I remain yours very truly
Chs. Fk. Hall

THE

CANADIAN RECORD

OF SCIENCE.

VOL. IV. APRIL, 1890. NO. 2.

Some Temperatures in the Great Lakes and St. Lawrence.

By A. T. Drummond.

The equalizing influence exerted by great and deep bodies of water upon the climate of the surrounding land is well known. Apart from this general result, the temperature of the water has also a direct effect. On the banks of the Lower St. Lawrence these two effects are well illustrated. Where the cold Labrador current, trending inward from the Straits of Belle Isle, skirts the north shore of the estuary, the little semi-arctic plants are more numerous than on the south shore, where the same current returning outwards carries with it the milder waters which have descended from the Great Lakes and the St. Lawrence. Lake Superior, around whose jutting headlands dwell semi-arctic and northern plants, and west of whose coasts many of the familiar forest trees of Ontario and Quebec do not range, affords another illustration.

The vast area and depth of the St. Lawrence Great Lakes, the different latitudes in which they lie, and their relations to each other, taken in connection with the extremes of heat and cold of the Canadian seasons, combine to give an interest to the temperature of the waters of these inland seas. Lakes Superior and Michigan may be regarded as two distinct reservoirs—the former of cold and the latter of warmer water—which constitute the largest sources of supply for the lower Great Lakes. Hind found the surface of Lake Superior on 30th July, at noon, as low as 39.50° at fifty miles from land. The outlets of these two lakes into Lake Huron are close to each other, the Michigan waters flowing directly into the main basin of Lake Huron, and the colder waters from Superior, while joining them in part through the detours between the Manitoulin Islands, appearing in part also to find their way eventually to the Georgian Bay by the channels north of the same islands. Now, Lake Huron in its profound depths forms three great basins—the Georgian Bay, the Central and the Southern Basins. The Georgian Bay is separated from the Central Basin, not only by the Bruce Peninsula, but by a continuous subaqueous ridge which comes to the surface in islands at different points, whilst under water it presents on the one side bold precipitous cliffs facing the Georgian Bay, and on the other, shelves somewhat gradually towards the deeper waters of the Central Basin. This ridge prevents the free interchange of water between the deeper portions of the Georgian Bay and Lake Huron proper, and makes the former a somewhat isolated basin of cold water without any considerable free current of warmer water flowing into and through it. This isolation aids in retaining in the Bay the colder waters which have accumulated there during the winter months. Thus, whilst the surface in July and August may be as high as 65° F., the bottom temperature at 31 fathoms and upwards, varies between 39.5° and 37.75° F.

The Central and Southern basins of Lake Huron, on the other hand, are separated by the sub-aqueous corniferous escarpment which diagonally crosses the lake in a south-eastern direction from the outlet of Lake Michigan, and which also appears to have its effect on free circulation between the deeper waters of these two basins. In the Central basin, at the bottom in 65 fathoms the temperature in July was 42° F., whilst in the Southern basin at the bottom in 38 and 45 fathoms it was 52° F. The Southern basin not only lies in a lower latitude, but is much shallower and has a bottom largely composed of sand. Apart from these circumstances, the natural flow of the warm Michigan surface waters is towards and into this basin before their final entrance into the St. Clair River at Sarnia. On the other hand, the tendency of the colder Superior waters constantly flowing into the Central basin and modifying the warm surface waters from Lake Michigan, is to maintain a somewhat lower temperature in the depths of the Central than in the lesser depths of the Southern basin.

In their main expanse, Lake Superior and the Georgian Bay thus constitute in midsummer, great bodies of colder water, whilst the Central basin of Lake Huron in its greater depths also forms a reservoir of cold water, but tempered by the warmer inflow from Lake Michigan.

Lakes Erie and Ontario are, on the other hand, warmer lakes, consequent on their geographical position, their affluent streams from the south and south-west, and the necessarily higher temperature of the larger volume of waters which have flowed over the great shallows of Lake St. Clair before reaching Lake Erie.

Records of observations made by myself during this last summer near the outlet of Lake Ontario, and in the St. Lawrence and other rivers, and by Staff-Commander Boulton, R.N., during last and previous seasons in the Georgian Bay, appear to establish some interesting results which are here appended. It is not assumed that these results are new, but they exemplify some characteristics of fresh water in the great masses in which it occurs in the Canadian Great Lakes and rivers, and under the varying conditions of climate which the geographical position of these lakes and rivers presents.

