Col. By—was then given to the two settlements, which were separated not only by the Canal but also by what was known as Barrack Hill, now the site of the Parliament Buildings. The name Bytown, soon became thoroughly established. Reference is made to it in the Imperial Commissioner's report of the 28th June, 1828, and on the 18th July, 1829, a petition from "some of the inhabitants of Bytown" was forwarded to Sir James Kempt, complaining about the conditions on which town lots had been sold. Thus originated the present city of Ottawa.

ON THE POLITICAL AND ECONOMIC SIGNIFICANCE OF THE SMALL INDUSTRIES; AND THEIR ENCOURAGEMENT BY CENTRAL-STATION POWER SUPPLY.

By J. T. NICOLSON, B.Sc. (Edin.), McGill University.

II.

In a former number of the RECORD[1] the author endeavoured to present to its readers two practical solutions of the labour troubles which now agitate the commercial world. The belief was expressed in that article that these troubles proceed from the real and actual ill conditions of life of the manufacturing classes, and not from an unreasonable and insatiable desire to possess more than their proper share of the world's good things. This led to the claim being then made that either the artisan must become a partner in the profits as well as the labours of those large manufactories where he at present occupies such an unconsidered position; or that he must be helped to become an independent workman or small employer himself; so that in either case he may have an adequate reward for his skill and diligence, and may eventually look forward to a modest competence as the fruits of his toil.

The former of these plans was stated to have been tried on several occasions, and with most successful results: the obstacle to its more general adoption being only the selfishness and rapacity of our capitalists, who, either in their own persons or their successors, must inevitably pay a penalty for their political short-sightedness.

The latter method was declared to be impossible, so long as the cost of steam or other power remains as high as it is now when used in such small quantities as in the case of workmen desiring to be their own employers. If the idea of making a large number of our artizans contented because self-dependent be worthy of adoption, the first desideratum was shown to be the possibility of supplying power at such a low price as to enable them to compete with their, at present, much too favourably situated competitors, the mill-owners. That this was the real want was emphasized by reference to the enormous advance recently made in the amount of machinery used by man, and to the certain continuance of this increase in the future.

Difficult problems must arise for solution in connection with the adoption of such schemes. The probability of their successful survival in the face of the changed relations between capital and labour, the altered conditions of demand and supply, and the effects of their action upon the national industries and international trade must be investigated. In short, their entire political and economic significance must, no doubt, be well considered in all generality before their establishment on a large scale as working systems can be acquiesced in.

With such an inexact science as political economy, however, a good experiment is worth more than an excogitation and demonstration of results which may never happen, owing to the uncertain action of human free will.

It was hence finally concluded that the whole matter of alleviation of the condition of the working classes lay largely in the hands of the engineering profession, on whom rests the *onus* of cheapening the supply of power by technical advances to be made by them in the transmission and distribution in large manufacturing centres. Not until this has been done will it be possible to make trial with any hope of commercial success of the latter system of industrial organization here proposed.

It would be useless to encourage artizans to become their own employers so long as the cost to them of their most vital need, machine-power, remains five or six times what the capitalist has to pay.

This paper is accordingly devoted to a brief account of the present conditions and the possibilities of success of one of the three systems of power supply most commonly used.

Of these three, electric, hydraulic and pneumatic, the last-named has been chosen for first discussion.

In a scheme for the transmission and distribution of power by means of air under pressure, the chief parts are: the source of power, the prime mover, the air-compressor, the air reservoir and mains, the distributing pipes, the pre-heaters, and the motors.

Source of power.—This may be either a waterfall or simply coal. So long as coal retains its present position as the cheapest vehicle of energy we possess, our cataracts and rapids must continue to occupy the secondry place as cheap sources of power. This is due to the fact that the interest on the first cost of the plant necessary to intercept, as it were, the power from the falling water, and to transmit it to the required locality is usually greater than the annual outlay due to capital expended on boilers and engines and the price of coal used. The cost per annum per horse-power delivered by a turbine (for the dam, head- and tail-races, penstocks, gates and wheel-pit) varies from $2.00 to $25.00, according to the height of the water-fall impounded. On the other hand, the sum of $20.00 will amply cover the cost per annum of one horse-power delivered by a large steam engine. The difference between these figures, varying from $18.00 to $5.00 per horse-power, is what remains available to cover the expense of transforming the power at the water supply into a form suitable for transmission, for its subsequent conveyances, and for its retransformation into mechanical work at the point where it is required to be employed. The interest on the capital outlay and running expenses of any such transmission system usually exceeds the balance above shown available, and allows the steam engine to win the race.

The great transmitters of energy are, indeed, our railways and steamships, which transport, at a rate vastly cheaper than by any other means, the enormous stores of mechanical energy accumulated in our coal fields; and that in any amount and to any distance, unhampered by the losses of power which inevitably accompany every transportation.

Prime-movers.—When water is the source of power the prime-mover is a turbine, which is turned by either the pressure or the velocity, or both, of the falling water. If coal is used, steam-engines and boilers give out the necessary mechanical work. In either case the energy is ready to be taken from a rotating shaft, which, if it is to be applied so as to compress air, may not turn more than about eighty times a minute. This speed is for turbines a somewhat slow one. The slower the speed, the larger must be the turbine to develope a given power. This is a disadvantage, as it largely increases the first cost.

Air-compressor.—A machine having organs almost identical with those of a steam-engine is used to transform the energy obtained from the above-mentioned rotating-shaft into that of a potential kind possessed by compressed air. Such an air-compressor, if large, will consist of three cylinders and two intermediate vessels or receivers. These three cylinders are of different sizes. When the piston in the largest of the three moves in one direction it draws, by the ordinary principles of suction, a cylinder-full of air from the atmosphere. During the return stroke the air is compressed, by the closing of the inlet valve, into a smaller volume, and its pressure is correspondingly raised. When the pressure rises to that of the first of the two receivers, the outlet valve opens and the remainder of the stroke of the piston is devoted to delivering this air into it. The second cylinder, which is smaller, acts in precisely the same way, except that it draws air from the first receiver instead of the atmosphere, and delivers it into the second receiver at a still higher pressure. The third and smallest of the three cylinders derives its supply of air at a high pressure from the second receiver, and finally delivers it in a still more compressed state into the storage reservoirs or transmission mains at the required high pressure suitable for conveyance to a distance.

The two intermediate receivers have another and most important function to fulfil besides that of mere receptacles. In the act of compression, heat is very apt to be generated in the air; and the receivers are intended to act also as cooling vessels where the fluid, by remaining for some time before suffering further compression and consequent heating in the next cylinder, can part with some of its heat. Thus, by the action of the inter-coolers, the pressures against which the piston in the second and third cylinders have to act, are lower than they otherwise would be with a high temperature of final delivery into the mains. Any heat which the air entering the mains may possess above the temperature of the atmosphere will obviously be lost during the long journey to the distributing pipes and motors. The less heat, consequently, that is generated during the process of compression, the more economical in power that process will be. Every means for keeping the air cool that can with advantage be used, such as jacketing the cylinders with cold water, injecting water into the cylinders as a fine spray, and in the case of compound compressors the adoption of inter-coolers, is consequently resorted to. The air finally delivered by the compressor must, if it has been subjected to spray injection, before it passes into the mains, be deprived of all particles of water suspended amongst it. This is done by passing it through reservoirs containing baffle plates, which separate out the water particles from the air by the action of the surface film on the little drops, and by gravity.

Air Mains.—The pipe for conveying the compressed air from the source of power to the locality where it is to be distributed is preferably as smooth in its interior as possible. If large enough to be a riveted structure, the heads of the rivets inside should be countersunk, so as to offer no projections to increase the resistance. The joints which connect together successive lengths of pipe, must be flexible to some extent, so as to allow of the pipe line yielding to lateral movements of the earth which surrounds it. They must at the same time be and remain so tight that the loss of air by leakage is inappreciable.

These conflicting conditions are perfectly capable of a satisfactory simultaneous fulfilment. In the mains of Paris, which has a large pneumatic system of power distribution, the loss due to leakage was less than half a pound per square inch of the working pressure in one mile of main; and the joints which produced these good results have been found satisfactory in every other respect. The loss of power due to friction in the pipes proved also unexpectedly small, as was shown in the experiments of Professors Riedler and Gutermuth.

Satisfactory results can certainly be obtained when the distance of transmission is as great as fifteen or even twenty miles.

Distributing Pipes.—The same remarks regarding tightness and efficiency, when transmitting a supply of air under pressure, apply to the distribution pipes. And it should be further mentioned that the depth at which such pipes need be laid is much smaller than is required for water or gas mains. This is a very obvious advantage, especially in large cities.