The instruments used in my observations were:—for surface readings, Negretti & Zambra's Reference Thermometer with Kew corrections, and, for deep water, the same makers' Patent Marine Thermometer, carefully compared with standard instruments. Staff-Commander Boulton's thermometers were previously tested at the Toronto Observatory.

Motion as Affecting the Temperature of Water.

Some tests made above and at the foot of the rapids in the Richelieu River at Chambly, would seem to show that the motion of the water during the one mile of continuous rapid here, raises the temperature of the water at least perceptibly. Above the rapids at 3 p.m. on 29th August, the air at the surface indicated 80° F., and the water at a depth of 1.5 feet, 73.75° to 74° F., whilst at 3.45 p.m., at the foot of the rapids, with the air at the surface, 75° F., the water in 1.5 feet in the rapids was, in different tests, 74° to 74.5° F. In other words, the water showed an increase of about one-half a degree in the face of the decreasing temperature of the air, as the afternoon wore on. Again, on 7th September, at 4.20 p.m., above the rapids, with the air on the bank registering 66.5° F., the water at 1.5 feet depth indicated 69.75° F. in the sun, while at 5.30 p.m., at the foot of the rapids, the water in the rapids was still 69.75° F., though the sun was clouded and the air on the bank had fallen to 62.5° F.

Rapid currents have, however, the effect of equalizing the temperature of the water. Thus, in June, at Rockport, among the Thousand Islands in the St. Lawrence, where there is a strong current, the water, at nearly 40 fathoms, indicated only 0.5° lower temperature than at the surface.

Areas of Water of Different Temperatures.

Under conditions which appear to be the same, and at points relatively near each other, the water on the surface of the lakes and rivers is not uniform in temperature, but seems to flow in areas of different temperatures—the variation being generally from 1° to 3°. At different depths down to the bottom, there are equally marked variations. In the tributary streams similar results appear. An interesting illustration occurred in a shallow creek, fully exposed for an eighth of a mile to the sun's rays, and slowly flowing over a succession of limestone ledges, where, in 1.5 inches of water, the mercury on a warm June afternoon could be seen rising and falling between 81° and 83° F. Here there were some exceptional causes, but in the line of outflow from Lake Ontario to the St. Lawrence, the fluctuations are rather to be ascribed to the evaporation at the surface, and to the cooler waters beneath ascending to supply the place of the evaporated water. As the evaporation would be irregular, varying with the passing clouds, the gusts of wind, and the features of the land, the ascending currents would also be irregular. These ascending waters would give rise to a slight inflow at the bottom from deeper and cooler parts of the lake to take their place, and both these currents would be affected by the general onward flow of the lake waters towards the entrance of the St. Lawrence.

Bottom Currents in Georgian Bay.

On 20th August, 1886, Commander Boulton, in a series of soundings diagonally across the centre of the Georgian Bay, in a somewhat southerly direction, found the temperature of the water at the bottom at one point (31 fathoms deep) 39.5° F., at another (47 fathoms) 38.25° F., and at a third (42 fathoms) 37.75° F.—the distance between the extreme points being about 40 miles. On 10th July, 1889, nearer the Bruce peninsula, the readings in 70 fathoms gave 38.75° F., and on 8th September following, at another point in 63 fathoms, the reading was 39° F. In all these different cases, the surface water varied from 59.75° to 68°—the last being on 8th Sept., at 10.10 a.m. As the temperature of water at its maximum density is 39·2° F., and below that, the density again diminishes, there would be a tendency in these bottom strata of water to rise until they intermingled with water of a higher temperature and equivalent density. It is thus necessary to seek some explanation of this singular fact that the bottom temperatures in this extensive bay are in summer as low in places as 37.75° F. The probability is that there are strong bottom currents which prevent what would be the natural course upwards of the colder and lighter waters of the bottom. Commander Boulton is also inclined to take this view. The two leading physical features which characterize the bottom of the bay, are, first, the somewhat shelving nature of the bottom from east to west, the western side, along nearly its whole length, being remarkably deep, and continuing so up to the very cliffs which bound it, and, secondly, the apparently complete severance of its deeper waters from those of Lake Huron by the submerged escarpment between the Bruce peninsula and the Manitoulin Islands. These two features may be found to have some influence in this connection.

Harbour Temperatures.

The more land-locked a harbour is, the higher is the temperature of its water as compared with that of the water outside of the harbour. It may be equally predicated that, up to a certain point, the more foul the harbour water is, the higher, to a further extent, is the temperature likely to be. At Kingston, this occasionally, in midsummer, is well illustrated. On 10th July last, after two or three days of comparatively calm weather, during which the upturned sediment of the bottom. the floating harbour accumulations, surface drainage, and the sewage appeared to be gathered together in the harbour to an unusual extent, while the mercury at 3000 feet off the wharves indicated 73.5° F. two inches under the surface; it, at 100 feet, rose to 78° F., at the same depth three hours subsequently, though in the meantime the sky had become overcast with clouds. These accumulations contaminate the water for very considerable distances outward in the harbour, and warn us how important to the health of cities and towns, similarly situated, it is to have the water, supplied for domestic uses, taken from points beyond any possible line to which such accumulations may extend. The higher temperature of the harbour waters would form some objection to their use for household purposes, though not so serious an objection as their contamination.

TEMPERATURE IN RELATION TO DEPTH.

It is impossible to lay down any general rule regarding the changes of temperature with the increase of depth. Apart from variations resulting at the different seasons, surface readings are affected by sunlight and cloud, gusts of wind, channel currents, the inflow of affluent streams, and the physical features of the surrounding land. Readings beneath the surface are affected by the depth of the water, by ordinary currents resulting from changes of level, by evaporation at the surface creating an upward flow of the water underneath, by the contour of the bottom, and by high winds which drive the surface waters before them, creating return currents underneath to take their place. Each case has to be judged by its own special circumstances. Thus, in the Georgian Bay, between Cabot's Head and Cape Croker, Commander Boulton, on 27th July, 1888, at 8.30 a.m., obtained the following record:

Surface	60·2° F.
10 fms	45·7°
20 "	41·4°
35 "	41°
66 " (bottom)	39·5°

On 14th June, 1889, at 11.25 a.m., one mile south-west of Kingston, in the channel from the lake to the river, one of the records was:

Air in sun	79° F.
Surface water	58.5°.
6 feet	56.25°.
18 "	54°.
30 "	54.25°.
60 " (bottom)	52°.

On the 25th July following, at 4.15 p.m., at a point in the same channel, two miles distant, the readings showed not only a higher range, but a much nearer approach between the surface and bottom temperatures, thus:

Air in sun	80° F.
Surface water	69°.
5 feet	68.75°.
12 "	67.75°.
18 "	67.66°.
30 "	67.75°.
72 " (bottom)	67°.

Again, in a very shallow stream on Wolfe Island, lightly flowing over exposed limestone rocks, the air on June 14th, at 3.15 p.m., at three feet above the water, indicated 73° F., whilst the water at 1.5 inches registered 83° F., at 4 inches varied between 79.5° and 82 5° F., and at 7 inches, on the bottom, fell to 72.5° F.

Junction of Affluent Streams.

An illustration of the effects of the warmer waters of the affluent streams on the main body of the St. Lawrence waters, was the case of the Gananoque River at its outlet. The temperature of the bottom near the foot of the fall was, on 10th June, 62.75° F.; a quarter of a mile down stream, at the outlet to the St. Lawrence, it was 61.5° F.; in the St. Lawrence, 150 yards off the outlet, 57° F.; 100 yards west of this, against the current of the St. Lawrence, 56.75° F., and 100 yards still further west 54.25° F. The surface water at these different points varied only between 62.25° and 63° F. The Gananoque River current below the falls is strong, and by a westward deflection of the sandstone banks at the outlet, it is thrown against the much lighter St. Lawrence current, but as above shown, the effect is soon gradually lost at the bottom of the St. Lawrence, however much farther it might be traced at the surface.

Gradual Absorption of Heat.