Motors and Pre-heaters.—The pressure of the air in the distributing pipes is owing to friction and leakage, less than that at which it was delivered by the air-compressors. It ought, however, still to be higher than the greatest pressure to be used in any of the air motors of the system. The air has also lost all superfluous heat above the temperature of the atmosphere it may have possessed on its entrance into the mains.

The reader will perhaps remember that during the process of compression the air was unavoidably heated by the working pistons. He will then readily understand that during the process of expansion and abstraction of work from the compressed air in the air motors a considerable fall of temperature will take place. So much is this the case that in many air motors working in mines the exhaust pipe becomes eventually choked up by the accumulations of frozen vapour in the escaping air.

In the attempt to remedy this by heating the air before its entry into the cylinders of the motor, it has been found that a higher degree of heating than is necessary merely to keep the exhausting air at atmospheric temperature is very conducive to economic working, as it can be effected at an insignificant cost.

The pre-heaters used in Paris for this purpose are tiny little stoves, requiring an insensible amount of fuel and almost no attention.

Notwithstanding this, the air delivered to motors, although at the same pressure, is so much increased in volume and temperature that all the losses due to leakage, friction and inefficiency of the operating machinery can be entirely wiped out at an additional expenditure almost infinitesimal, and without increasing the complexity or working difficulties of the system.

The air motors may be simply old steam engines, no alteration being necessary except the putting of them in good repair. If the motors are specially designed for use with air, instead of steam, better results will, of course, be obtained; and this is above all the case with the smallest sizes. For the larger sizes, however, a consumer who wishes to change from steam to air has only to discard his boiler, discharge his fireman, and couple his steam pipe to the compressed air main.

Turning to the commercial feasibility of a scheme for the supply of power by means of compressed air in a large industrial centre, the author has estimated that a Central Station Power Supply Company could, in a city like Montreal, supply to consumers, whether large or small, sufficient air to generate one horse power on their motor-brakes for $24.00 per annum; and secure at the same time 10 per cent. interest on their capital outlay. The price now paid for power by small cousumers ranges from $60.00 to $120.00 per annum, and is never less than $50.00.

Reference may now be made to many advantages, apart from the question of cost, which attend the adoption of the pneumatic system.

In the first rank we may place the elimination of 95 per cent. of the smoke which now renders manufacturing centres so obnoxious from an æsthetic point of view, and of the dangers and responsibility attending the use of steam boilers by unskilled persons: these being done away with or removed from the more crowded parts of the city. The possibility of running air motors in the centre of the city, where a supply of water for condensing or even feed is extremely expensive, is an obvious advantage.

The extreme handiness of the working medium and its suitability for use by technically unskilled attendants may be adverted to. In this respect the air motor bears away the palm from the electric motor, the gas engine, and even the much-enduring steam engine, all of which require a certain modicum of knowledge or experience. The repair also of such a machine requires only a knowledge of perfectly well understood mechanical details.

The use of the exhaust for either refrigeration, ventilation or even heating renders the rejected air a beneficial by-product instead of a nuisance, as the exhaust from a steam engine certainly is in summer.

The suitability of compressed air for the working of lifts ought not to escape mention; a cheapening of the first cost by at least 10 per cent. and of running expenses at the rate of 75 over other systems can be easily attained.

Tram cars worked by compressed air are now in use in Nantes, Brussels, Chester and other places; they have there proved both serviceable and economical, in spite of the fact that the power they use is generated in small compressing stations. A reservoir capacity with air at perfectly safe pressures can be obtained with an ordinary sized car to do a return journey of five miles without any intermediate charging station; and the consequent removal of a dangerous overhead wire, such as is used on the electric trolly system, is not to be despised in a populous city. The difficulty of snow could be overcome by having a car devoted to clearing the tracks alone; but this will be preferably effected by having a light overhead railroad, as the ruts in the streets caused by keeping a clean tramroad in winter are extremely unpleasant, not to say dangerous, to occupants of vehicles.

Other advantages of the adoption of a scheme for power distribution by means of air under pressure might be discussed. Enough has been said, however, to warrant the assertion that the great technical advances recently made in this matter are sufficient to place the pneumatic system in the forefront as a realizable scheme.

The practical success it has met with in Paris, where 13,000 horse power are now at work, is an instance on a large scale of the possibility of the distribution of power by means of compressed air.

THE WORLD'S GEOLOGICAL CONGRESS.

By HENRY M. AMI, M.A., D.Sc.

As an auxiliary of the World's Columbian Exposition, the World's Geological Congress was held at Chicago during the week commencing Monday, the 21st of August, 1893.

It had been thought desirable "that there should be an exposition and comparison of the progress which the various countries have made in the delineation of their geological formations," and, accordingly, the committee appointed by the Congress Auxiliary to prepare a programme for the Geological Congress submitted the following themes for discussion and consideration :

I. On geological progress.
II. On continental growth and international relations.
III. On palæontological and archæological geology.
IV. On physical, structural and petrographical geology.
V. On economic geology.
VI. Miscellaneous.

There was a fairly good representation of geologists from the United States and Canada; but very few Europeans were present, a circumstance much to be regretted. Yet these latter sent papers, which were read and formed an interesting part of the work in the sessions.

The first three days of the Congress were devoted to geological work and papers by women, during which time the following papers were presented :

Methods of Teaching Geology—Miss Mary Holmes, Ph.D., Rockford, Ill.

Physical Geology—Miss Mary K. Andrews, Belfast, Ire.

Chemical Geology—Miss Louise Foster, Boston, Mass.

Granites of Massachusetts and their Origin—Mrs. Ella F. Boyd, Hyde Park, Mass.

Artistic Geology—Mrs. S. Maxon-Cobb, Boulder, Colo.

The Geology of Ogle County—Mrs. C. M. Winston, Chicago.

The Fossils of the Upper Silurian—Mrs. Ada D. Davidson, Oberlin, Ohio.

Crinoidea and Blastoidea of the Kinderhook Group as Found in the Quarries near Marshalltown, Iowa—Jennie McGowen, A.M., M.D., Davenport, Iowa.

The Evolution of the Brachiopoda—Miss Agnes Crane, Brighton, England.

The Mastodon in Northern Ohio; Post-Glacial or Pre-Glacial—Miss Ellen Smith, Painesville, Ohio.

Palæontology—Miss Jane Donald, Carlisle, England.

Glacial Markings—Miss Thompson, Newcastle, England.

On the 24th, 25th and 26th of August the Congress met in the Art Institute of Chicago, under the presidency of Dr. A. R. C. Selwyn, Prof. J. Le Conte and Prof. James Hall, respectively.

As representatives of Canada, Dr. Selwyn, director of the Geological Survey, Dr. Bell and Dr. Ami read papers at the Congress, all of which elicited interesting discussions. Besides these the following Canadian geologists registered. Dr. G. T. Kennedy, Nova Scotia, Messrs. N. J. Giroux, H. P. Brunnell, L. M. Lambe and E. D. Ingall, of the Geological Survey Staff.

The following is a complete list of the other papers presented at the Congress, whose sessions were held in the morning in order to give the members an opportunity of visiting the fair grounds in the afternoons, special prominence being placed on the Mining Department building.

Thursday, August 24.

The General Geology of Venezuela—Dr. Adolph Ernst, special delegate from Venezuela so the Columbian Exposition.

Pre-Cambrian Rocks of Wales—Dr. Henry Hicks, London, England.

The Classification of the Rock Formations of Canada, with special reference to the Palæozoic Era—Dr. Henry M. Ami, Geological Survey of Canada.

The Cordilleran Mesozoic Revolution—Dr. A. C. Lawson, University of California.

The Oil Shales of the Scottish Carboniferous System—Henry M. Cadell, late of the Geological Survey, Scotland.

The Pre-Palæozoic Floor in the Northwestern States—Prof. C. W. Hall, University of Minnesota.

Distribution of Pre-Cambrian Volcanic Rocks along the Eastern Border of the United States and Canada—Prof. George H. Williams, Johns Hopkins University.

They were followed by a special discusston on the question: "Are there any Natural Geological Divisions of World-wide Extent?" Introduced by Prof. J. Le Conte.

Friday, August 25.

Huronian versus Algonkian—Dr. A. R. C. Selwyn, Geological Survey of Canada.

On the Migration of Material during the Metamorphism of Rock Masses—Alfred Harker, St. John's College, Cambridge, England.

Wave-like Progress of an Epeirogenic Uplift—Warren Upham, Geological Survey of Minnesota.

Zur Nereiten Frage—Dr H. B. Geinitz, Dresden.

Genetic Classification of Geology—W. J. McGee, Bureau of Ethnology.

Precious Stones and their Geological Occurrence—Dr. George F. Kunz.

The Extent and Lapse of Time Represented by Unconformities—Prof. C. R. Van Hise, U. S. Geological Survey.

The Phylogeny of the Classes of Vertebrates—Dr. O. Jaekel, Berlin, Germany.

Restoration of Clidastes (illustrated)—Prof. S. W. Williston, University of Kansas.

Special Discussion.

"What are the Principles and Criteria to be Observed in the Restoration of Ancient Geographical Outlines?"—by Dr. W. J. McGee.

Saturday, August 26.

Glacial Succession in the British Isles and Northern Europe—Dr. James Geikie, Geological Survey of Scotland.

Glacial Succession in Sweden—Hjalmar Lundbohm, Geological Survey of Sweden.

Glacial Succession in Switzerland—Dr. Albrecht Heim, Zurich.

The Succession of the Glacial Deposits of Canada—Dr. Robert Bell, Canadian Geological Survey.

Glacial Succession in the United States—Dr. T. C. Chamberlin, University of Chicago.

Pleistocene Climatic Changes—Warren Upham, Geological Survey of Minnesota.

Evidences of the Diversity of the Older Drift in Northwestern Illinois—Frank Leverett, U. S. Geological Survey.

The presence of the venerable Prof. Hall at the Congress was the signal for a hearty welcome being tendered him as he entered the hall.

In the discussion which followed the reading of Dr. Selwyn's paper entitled "Huronian versus Algonkian," Prof. Van Hise stated that the term Algonkian was only a provisional one. Prof. T. C. Chamberlin advocated the use of the term Proterozoic in the place of Algonkian, inasmuch as the termination of the letters is not uniform with such terms as Palæozoic, Mesozoic, etc., to which the term Algonkian is alleged to be comparable.

Following the first special discussion on "Natural Divisions in Geology of World-wide Extent," Prof. H. S. Williams pointed out the *rôle* which the "cuboides zone" played in this respect, whilst Dr. Ami pointed out the world-wide extent of certain graptolitic zones and the reasons which probably led thereto. Dr. Le Conte considered at length the present Human Period.

OBITUARY NOTICE.

DR. JOHN RAE, F.R.S., F.R.G.S.

In the death of Dr. John Rae, Canada and Natural Science have lost a warm friend, and the world loses one of the most active and energetic of geographical explorers. Dr. Rae was born at the Hall of Clestrain, Orkney Islands, on September 30th, 1813, and died at No. 4 Addison Gardens, London, on July 22nd, 1893, having nearly attained the age of 80 years. The following notice is from the *Canadian Gazette:*

At the beginning of April last Dr. Rae was seized with a violent attack of influenza followed by congestion of the lungs, and although at times during the interval he seemed to be getting better, he never permanently recovered. Three weeks before his death his conditton seemed so greatly improved that arrangements were made for him to leave his bedroom for the first time since April, and Mrs. Rae had even gone so far as to contemplate his removal to the seaside. On July 13th, however, he had a sudden and severe relapse, though hopes were still entertained of his recovery when he passed away last Saturday. Up to the very last he was perfectly conscious, his robust physique seeming to defy even the ravages of time, and on the morning of his death he read through the whole account of the Bisley meeting, taking an especial interest in the doings of the Canadian team. The remains are to be conveyed to Kirkwall, Orkney, and will be interred in the cathedral burial ground by the side of those of his old friend and companion, Dr. Bakie, the African traveller.

Dr. Rae was popularly known as the discoverer of Sir John Franklin's remains. He was born at the Hall of Clestrain, Orkney Islands, on September 30th, nearly eighty years ago. He studied medicine at the University of Edinburgh, and in 1833 was appointed surgeon to the Hudson's Bay Company's vessel which annually visited Moose Factory on Hudson's Bay. In June, 1846, he set out on his first voyage of exploration on behalf of the same company, and so successfully was this accomplished that he was offered and accepted, in 1848, the place of second in command of the expedition under Sir John Richardson to search for Franklin. This expedition was unsuccessful, but in the spring of 1849 Dr. Rae was appointed to command another search party to the Arctic coast. In order to utilize the time before navigation opened, he, accompanied by two men, made a journey along the shores of Wollaston Land, traversing over 1,100 miles, he himself dragging his sleigh. The average day's journey was about twenty-five miles, and the whole shore was minutely examined, including Victoria Strait, in which, as it afterwards appeared, Franklin's ships had been abandoned. Continuing the exploration, he and his party, with the aid of snowshoes, marched continuously, at the rate of twenty-seven miles a day, to Fort Garry, now the city of Winnipeg. In about eight months they travelled 5,380 miles, 700 miles of which was newly discovered territory.

For his services in this connection, and for the survey of 1847, Dr. Rae was awarded the Founder's Gold Medal of the Royal Geographical Society. There being still a considerable portion of the Arctic coast unexplored, Dr. Rae in 1853 took command of an expedition organized by the Hudson's Bay Company to trace the west coast of Boothia, and, from information obtained from the Esquimaux, he succeeded then in placing beyond all doubt the fact that Franklin and his men had perished from exposure and hunger. On this occasion he purchased from the natives a number of relics of the ill-fated party. Returning to London in the latter part of 1855, he found that he was entitled to £10,000, which the Government had offered for the first news of Franklin, a fact unknown to him while conducting the expeditions. In 1860 Dr. Rae took the land part of a survey of a contemplated telegraph line to America *via* the Faroe Islands and Iceland. Greenland was next visited, and in 1864 he took a leading part in a telegraph survey from Winnipeg across the prairie and through the Rocky Mountains. Subsequently some hundreds of miles of the most dangerous parts of Fraser River were run down in small dugout canoes without a guide—a most perilous undertaking, but successiully accomplished.

But though Dr. Rae travelled much, and saw much of unknown parts, covering in his time some 1,500, if not 1,800 miles of previously unexplored ground, he wrote little. His reports to the Royal Geographical Society are on that account all the more valued, as are his short papers on the Esquimaux and other subjects; and in 1850 he published a "Narrative of an Expedition to the Shores of the Arctic Sea in 1846 and 1847." He was a frequent and welcome attendant at the meetings of the Royal Geographical Society, where his record of travel, his genial manner, and graphic powers of description were often in request. During the latter years of his life he maintained a keen interest in colonial matters. He was an active member of the Royal Colonial Institute, and with Sir Henry Tyler he represented Ontario on the executive of the Imperial Institute. As one of the first directors of the Canada North-West Land Company, and as director of other commercial enterprises in Manitoba and British Columbia, he evinced his belief in the future of the new West, and that belief he was never slow to attest in his communications to the columns of this and other journals.

Dr. Rae leaves no children. Mrs. Rae, to whom he was married in 1860, nursed her husband with devoted care during his long illness. her watch being shared py her sister, Miss Skeffinton Thompson, and they will have the sympathy of many friends in Canada and this country and of all who came into association with the deceased in his many activities,

The following, relating more especially to the scientfic value of his labours, is from *Nature:*

In 1845 his true career as an Arctic explorer began in his undertaking the leadership of a small expedition to explore a considerable extent of the coast line ef the Arctic Sea. In June, 1846, he set out on this expedition from York Factory, coasted along the west side of Hudson Bay, and wintered on the shore of Repulse Bay. Early in 1847 he made an extensive land journey to the north and west, with the result that 700 miles of new coast were surveyed, almost filling the gap between Ross's work in Boothia and Parry's at Fury and Hecla Strait. In 1859 Dr. Rae published an account of this expedition in the form of a book of 250 pages. This was, curiously enough, his only permanent contribution to geographical literature, his subsequent journeys being recorded merely in formal reports published in the *Journal* of the Royal Geographical Society. After this journey Rae came to London, but was almost immediately induced to join the first land expedition sent to seek for Sir John Frankln, under the leadership of Sir John Richardson. The expedition was unsuccessful as to its primary purpose of finding traces of Franklin, but it effected a satisfactory survey of the whole coast between the Mackenzie and Coppermine rivers. In 1851 Rae received the command of another boat expedition for the Hudson Bay Company, in the course of which he thoroughly explored and mapped the south coast of Wollaston Land and Victoria Land, still searching vainly for traces of Franklin's party. On his return from this arduous undertaking, which he conducted throughout with conspicuous daring and sagacity, he had to travel on snowshoes, and himself dragging a sledge, across the whole breadth of Canada from the Arctic Sea, through Fort Garry (now Winnipeg) until he reached United States territory. His total walking on this expedition was 5,000 miles, of which 700 miles were traversed for the first time. On returning to England in 1852 the gold medal of the Royal Geographical Society was presented to him by Sir Roderick Murchison, in a speech the cordial terms of which showed how fully Dr. Rae's genius for Arctic travel with the minimum of equipment and an infinitesi mal expense was appreciated by the highest authorities. In no wise deterred by the hardships of his earlier campaigns, Rae left England early in 1853 to continue his work in the far north; the Hudson Bay Company equipping an expedition on condition that he would lead it personally. He completed the survey of King William's Land on this occasion, proving it to be an island; 1,100 miles of sledging were accompiished in the process, of which 400 miles were new discovery. But the really important result of this expedition was Dr. Rae's meeting with the first evidence of Sir John's Franklin's fate, from the story of a party of wandering Eskimo. The tribe encountered were in possession of many personal relics of members of that ill-fated expedition, which Rae secured and brought home. When he returned to England with the news so long searched for and so anxiously awaited, the Admiralty, which had spent large sums in fitting out successive expeditions, concluded that the fate of Franklin was decided beyond a doubt, and accordingly awarded to Dr. Rae the sum of £10,000 offered by Government to the first who brought back decisive information. The justice of this award was at the time strongly objected to by Lady Franklin, and, although no further action was taken by Government, she continued to organize private expeditions, which, while proving in effect the correctness of Dr. Rae's information from the Eskimo, served in no small degree to advance the geographical survey of the polar area.