The general rise in the temperature of Lake Ontario waters as the summer advances is, at first, slow, compared with the general rise in the temperature of the air, but, as midsummer is reached, the rise is more rapid both at the surface and at the bottom. On June 14th, at noon, when the air indicated 79.75° F., the surface water in the main channel, two miles from Kingston, was still as low as 57.5° F. or only 5° higher than on May 23rd. On July 5th, the readings at the same place and hour had increased to 69.5° F., with the air at 79° F., and on July 10th to 74.75° F., with the air at 92.75° F., the thermometer being always in the sun. The most marked change was between June 25th and July 5th, when the advance registered was 9°. The bottom temperatures indicated somewhat similar results. On May 23, at 13 fathoms, the deep sea thermometer registered 50.25° F.; on June 14, at 12 fathoms, 52° F., on July 10, at 11 fathoms, 62.25° F., and in another spot in 17 fathoms, 53° F., and on July 25, at 12 fathoms, 67° F.

The absorption and retention of the sun's heat is most noticeable in the small streams and quiet pools. There we find well illustrated the general proposition that in high temperatures, the surface of comparatively still water, where unaffected by under currents, absorbs and retains the heat of the sun to a much greater degree than the immediately overlying air. A remarkable illustration has already been given in the case of the lightly flowing but shallow Wolfe Island stream, where the surface water was 7° higher than the immediately overlying air, and 10° higher than the air at 3 feet above, whilst on the bottom, at 7 inches in depth, the temperature fell again to 10.5° below that of the surface water. The records of other creeks did not indicate such extremes, but showed that each stream in its bottom, current and surroundings, may have circumstances which vary the temperature. In very shallow, still pools, exposed freely to the sun and breeze, but almost isolated from the main stream, the difference between the temperature of the surface of the water and of the immediately overlying stratum of air, is, however, sometimes still more marked, the water on sunny afternoons in June and July showing over 11° higher range. In such pools, the water, though indicating variation, is tolerably uniform even to the bottom.

Note on a Fossil Fish and Marine Worm found in the Pleistocene nodules of Green's Creek on the Ottawa,

By Sir William Dawson, LL.D., F.R.S.

I. Cottus fasciatus. Reinhardt.

The Pleistocene clays of Green's Creek on the Ottawa, are celebrated for the nodules holding fossil fishes which they contain. The most common of these is the Capelin (*Mallotus villosus*, Cuvier) but the Lump-sucker (*Cyclopterus lumpus*, Lin.) also occurs, and I have also found a species of Gasterosteus, possibly the two-spined stickleback of the St. Lawrence, (*G. aculeatus*, Lin.,) and a skeleton which seems to be that of the smelt (*Osmerus mordax*, Gill.)[1]

There have been in my collections for some time two specimens of these nodules, which appear to contain the skeletons of some species of *Cottus* or Sculpin. They are, however, imperfectly preserved, so that I have been unable to identify the species. Recently, Mr. J. Stewart of Ottawa has kindly placed in my hands a better preserved specimen, showing more especially the pre-opercular spines and pectoral fins in comparatively good preservation, and with the help of this I think I can identify the species, notwithstanding the confusion which at present seems to reign as to our North American cottoids.

The characters of the hooked spines and of the pectoral fin seem to identify this specimen with *Cottus (Centrodermichthys) uncinatus* of Gunther's British Museum catalogue. This is *C. uncinatus* of Reinhardt, and *Icelus uncinatus* of Kroyer and Gill. I feel convinced, also, that it must be the *Cottus gobio* of Fabricius, though this is usually identified with *C. (Gymnacanthus) tricuspis* of Reinhardt, a very distinct species. *Cottus uncinatus*, occurs in Greenland, and in

[1] Notes on Pleistocene of Canada, Canadian Naturalist N. S. Vol. V, 1871.

deeper water as far south as New England, according to Jordan, who creates for it a new genus (*Artediellus*).[1]

The total length of the specimen, without the caudal fin which is absent, is 4 inches, of which the head measures one inch. It belongs to the collection of Mr. Stewart. The other and less perfect specimens, which I refer to the same species, are in the Peter Redpath Museum.

Nereis, Sp.

Among the specimens submitted to me by Mr. Stewart are two that represent remains of marine worms, but not sufficiently perfect for determination. Their study has, however, induced me to re-examine some specimens of this kind collected some years ago and now in the Peter Redpath Museum, and one of these affords some characters which it may be useful to describe.