In all his expeditions Dr. Rae made collections of characteristic plants and animals as well as physical and meteorological observations. The material, described by other workers, went to swell the sum of our knowledge of the general conditions of climate and life in the Arctic basin.

In 1860 and subsequent years Dr. Rae made a series of intaresting journeys in Iceland, Greenland and North America with the object of exploring and arranging routes for telegraph lines. His later years were spent in this country, where he made himself conspicuous by his zeal in forwarding the volunteer movement, being himseif an excellent shot. The feeling which grew upon him to a painful extent as he became older, that his brilliant explorations were not adequately recognized and acknowledged on the Admiralty charts, unfortunately somewhat embittered his last years. But to the end he took the keenest interest in Arctic travel, and was ever ready to take part in discussions bearing on the region in which he lived so long and suffered so much. He was a regular attendant at meetings of the Royal Geographical Society and Colonial Institute, and for many years attended the gatherings of the British Association.

NOTICES OF BOOKS AND PAPERS.

"THE FOSSIL INSECTS OF NORTH AMERICA, VOLS. I AND II, BY PROF. S. H. SCUDDER; MACMILLAN & CO., NEW YORK, 1890," WITH SPECIAL REFERENCE TO CANADIAN SPECIMENS.

Having had occasion to look into Prof. Scudder's recent monograph of "The Fossil Insects of North America" it has occurred to me that for students of Canadian geology, it might not be uninteresting to write a few notes on that part of this admirable work which affects them more particularly, and give a condensed list of the forms therein described with a view of ascertaining what has been done to date.

VOLUME I.

The first paper or portion of this volume which refers to Canadian insects, is one entitled: "On the Carboniferous Myriapods preserved in the Sigillarian stumps of Nova Scotia," with supplementary page and cut, pp. 21—31.

Full descriptions of the following species are therein given :—

MYRIAPODA.

1. Xylobius sigillariæ, Dawson.
2. " similis, Scudder.
3. " fractus, Scudder.
4. " Dawsoni, Scudder.
5. Archiulus xylobioides, Scudder.

Then comes the chapter on "The Devonian Insects of New Brunswick," with a note by Sir William Dawson, pp. 154-194, and elaborate descriptions of six species from the Devonian rocks of New Brunswick, as follows:

1. Platephemera antiqua, Scudder.
2. Gerephemera simplex, Scudder.
3. Dyscritus vetustus, Scudder.
4. Lithentomum Harttii, Scudder.
5. Xenoneura antiquorum, Scudder.
6. Homothetus fossilis, Scudder.

These belong to the family of the Ephemeridæ, whose structure and affinities are discussed at great length, whilst a summary of facts regarding fossil insects is given, which may well be presented here in a condensed form :—

Prof. Scudder's conclusions regarding early fossil insects are these :—

(1.) "That the general type of wing structure has remained unaltered from the earliest times.

(2.) These earliest insects were Hexapoda.

(3.) They were all lower Heterometabola.

(4.) Nearly all are synthetic types of a comparatively narrow range.

(5.) Neariy all bear marks of affinity to the Carboniferous palæoictyoptera.

(6.) On the other hand, they are often of more and not less comlicated structure than most *palæodictoptera.*

(7.) With one exception, they bear little special relation to Carboniferous forms, having a distinct facies of their own.

(8.) The Devonain insects were of great size, had membranous wings and were probably aquatic in early life.

(9.) Some of the Devonian insects are evidently precursors of existing forms while others seem to have left no trace.

(10.) They show a remarkable variety of structure indicating an abundance of insect life at that epoch.

(11.) The Devonian insects also differ remarkably from all other known types, ancient or modern ; and some of them appear to be even more complicated than their nearest living allies.

(12.) We appear, therefore, to be no nearer the beginning of things in the Devonian epoch, than in the carboniferous so far as either greater unity or simplicity of structure is concerned.

(13.) Finally, where there are some forms which tosome degree bear out the general derivative hypothesis of structural development, there are quite as many which are altogether unexpected, and cannot be explained by that theory, without involving suppositions for which no facts can at present be adduced."

Sir William Dawson's note is entitled : " Note on the Geological relations of the Fossil Insects from the Devonian of New Brunswick," in which a section of the rocks taken at the " Fern ledges" is presented and no less than eight "plant-beds" are enumerated and the various forms found in each recorded—the total thickness of the beds embraced in this section " being" 440 feet, 11 inches.

Fossil Cockroaches.

Then comes " The species of Mylacris, a Carboniferous genus of Cockroaches" with reference to a form described from the coal measure of Sydney, Cape Breton under the following designation:—

1. Mylacris Bretonense, Scudder. The other palæozoic cockroaches known from Canadian rocks were described by the same author in a preceding chapter, viz : " Palæozoic cockroaches, a complete revision of the species of both worlds, with an essay toward their classification." These are described in the monograph, pp. 43-154, and are from the Acadian coal field. They include

Sydney, Cape Breton,

1. Mylacris Bretonense, Scudder.
2. " Heeri, Scudder.
3. Petroblattina sepulta, Scudder.

Pictou, Nova Scotia,

4. Archimylacris Acadicum, Scudder, from the "shale overlying roof of main coal seam," East River, Pictou.

In another chapter on "The earliest winged Insects of America," Prof. Scudder gives to the scientific public the result of his "re-examination of the Devonian Insects of New Brunswick, in the light of criticisms and of new studies on other palæozoic types," pp. 275--282.

Gerephemera is here referred to the order *Protophasmida* and Homothetus is taken from the order Odonata, whilst the relations of the Devonian forms to Carboniferous more akin than at first supposed are given. The criticisms made by Dr. Hagen on Prof. Scudder's works and writings are here treated in the kindly spirit of searching for light and finding it.

VOLUME II.

Volume II contains notes on and descriptions of the Tertiary insects of North America, and it is of special interest to students of Canadian Geology and Palæontology, inasmuch as it throws much light upon the structure and affinities of fossil specimens from two principal horizons in the stratigraphical sequence, viz.: (1) the Miocene rocks of British Columbia, and (2) the Interglacial beds of Scarboro, in the Province of Ontario.

In this volume no less than sixty-seven Canadian species of insects are described in full and figured. They belong to the orders Hemiptera, Coleoptera, Diptera and Hymenoptera, which are here appended in tabular form, so as to make them easy for reference.

Notes on the localities where these fossil insects are found are here inserted from the large monographs, and will no doubt prove interesting. These writings of Prof. Scudder will shortly be supplemented by description and figures of fossil insects from British Columbia, and from the Leda clay of Green's Creek, near Ottawa.

"The discovery of the different localities for fossil insects in British Columbia by the Geological Survey of Canada, has been due entirely to the investigations of Dr. George M. Dawson. On the left bank of the Fraser River, at the town of Quesnel, he discovered a series of clays, sands and gravels, their upturned edges covered by the valley deposits, in one of which series (a stratum of fire clay eight or nine inches thick) insects and plants were found, the beds being exposed on the river bank at a low stage of the water. Nearly twenty species of plants were met with, mostly of apetalous families, in the neighborhood of the Cupuliferæ, such as the beech, walnut, oak, birch and poplar, and a considerable number of insects. Such of these as are included in the present report consist of twenty-five species, nearly all Hymenoptera and Diptera, and especially the latter, and, what is very unusual, only a single beetle. Sir William Dawson, who determined the plants, regarded them as to a garat extent identical with those from the Miocene of Alaska, but adds: "Whether the age of these beds is Miocene, or somewhat older, may, however admit of doubt." Apart from an uncharacteristic egg cocoon of a spider, none of the insect remains can be regarded as identical with any found elsewhere.

The other localities at which remains of insects have been found, though in smaller numbers, lie at no great distance apart to the south of Quesnel, and south of the Canadian Pacific Railway, near our own border. One of these localities is upon the Nicola River, two miles above its junction with the Coldwater, at the base of a series of beds containing coal. Another is on the north fork of the Similkameen River, three miles from its mouth; the beds here, on the bank of the river, "include a layer of lignite about a foot thick, which rests on black, rather earthy, carbonaceous clays, and is overlain by fifteen feet or more of very thinly bedded, almost paper like, yellow gray siliceous shales," which contain plants and insects. The third is on Nine Mile Creek, flowing into Whipsaw Creek, a tributary of the Similkameen, where a small section of hard, laminated clays occurs with layers of softer arenaceous clays: *Seven* species were obtained from the first named locality, *five* from second and *four* from the third. The Nicola locality is remarkable for yielding only Coleoptera and one of Hemiptera; while the Similkameen locality like Quesnel, affords us Hymenoptera, Diptera and Hemiptera—three species of the last—but no Coleoptera. There can be no doubt, Dr. Dawson informed me, "that the specimens from the North Similkameen and Nine Mile Creek represent deposits in different portions of a single lake. A silicifying spring probably thermal, must, however have entered the lake near the first named place, as evidenced by the character of some of the beds, in which fragments of plants, with a few fresh water shells, have been preserved." The insects of each locality are specifically distinct from those of any of the others. As to their age, Dr. Dawson, the only geologist who has studied them, remarks that we shall "probably err little in continuing to call the Tertiary deposits of the interior as a whole Miocene, and in corelating them with the beds attributed to the same period to the southward, in the basin lying east of the Sierra Nevada."

FOSSIL INSECTS FROM ONTARIO.

"In the vicinity of Toronto and along the shore of Lake Ontario, Mr. George J. Hinde has discovered vegetable and animal remains in thin seams in clay beds which he regards as interglacial, lying as they do upon a morainic till of a special character and overlain by till of a another and quite distinct kind. His account of the locality and the reasons for his conclusions have been given by him in full.[1]

[1] Canadian Journal, New Series, vol. xv, 1887, pp 338-413.

"Among the material found by him was a considerable number of the elytra and other parts of beetles, an assemblage indeed larger than had ever been found in such a deposit in any part of the world. and they are mostly in excellent condition. Twenty-nine species have been obtained, some of them in considerable numbers. Five families and fifteen genera are represented; they are largely Carabidæ, there being six or seven species each of Platynus and Pterostichus and species also of Patrobus, Bembidium, Loricera and Elaphrus. The next family of importance is the Staphylinidæ, of which there are five genera, Geodromicus, Arpedium, Bledius, Oxyporus, and Lathrobium, each with a single species. The Hydrophilidæ are represented by Hydrochus and Helophorus each with one species; and the Chrysomelidæ by two species of Donacia. Finally, a species of Scolytidæ must have made certain borings under the bark of juniper. Most of these are described and figured in the present volume. Looking at them as a whole, and noting the distribution of the species to which they seem to be most nearly related, they are plainly indigenous to the soil, but would perhaps be thought to have come from a somewhat more northern locality than that in which they are found; not one of them can be referred to existing species, but the nearest allies of not a few of them are to be sought in the Lake Superior and Hudson Bay region, while the larger part are inhabitants of Canada and the Northern United States, or in the general district in which the deposit occurs. In no single instance were any special affinities found with any characteristically southern forms, though several are most nearly allied to species found there as well as in the north. A few seem to be most nearly related to Pacific forms, such as the Elaphrus and one each of the species of Platynus and Pterostichus. On the whole, the fauna has a boreal aspect, thought by no means so decidedly boreal as one would anticipate under the circumstances."

Table giving list of Fossil Insects from Canada, described by Prof. S. H. Scudder, in his work, "The Fossil Insects of North America," 1890:

Name.	Locality.	Formation.	Collector, etc.
HEMIPTERA.			
HOMOPTERA.			
1. Geranchon pétrorum, Scudd.	Quesnel, B. C......	Miocene.	G. M. Dawson.
2. Sbenaphis Quesneli, Scudd	"	" ..	"
3. Planophlebia gigantea, Scudd	Similkameen Riv., B. C..	" ..	"
4. Cœlidia Columbiana, Scudd..	Similkameen Riv., B. C.............	" ..	"
5. Cercopis Selwyni, Scudd.....	Nine Mile Creek, B. C	" .	"
HETEROPTERA.			
6. Telmatrechus stali, Scudd...	N. F. Similkameen R., B. C.........	Miocone...	G. M. Dawson.
7. Teleoschistus antiquus, Scudd	Quesnel, B. C.....	"	"

Name.	Locality.	Formation.	Collector, etc.
COLEOPTERA.			
Scolytidæ.			
8. Hylastes? squalideus, Scudd.	Scarboro, Ont......	Interglaci'l	G. J. Hinde.
Tenebrionidæ.			
9. Tenebrio primigenius? Scudd	Nine Mile Creek, B. C............	Miocene. ..	G. M. Dawson.
Chrysomelidæ.			
10. Galerucella picea, Scudd.....	Nine Mile Creek, B. C	Miocene ..	G. M. Dawson.
11. Donacia stiria, Scudd	Scarboro, Ont......	Interglaci'l	G. J. Hinde.
12. Donacia pompatica, Scudd.	"	"	"
Scarabædiæ.			
13. Trox ous:aleti, Scudd........	Nine Mile Creek, B. C............	Miocene ...	G. M. Dawsou.
Buprestidæ.			
14. Buprestis tertiaria, Scudd....	Nicola R., B. C....	Miocene ...	G. M. Dawson.
15. Buprestis saxigena, Scudd. .	"	" ..	"
16. Buprestis sepulta, Scudd....	"	" ..	"
Elateridæ.			
17. Cryptohypyus? terrestris, Scudd. .	Nicola R., B. C ...	Miocene ...	G. M. Dawson.
18. Cryptophynus? planatus, Le Coute	"	" ..	"
19. Elateridæ? sp..............	"	" ..	"
Nitidulidæ.			
20. Prometopia depilis, Scudd.	Quesnel, B. C.?....	Miocene ...	G. M. Dawson.
Staphylinidæ.			
21. Bledius gla.?atus, Scudd.....	Scarboro, Ont......	Interglaci'l	G. J. Hinde.
22. Oxyporus stiriacus, Scudd...	"	"	"
23. Lathrobium interglaciale, Scudd..	"	"	"
Hydrophilidæ.			
24. Cercyon? terrigena, Scudd..	Nicola R., B. C....	Miocene. ..	G. M. Dawson.
25. Hydrochus amictus, Scudd..	Scarboro, Ont	Interglaci'l	G. J. Hinde.
26. Helophorus rigescens, Scudd.	"	"	"
Carabidæ.			
27. Platynus casus, Scudd.......	Scarboro, Ont.........	Interglaci'l	G. J. Hinde.
28. Platynus Hindei, Scudd.	"	"	"
29. Platynus Halli, Scudd........	"	"	"
30. Platynus dissipatus, Scudd.	"	"	"
31. Platynus desuctus, Scudd....	"	"	"
32. Platynus Harttii, Scudd*....	"	"	"
33. Pterostichus abrogatus, Scudd	"	"	"
34. Pterostichus dormitans, Scudd	"	"	"
35. Pterostichus destitutus, Scudd..	"	"	"
36. Pterostichus fractus, Scudd..	"	"	"
37. Pterostichus destructus. Scudd	"	"	"
38. Pterostichus gelidus, Scudd..	"	"	"
39. Patrobus gelatus, Scudd.....	"	"	"

Name.	Locality.	Formation.	Collector, etc.
40. Bembidium glaciatum, Scudd	"	"	"
41. Bembidium fragmentum, Scudd ..	"	"	"
42. Nebria paleomelas, Scudd...	Nicola R., B.C.....	Miocene ...	G. M. Dawson
43. Loricera? glacialis. Scudd ..	Scarboro, Ont......	Intergraci'l	G. J. Hinde.
44. Loricera? lutosa, Scudd.....	"	"	"
45. Elaphrus irregularis, Scudd	"	"	"
DIPTERA.			
Lonchæidæ.			
46. Lonchæa senescens, Scudd...	Quesnel, B. C.	Miocene ...	G. M. Dawson.
47. Palloptera mortioina, Scudd.	"	" ..	"
Ortalidæ.			
48. Lithortalis picta, Scudd.....	Quesnel, B. C	Miocene ...	G. M. Dawson.
Sciomyzidæ.			
49. Sciomyza revelata, Scudd ...	Quesnel, B. C.....	Miocene ...	G. M. Dawson.
Helomyzidæ.			
50. Heteromyza senilis, Scudd. .	Quesnel, B. C......	Miocene ...	G. M. Dawson.
Anthomyidæ.			
51. Anthomyia inanimata, Scudd	Quesnel, B. C......	Miocene ...	G. M. Dawson.
52. Anthomyia Burgessi, Scudd..	"	" ..	"
Asilidæ.			
53. Asilidæ, sp...........	N. F. Similkameen B., B. C..........	Miocene ... " ..	G. M. Dawson. "
Bibionidæ.			
54. Plecia Similkamena, Scudd.	N. F. Similkameen R., B. C	Miocene ... "	G. M. Dawson. "
Mycetophilidæ.			
55. Sciara deperdita. Scudd.....	Quesnel, B. C	Miocene ...	G. M. Dawson.
56. Trichonta Dawsoni, Scudd...	"	" ..	"
57. Brachypeza abita. Scudd....	"	" ..	"
58. Brachypeza procera, Scudd..	"	" ..	"
59. Boletina sepulta, Scudd......	"	" ..	"
HYMENOPTERA.			
Braconidæ.			
60. Calyptites antediluvianum, Scudd	Quesnel, B. C......	Miocene . .	G. M. Dawson.
61. Bracon, sp..................	"	" ..	"
Ichneumonidæ.			
62. Pimpla saxea, Scudd.	Quesnel, B. C......	Miocene . .	G. M. Dawson.
63. Pimpla senecta, Scudd.	"	" ..	"
64. Pimpla decissa, Scudd.	"	" ..	"
Myrmicida.			
65. Aphænogaster longæva, Scudd	Quesnel, B. C	Miocene...	G. M. Dawson.
Formicidæ			
66. Hypoclinea obliterata, Scudd	Quesnel, B. C......	Miocene ...	G. M. Dawson.
67. Formica arcana, Scudd.	"	"	"