It resembles at first sight a whitish stripe of calcareous matter about four inches in length and scarcely two lines in breadth. This strip of calcite is a longitudinal section through the body of the worm, and shows nothing of its external characters, and the somites of the body are indicated only by the tufts of brown bristles or setæ at intervals along the sides. In the specimen in question, these are in the middle portion of the body from a tenth to a twelfth of an inch apart. On the anterior segments they are closer together, the body having apparently been contracted in that part. Each foot, as indicated by the setæ—the soft parts having entirely perished—seems to have had one strong spine and several others very fine and hair-like in a separate bundle. When disengaged from the matrix (which can easily be done by treating a small portion with diluted acid) and examined microscopically, they seem to be simple, nearly straight and pointed. Near what seems to be the anterior extremity, are obscure indications of one of the horny mandibles. These characters, as far as they go, would indicate a chætopod worm or "sea centipede," and, of the

[1] Catalogue of Fishes, Fish Commission Reports.

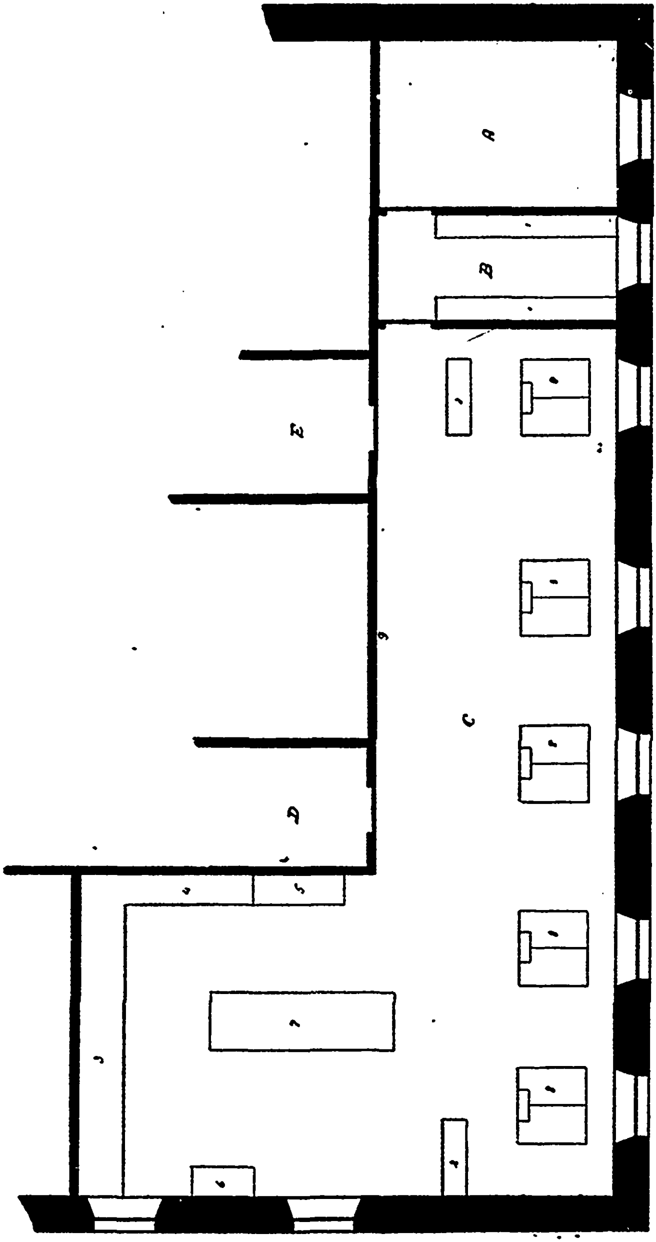
species known to me on our coasts, they resemble most nearly those of *Nereis pelagica*, Lin., a common and widely distributed animal, found in the Arctic seas and on the Northern coasts both of Europe and America, and which therefore would be a fitting associate of the species found with it at Green's Creek. It appears to be the *Nereis cæca* of Fabricius.

I would not, however, be too positive as to the specific identification of such material; but there can be no doubt that it indicates a member of the group Polychæta, of the family Nereidæ and probably of the genus Nereis.

A New Botanical Laboratory.

By D. P. Penhallow.