Ottawa, 1893. H. M. AMI.

GUIDE TO THE STUDY OF COMMON PLANTS; AN INTRODUCTION TO BOTANY; BY VOLNEY M. SPAULDING, BOSTON. D. C. HEATH & CO., 1893. 8vo., pp. 246.

When all the attendant conditions are fuily considered, the ques tion as to how modern botany may be taught in the best way, is one which does not admit of ready solution in such a manner as to meet the requirements of even the majority of cases, yet there seems to be a fairly general agreement upon one point, and that is laboratory work—a living, practical acquaintance with the object to be studied—must in the future more completly replace the old text book methods.

The little book before us has methods from a recognition of these facts, and an attempt on the part of the author to outline what, to him, appears to be a desirable method of proceedure for students who are pursuing a high school course, or a course preparatory to the university or college.

A chapter of advice to the student contains many hints to the student, which are both opportune and valuable, while upon the teacher is impressed the idea that for the proper study of modern botany, the subject must be pursued from a practical point of view and with plenty of simple laboratory appliances. And here the author gives the real way to the discipline of students, whom he shows that to get a pupil thoroughly interested in an important line of work, where hands, eyes and all the faculties are fully engaged, is to secure a discipline that can be attained in no other way—a result which alone more than compensates for the expense of equipment.

The subject matter of the book deals with the plant from the standpoint of its life history—the idea of development being the leading one. The absence of illustrations is to be regretted, but notwithstanding this, it is likely to prove a useful manual in the hands of a competent teacher. If it accomplishes no other object than to give an impetus to the establishment of laboratories for elementary biological work in our various schools, it will have done well. The fact that it was written in response to inquiries from teachers preparing pupils for university examinations is significant.

D. P. P.

BOTANICAL LABORATORY,
McGill University, Oct. 1893.

A READER IN BOTANY. PART II. FLOWER AND FRUIT. SELECTED AND ADAPTED FROM WELL KNOWN AUTHORS BY JANE H. NEWELL, BOSTON. GIUN & CO., 1893. 8vo., pp. 179. ILL.

The structure of the flower and its many remarkable adaptations to the visitation of insects, and the purposes of cross fertilization, is a subject that has always been invested with special interest for the amateur as well as for the professional botanist, and nowhere has the subject been presented in a more attractive form, than in the charming little volume from the pen of Miss Newell, who, in a well arranged summary, gives some of the more important results reached by well known investigators. The book lays no claim to originality, yet it is evident from the context, that the authoress has herself been a close observer of many of the phenomena she deals with, and therefore she speaks of things of which she has personal knowledge.

The excellenc of the illustrations adds much to the attractive manner in which the facts are presented. For those who have not the time or opportunity to gain a more extensive acquaintance with the subject, this little book will prove a most useful and reliable guide to some of the most remarkable of Nature's processes.

D. P. P.

BOTANICAL LABORATORY,
McGill University, Oct. 1893.

INDEX.

ABSTRACT FOR THE MONTH OF JULY, 1893.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	* BAROMETER. Mean.	§ Max.	§ Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	74.47	87.1	63.7	23.4	29.9805	30.047	29.920	.127	.5385	64.7	60.8	S.W.	8.3	6.2	10	0	67	....	....	....	1
SUNDAY....... 2	.....	85.5	64.5	21.0	....	.....	......	. ..	.....	....	....	S.	10.5	....	....	..	83	....	....	....	2 ....SUNDAY
3	68.72	77.5	63.6	13.9	29.7745	29.800	29.759	.041	.5653	81.3	62.3	S.W.	11.8	9 0	10	2	11	0.26	....	0.26	3
4	67.23	76.8	60.8	16.0	29.8403	29.872	29.813	.059	.5100	76.8	59 3	W.	10.3	7 7	10	4	50	0.23	....	0.23	4
5	64.93	75.2	60.0	15.2	29.8018	29.867	29.735	.132	.4908	80.3	58.5	S.W.	11 9	9.2	10	5	00	0.24	....	0.24	5
6	68.42	79.3	58.0	21.3	29.9270	29.995	29.827	.168	.4507	66.3	56.0	S.W.	8.7	1.8	8	0	97	....	....	....	6
7	71.52	81.0	61.5	19.5	30.0008	30.063	29 918	.145	.4838	63.3	57.8	S.W.	6 7	3.7	8	0	67	....	....	....	7
8	71.57	85.2	64.0	21.2	29.7163	29 905	29.546	.359	.5762	75 3	62.7	S.E.	14.9	8 2	10	0	16	0.91	....	0.91	8
SUNDAY........ 9	.....	09.8	54.0	15.8	....	......	......	....	.....		....	W.	12.9	....	....	..	67	....	....	....	9 ....SUNDAY
10	63.68	72.5	55.1	17.4	29.9950	30.017	29 951	.066	.3860	66.5	51.8	W.	13.7	6.5	10	3	67	....	....	....	10
11	67.20	77.0	56.5	20.5	30.0293	30.067	29.992	.075	.4430	67.8	55.3	S.W.	21.5	2.2	10	0	85	....	....	....	11
12	60.00	76.5	58.8	17.7	29.9725	30.041	29.907	.134	.4730	74.3	57.5	S.W.	17.1	5.0	10	0	98	....	....	....	12
13	64.73	75.1	57.8	17.3	29.8972	29.912	29.883	.029	.4317	72.8	54 8	N.E.	4.8	7.3	10	0	62	0.04	....	0.04	13
14	69.23	79 0	57.1	21.9	29.8915	29.940	29.840	.100	.4755	67.5	57 5	S.E.	1.7	2.0	5	0	91	....	....	....	14
15	71.73	80.0	63.5	16.5	29.7057	29.855	29.573	.282	.6315	81.3	65.5	S.E.	11.6	8.0	10	0	07	0.18	....	0.18	15
SUNDAY........16	.....	82.5	67.3	15.2	....	......	......	....	.....	....	....	S.W.	18.4	....	...	..	86	....	....	....	16 ....SUNDAY
17	67.95	79.4	61.1	18.3	29.7682	29.828	29.619	.209	.4952	74 2	58.7	N.	1.3	7.2	10	0	56	0.17	....	0.17	17
18	66.03	77.8	61.0	16.8	29.8982	29 925	29.869	.056	.5075	77.5	59.5	S.W.	5 3	5.3	10	0	54	....	....	....	18
19	66.10	75.5	58.0	17.5	30.0460	30.087	29 986	.101	.3880	61.8	52.0	N.W.	9.5	2.8	9	0	77	0.02	...	0.02	19
20	68.89	77.5	56.6	20.9	30.0428	30.136	29.903	.233	.3857	55 3	51.7	S.W.	12.7	1.7	8	0	95	....	....	....	20
21	73.83	85.0	64.0	21.0	29.7812	29.884	29.655	.229	.5540	66.5	61.7	S.W.	25.2	4.7	9	0	76	....	....	....	21
22	66.85	78 1	60.8	17.3	29 5687	29.638	29.508	.130	.5380	80.5	60 5	S.W.	18.5	8.7	10	4	30	0.25	....	0.25	22
SUNDAY........23	.....	67.3	53.5	13.8	....	......	......	....	.....	....	....	N.W.	16.7	....	....	..	34	0.18	....	0.18	23 ....SUNDAY
24	61.12	70.1	52.0	18.1	29.9935	30.046	29.929	.117	.3817	70.8	51.3	W.	16.1	6.2	10	0	35	....	....	....	24
25	59.97	62.8	57.0	5.8	29.9282	30.049	29.773	.276	.4570	88.5	56 5	S.E.	14.9	8.3	10	3	04	0.19	....	0.19	25
26	68.35	80.5	58.0	22.5	29.5930	29.696	29.518	.178	.6197	88.8	64 7	W.	12.0	8 0	10	4	55	1.82	....	1.82	26
27	62.77	70.5	56.2	14.3	29.8505	29.970	29.655	.315	3753	66.5	50.8	N.W.	22.0	5.2	10	0	79	0.04	....	0 04	27
28	67.67	77.5	59.8	17.7	30.0183	30.072	29.956	.116	.4598	67.8	56 5	S.W.	16.7	0.8	10	0	58	Inap	....	Inap	28
29	66.43	74.2	62.0	12.2	29.8115	29.907	29.740	.167	.5450	84.2	61.3	S.W.	13 8	8.3	10	4	28	0.05	....	0.05	29
SUNDAY........30	.....	80.1	63 5	16.6	....	.0....	......	....	.....	....	....	S.W.	13.2	....	....	..	96	....	....	....	30 ....SUNDAY
31	72.47	82.7	62.0	20 7	29.7905	29.873	29.711	.162	.5372	67.8	61 0	S.W.	12 0	7 8	10	0	66	0 01	....	0.01	31
....Means	67.69	77.40	59.73	17.66	29.8624	.....	......	.154	4884	72.6	57.9	S. 70° W.	12.73	6.07	..	..	¶ 58	4.59	....	4.59	Sums ....
19 Years means for and including this month	68.83	77.28	60.73	16.55	29.8908	.....	......	.140	.4995	71.0	...	......	....	5.5	..	..	59.3	4.15	....	4.15	19 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	549	61	10	613	685	4500	2017	1051	
Duration in hrs .	68	21	6	63	65	292	137	73	19
Mean velocity...	8.1	2.9	1.7	9.7	10.5	15.4	14 7	14.4	