The Chair of Botany in the McGill University was first filled by Dr. Andrew F. Holmes, afterwards Dean of the Faculty of Medicine, who was appointed in 1829. Dr. Holmes was a zealous botanist who had studied in Edinburgh, had collected in Great Britain and France while pursuing his studies in medicine, and had formed a large Canadian collection which he afterwards presented to the University. When Dr. Holmes, owing to other engagements, became unable to attend to these duties, the lectures were delivered for a time by Dr. Papineau. After the reorganization of the University, in 1852, a combined Professorship in Art and Medicine was created in favor of Dr. James Barnston, an able and accomplished botanist, trained under Dr. Balfour, in Edinburgh, who lectured not only in the University, but in connection with a botanical society, which owed its origin to him, to create a taste for the science. Dr. Barnston was appointed in 1857, but had only been in office for two years when he was removed by death, and in the then depressed condition of the finances of the University, the Board of Governors found it necessary to assign the duties of the chair to Dr. Dawson, as Professor



BOTANICAL LABORATORY, McGILL UNIVERSITY.

of Natural History, by whom they were performed without remuneration till 1882. In 1883 the chair of Botany was established by the appointment of Professor D. P. Penhallow, B. Sc., under whom practical and additional courses and laboratory work have been introduced, to which it is desired more particularly to refer in the present paper.

In 1886 an additional course in the third and fourth years, embracing practical histology, was instituted for the benefit of those students who evince a special taste for such work, and desire to carry it on beyond the ordinary course of the second year. Accommodations for this purpose were secured in the Peter Redpath Museum, but within the past two years the combined growth of the botanical collections and of a greater desire for instruction in this branch, resulted in the room then occupied being wholly inadequate to meet the requirements of the work. The removal of the Faculty of Applied Science to new quarters, left vacant a suite of rooms in many respects well adapted to the purpose of a laboratory, and which were granted by the Board of Governors for this use. They are on the upper floor of the main building, and thoroughly lighted, the aspect being northern. The problem then was to convert these rooms to the required purpose with a minimum of expense, utilizing, as far as possible, such furnishings as were on hand. This has been accomplished in such a way as to meet present requirements in a very satisfactory manner, although were a laboratory to be constructed *de novo*, various changes from the present form and arrangements would be made. By reference to the plan, the details will be made clear. Room C originally consisted of two apartments which were thrown into one. Room A is used as a private office and laboratory. It measures 11 × 15.5 feet. Room B, 7 × 15.5 feet, contains two series of shelves, 1, 1, with drawers and cupboards for the storage of apparatus, reagents in bulk, general supplies and balances. Room C is the general laboratory, measuring 15.5 × 56.5 feet, with an ell room, 19 × 21 feet. Access to these rooms is gained through the halls D, E, which open out from the main hallway of the building.

The windows are five feet wide and at just the height of an ordinary table from the floor. They afford an abundance of good light. Opposite each window are two tables, $4\frac{1}{2} \times 2\frac{1}{2}$ feet, placed back to back. Accommodation is thus afforded for ten students at one time. which answers all present needs, though there is room for sixteen.

Affixed to each pair of tables, at the outer end, is a rack, two shelves of which hold test tubes and specimen bottles, while the two lower shelves hold narrow bottles containing such reagents and stains as are in common use. For those reagent which are required less frequently, the general reagent stands 2, 2, are provided. Each table has a plain wood top dressed with hot boiled linseed oil, while in the centre of the working side there is a black working square, 18×24 inches. The furnishings provided each student include a supply of needles, forceps, rods, dipping tubes, a razor, various covered dishes and watch-glasses for preparations; slides and covers, wash bottles holding distilled water and alcohol; drop bottles containing glycerine, carbolic acid and balsam: camera lucida, vegetation dishes, Bunsen burner, and an albo-carbon drop light for illuminating purposes—an essential part of the outfit, on account of the very early approach of darkness in winter. A row of gas pipes, bearing T arms, extends the whole length of the room. One end of each T—the outer—bears an ordinary burner for illuminating purposes, while the other bears a nozzle from which a rubber tube feeds the drop light of each table. A wall bracket at each table supplies gas for the Bunsen burner furnished to each student.

At 9, the entire wall space between the doors is occupied by a blackboard, which can be seen reaching from each end of the room. At 5, a large sink is provided with two taps, supplying water at a pressure of 120 pound; 4, is a short bench for section cutting and other work of a similar nature. It is provided with two microtome—one King and one Becker—and a paraffine bath for imbedding; 3 is a general work bench, well supplied with gas, and also with a water blast and exhaust. Above is a wall case for specimens in bulk. At 6 is a gas closet for macerations; 7 is a table holding a sterilizer, vegetation oven and other apparatus. An effort has been made to so arrange all the details that a student, when once seated at his table, may continue work with a minimum of interruption arising from the want of reagents or apparatus.