Greatest mileage in one hour was 33 on the 21st.
Greatest velocity in gusts 36 miles per hour, on the 21st.
Resultant mileage 6544.
Resultant direction, S. 70° W.

Total mileage, 9,486.
Average velocity, 12.73m. per hour.
On the 26th between 4.5 hrs. and 6 hrs., 1.60 inches of rain fell.
Rainbows were observed on the 4, 17.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 12 years only.

The greatest heat was 87.1 on the 1st; and the greatest cold was 52.0 on the 24th, giving a range of temperature of 35.1 degrees. Warmest day was the 1st. Coldest day was the 25th. Highest barometer reading was 30.136 on the 20th; lowest barometer was 29.530 on the 22nd, giving a range of 0.606 inches. Maximum relative humidity was 99 on the 26th. Minimum relative humidity was 41 on the 13th.

Rain fell on 16 days.

Auroras were observed on 3 nights.

Thunderstorms on 7 days.

ABSTRACT FOR THE MONTH OF AUGUST, 1893.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	* BAROMETER. Mean.	§ Max.	§ Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	68.85	77.5	62.5	15.2	29.8132	29.942	29.760	.182	.5185	74.0	59.8	S.W.	11 6	7.5	10	6	.78	0.03	....	0 03	1
2	65.12	72.5	56.0	16.5	30.0855	30.143	30.013	.130	.3947	64.0	52 0	S.W.	15 3	4.5	9	0	.89	....	....	....	2
3	69.17	78 3	61.0	17.3	30.0877	30.154	30.017	.137	.4785	68.0	57.8	S.W.	15.3	3.5	7	0	96	....	....	....	3
4	73.07	84 5	62.0	22.5	29.9300	30.015	29.862	.153	.5200	64.2	59 8	S.W.	14.0	0.8	5	0	93	....	....	....	4
5	73.25	84.0	63 2	20.8	29.8328	29 906	29.735	.171	.5385	67.8	60.8	S.E.	12.0	3.3	10	0	.87	0.06	....	0.06	5
SUNDAY...... 6	.	75.0	63.0	12.0	....	....	.....		.....	....	....	N.E.	5 9	....	....	..	02	0.07	....	0.07	6 ....SUNDAY
7	67 02	74.0	63.0	11.0	29.8287	29.862	29.795	.067	.5607	85 2	62.3	N.W.	11.2	6.8	10	0	.25	0.29	....	0.29	7
8	72.30	79.6	64.6	15.0	29.9610	30.022	29.924	.098	.5252	66.3	60 3	S.W.	14.5	1.0	5	0	.91	...	....	....	8
9	72.95	81.5	64.5	17.0	30.0768	30.113	30 045	.065	.5517	68.8	61.5	S.W.	16 9	.5	3	0	.93	....	....	....	9
10	78.18	87.6	65.0	22 6	29.9812	30 058	29.868	170	.6450	67.0	66 0	S.	10.1	0	0	0	.94	....	....	....	10
11	78.57	90.0	68.0	22 0	29.8300	29.908	29 740	.168	.6305	65 2	65 7	S.	8.7	8	3	0	.86	....	....	....	11
12	67.70	79 3	56.5	22.8	29.8433	30.029	29.757	.272	.5523	79.7	61.2	S.W.	17.1	8 0	10	0	.00	0.02	....	0.02	12
SUNDAY. 13	.. .	70.0	51.5	18.5	....	......	......	....	. ..		....	N.	16.8	....	....	.	.98	....	....	....	13 .... SUNDAY
14	66.50	75.5	55.5	20.0	30.0600	30.169	29 948	.221	3798	58.0	51.0	N.W.	9.6	2.7	7	0	.95	....	....	....	14
15	67.82	75.6	58.0	17.6	29.9338	29 987	29.899	.-88	.3842	57.8	51.5	S.E.	9.9	7 3	10	0	.60	....	....	...	15
16	64.45	72.5	57.9	14 6	29.9623	30.014	29 916	.098	.4545	75.8	56 3	N.E.	7 6	7 8	10	4	.53	....	....	....	16
17	63 00	71.0	54.7	16.3	29.7905	29.886	29 724	.162	.4963	86.2	58.7	N.E	5.7	9 8	10	9	.15	0.02	....	0.02	17
18	61.43	68.5	58.0	10.5	29.7780	29.813	29.757	.056	.4772	87.7	57 5	.NE.	10 8	9.8	10	9	.05	0 05	....	0.05	18
19	62.25	68.5	56.8	11.7	29.8620	29.8-6	29.850	.035	.4855	87.2	58 2	N.W.	6.2	9 7	10	8	.00	0 09	...	0.09	19
SUNDAY 20	.....	72.5	60.2	12 3	....	......	......	. ..	.....	....	....	N.E.	6.3	....	. .	..	.29	....	....	....	20 ....SUNDAY
21	63.35	70.3	61.0	9.3	29.8628	29.960	29.791	.169	.5287	94.3	60.5	N E.	11 9	10.0	10	10	.00	0.71	....	0 71	21
22	67.72	75.5	61.0	14.5	30.0268	30.122	29 895	.227	.5180	77.9	60.2	S.W.	11.2	3.3	10	0	.76	0 05	....	0 05	22
23	69.65	80.5	57.0	23.5	30.0905	3 .116	30.034	.132	.5048	71.8	59.2	S.E.	10.4	1 5	3	0	.89	...	....		23
24	66.93	75.1	62.8	12.3	29.8002	30.050	29.523	.527	.5825	89.7	63.2	S.	22 5	9.3	10	6	.00	2.20	....	2 20	24
25	71 55	80 9	62.9	18.0	29.8287	29.886	29 790	.096	.6305	82.0	65.5	W.	12.4	4.8	10	0	.49	0.02	...	0 02	25
26	68.37	76.1	63.4	12.7	29 9960	30 0.8	29.945	.083	.5103	74 3	59.3	E.	4.2	2.2	6	0	79	....	....	....	26
SUNDAY........27	.....	80.5	60.3	20.2	......	......	......	....	....	....	...	E.	1.4	....	....	..	.44	Inap	....	Inap	27 ....SUNDAY
28	70 78	80.0	65 2	14.8	29 8537	29 881	29.786	.095	6557	87.3	66 7	W.	3.5	7.8	10	0	.43	0.40	....	0.40	28
29	62.03	68.0	53.5	14.5	29.5437	29.837	29.124	.713	.5317	93.3	60 2	N.W.	22.5	10.0	10	10	.00	3 36	....	3.36	29
30	59.77	70 0	48.0	22.0	29.9865	30 054	29 920	.134	.3835	75 7	51.3	W.	17.6	2 7	3	0	.81	....	....	....	30
31	60.25	66.4	56.6	9.8	30.1275	30.139	30 107	.032	.3690	71.2	50.3	N.W.	10 2	4 0	7	0	.83	....	.	....	31
....Means	67.85	76.17	59.79	16.38	29.9175	.	.....	.166	.5133	75.54	....	S. 89½° W.	11.4	5.16	..	..	¶ 559	7.37	....	7 37	Sums ... ..
19 Years means for and including this month	66 96	75.25	58.89	16.41	29.9412	....	....	.134	.4839	72 9	...	.....	....	5 4	..	..	551	3.52	....	35 2	19 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	705	1283	180	391	537	2707	1076	1604	
Duration in hrs.	63	113	37	45	71	196	91	111	17
Mean velocity...	11 2	11 3	4 9	8.7	7.6	13.8	11 8	14.5	

Greatest mileage in one hour was 45 on the 24th.
Greatest velocity in gusts 60 miles per hour, on the 24th.
Resultant mileage 2760.

Resultant direction, S. 89½° W.
Total mileage, 8,485
Average mileage per hour 11.4 m. per hour.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 12 years only

The greatest heat was 90.0 on the 11th; and the greatest cold was 48.0 on the 30th, giving a range of temperature of 42.0 degrees. Warmest day was the 11th. Coldest day was the 30th. Highest barometer reading was 30.169 on the 14th: lowest barometer was 29.124 on the 29th, giving a range of 1.045 inches. Maximum relative humidity was 99 on the 21st. and 29th. Minimum relative humidity was 37 on the 13th.

Rain fell on 15 days.

Auroras were observed on 4 nights.

Lunar halo, one the 23rd.

Thunderstorms on 3 days. Lightning without thunder on 4 nights.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1893.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	* BAROMETER. Mean.	§ Max.	§ Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles perhour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. of Possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	59.87	68.7	48.2	20.5	29.9857	30.159	29.768	.391	.3902	77.3	52.0	N.E.	7 7	3.7	80	0	62	....	....	....	1
2	53.87	63.5	46.3	17.2	29.8045	29.964	29.671	.293	.3242	76.2	46.5	S.W.	20.2	7 0	10	0	54	0.19	....	0.19	2
SUNDAY 3	.....	56.9	42.9	14.0	....	......	......	....	.....	....	....	S.W.	15 6	....	....	..	25	0.02	....	0.02	3 .... SUNDAY
4	58.12	59.5	41.1	18.4	29.8763	29.914	29.831	.083	.2512	63.7	39.7	S.W.	17.5	0 8	2	0	94	....	....	....	4
5	55.82	65.1	46.8	18.3	29.8157	29.879	29.744	.135	.3610	80.0	49.7	W.	9.1	8 0	10	0	09	0.06	....	0.06	5
6	53.84	60 5	44.0	16.5	30.0557	30.084	29.985	.099	.2643	63.8	41.3	N.W.	9 0	6.3	10	6	81	....	....	....	6
7	52.68	58.2	49.5	8.7	29.8562	30.053	29.635	.418	.3335	83.5	47.7	S.E.	17.3	9.3	10	6	00	0.41	....	0.41	7
8	56.25	64.5	47.1	17.4	30.0265	30.085	29.940	.145	.3005	65.8	44 7	N.W.	15 4	1.7	6	0	90	....	....	....	8
9	60.30	70.1	51.7	18.4	30.0337	30.241	29.929	.212	.3668	70.5	50 3	S.W.	19.0	2.7	8	0	86	....	....	....	9
SUNDAY........10	.....	[illegible].9	50.3	16.6	....	......	......	....	.....	..	....	N.E.	18.8	....	....	.	64	....	....	....	10 .... SUNDAY
11	54.40	62.0	44.3	17.7	30.2913	30.327	30.262	.065	.2782	66.2	43 0	N.E.	6.4	0 0	0	0	91	....	....	....	11
12	56.47	66.5	44.6	21.9	30.2858	30.334	30.238	.096	.3235	71.3	46 8	E.	0.0	0.0	0	0	85	....	....	....	12
13	62.68	76.5	49.2	27 3	30.2065	30.299	30.126	.173	.4057	72.0	53.0	S.E.	1.4	3.2	8	0	82	....	....	....	13
14	66.92	74.5	60.0	14.5	30 0348	30.127	29.945	182	.5418	82.3	01.2	S.E.	5.3	9.3	10	7	00	....	....	....	14
15	67.85	75.5	65.2	10.3	29.7648	29.887	29.657	.230	.5772	84.7	63 0	S.E.	6.3	9 0	10	6	19	0.02	....	0.02	15
16	56.85	68.1	53.5	14.6	29.5042	29 592	29.415	.177	.4175	89.2	53.7	S.W.	11.1	8.0	10	0	03	0.42	....	0.42	16
SUNDAY........17	.....	55.5	44.0	11 5	....	......	......	....	. ..	....	....	S.W.	10.6	....	....	.	00	0 43	....	0.43	17 .... SUNDAY
18	51 45	60.4	42.4	18.0	29.8120	29.843	29.765	.078	.3225	84.7	46 8	S.W.	20 9	6.2	10	0	57	0.21	....	0.21	18
19	58.33	65.5	52.0	13.5	29.6968	29.730	27.664	.066	.4278	88.2	54 6	W.	9.8	10.0	10	10	00	....	....	....	19
20	55.10	60.8	47.5	13.3	29.8932	30.057	29.709	.348	.3133	71.3	45.5	N.W	21.2	3.8	10	0	76	0.09	....	0.09	20
21	49.13	55.6	44.0	14 6	30.0785	30.138	30.002	.136	.2402	67.8	38.5	S.W.	12.7	4 7	10	0	83	....	....	.	21
22	52.12	56.9	48.2	8.7	29.7922	29.933	29.660	.273	.3647	93.5	50.2	S.E.	13.5	9 0	10	4	00	0 11	....	0.11	22
23	55.27	60.0	50.5	9 5	29.8033	29.888	29.707	.181	.3865	86.5	51.8	S.W.	9.1	0.3	10	0	04	Inap	....	Inap	23
SUNDAY........24	.....	56 5	43.5	13 0	....	......	......		.....	....	....	S.W.	15.9	....	..	..	90	....	....	....	24 .... SUNDAY
25	50.75	60.9	42 5	18.4	29.8163	30.021	29.619	.402	.3437	90.8	47.8	S.E.	18.1	7.7	10	0	00	0.44	....	0.41	25
26	47.25	55.2	38.5	16.7	30.2277	30.312	30.092	.220	.2350	72.7	38.8	S.W.	15.4	3.7	8	0	84	....	....	....	26
27	49.50	57.4	45.1	12.3	30 2627	30.300	30.233	.067	.2780	79 5	43.0	S.W.	3.4	6.7	10	0	54	...	....	...	27
28	49.03	59.0	42.0	17.0	30.1432	30.237	30.060	.177	.2495	82 7	43 3	N.	5.8	4 0	10	0	56	....	....	....	28
29	48.75	56.1	44.0	12.1	30.1605	30 212	30.105	.107	.5535	75 3	42.8	N E.	15.0	8.0	10	4	31	Inap	....	Inap	29
30	49.25	58.4	39.0	19.4	30.1478	30.235	30.079	.136	.2418	70.5	39.2	N.	10.3	0.5	3	0	86	....	....	....	30
....Means	54.83	62.57	46.83	15.74	29.9760	....	......	.189	3345	77.38	...	S. 60½ W.	12.3	5.37	.	.	¶49.0	2.40	....	2.40	Sums ....
19 Years means for and including this month ...	58 46	66.55	50.74	15.81	30.0158	....	.....	.178	.3799	75.22	....	......	....	5 61	..	..	55.0	3.15	....	3.15	19 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles.............	484	788	25	1070	352	4012	679	1417	
Duration in hrs..	52	67	10	110	39	252	50	96	44
Mean velocity...	9.3	11.8	2.5	9.7	9.0	15.9	13 6	14.8	

Greatest mileage in one hour was 31 on the 16th.
Greatest velocity in gusts 48 miles per hour, on the 16th.
Resultant mileage 3702.
Resultant direction, S. 60½° W.

Total mileage, 8827.
Average mileage per hour, 12.3 m. per hour.
The mean temperature for September, 54.83 is the lowest that has been seen here since a record has been kept; the one which approaches it the nearest was in 1875, when it reached 55.19.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 12 years only

The greatest heat was 76.5 on the 13th; and the greatest cold was 38.8 on the 26th, giving a range of temperature of 38.0 degrees. Warmest day was the 15th. Coldest day was the 26th. Highest barometer reading was 30.334 on the 12th. lowest barometer was 29.415 on the 16th, giving a range of .919 inches. Maximum relative humidity was 100 on the 19th. Minimum relative humidity was 36 on the 4th.

Rain fell on 12 days.
Auroras were observed on 5 nights.
Luna halo on one evening.
Lunar corona on the 26th and 29th.
Fog on one day.
Rainbows were observed on two afternoons.
Solar halos on two afternoons.
Thundered on two days without lightning.