As now equipped, this laboratory affords ample facilities and accommodation for select classes in the third and fourth years, and for demonstrations to large classes in the second year. The course of study embraces a thorough grounding in vegetable histology. The work may be said to be divided into four stages. In the first, the student is instructed as to the construction and use of the microscope, the defects common to such instruments, and the means adopted to overcome them; determination of amplifications, and the measurement of objects. The second stage involves the examination of the various histological elements of the plant, which, for this purpose, are grouped as, 1st, albuminoids; 2nd, cellulose and its derivatives; 3rd, amyloids and sugars, 4th, glycosides; 5th, mineral products; 6th, miscellaneous organic products. These are dealt with in the order given, commencing with protoplasm. Each is fully considered with before proceeding to the next, and the student is thus made thoroughly familiar with the physical characteristics of every histological element, as well as with its behaviour under the action of micro-chemical tests.

This forms the basis for the third stage, which embraces a study of tissues and their constituent elements, after which the student proceeds to the fourth and last stage, for which he is now well prepared, the complete histology and life history of plants. In this part of the course, the higher Angiosperms are dealt with first, lower groups following in regular succession until the unicellular Thallophytes are reached. This order would more properly be reversed, were it not that some students cannot devote more than one year to the work, and for them a good knowledge of the higher plants is likely to be of the greatest value. It will be seen, however, that the aim is to lead the student on from the simple to the complex by natural stages, and in such a way that each successive step depends upon and is, to some extent a review of all the preceding.

Drawing constitutes an important feature of the course, and each student is expected to make a complete series of drawings of at least one plant in each of the groups studied. This not only fixes the main facts securely, but leads to greater accuracy of work, and a more critical judgment, while it also promotes facility in drawing, a most essential adjunct to all biological work.

Notes on Göthite, Serpentine, Garnet and other Canadian Minerals.[1]

By B. J. Harrington, McGill College, Montreal.

1.—Göthite.

In a report on the Iron Ores of Canada, published in 1874, the writer called attention to the occurrence of göthite in Nova Scotia. It was found by him associated with the hematite and limonite of Clifton (Old Barns), and also with black oxide of manganese, calcite, barite, &c., in veins cutting the Lower Carboniferous limestones of Black Rock, near the mouth of the Shubenacadie River. In some cases it appears as a velvety coating upon hematite, calcite, or other minerals, but the finest specimens obtained consisted of beautiful radiating needles with adamantine lustre (*nadel-eisenstein* or needle iron-ore), the needles occassionally being capped with rhombohedral crystals of calcite. Minute single crystals of the göthite were also observed.

[1] Read before the Natural History Society, Jan. 27th, 1890.

The mineral was recognized by its well-marked physical characters, and a determination of the water gave 10.23 per cent. Recently a specimen from the mouth of the Shubenacadie has been analysed by Mr. A. E. Shuttleworth, student in applied science, with the following result :—

Ferric Oxide	88·92
Manganic Oxide	0·14
Water	10·20
Silica	0·32
	99·58

The formula $Fe_2O_3 + H_2O$ gives, ferric oxide 89·89 per cent. The specific gravity of the specimen analysed was found to be 4·217 and the hardness 5.

2.—Serpentine.

I am indebted to Dr. Ells of the Geological Survey for specimens of an interesting variety of serpentine from Coleraine in the Eastern Townships. The mineral was obtained at Fenwick and Sclater's asbestus mine, about a mile and a-half from Coleraine station on the Quebec Central Railway, and according to Dr. Ells, occurs in irregular veins traversing the ordinary massive serpentine of the region. The veins are said to be generally thin, and to sometimes contain a little mica and asbestus. When first found, the mineral was quite soft, and could be readily squeezed between the fingers as in the case of saponite, but on exposure to the air, it soon became harder, and when examined by the writer, had a hardness of about 3½. It is sub-translucent and has a resinous lustre. The colour, in the specimens which I have seen, ranges from white to pale apple-green, but thin fragments often have an opalescent appearance, and show reddish reflections like some varieties of opal. This is best seen by gas-light. The fracture is distinctly conchoidal. The specific gravity as obtained without exhaustation of air was only 2·402 ; but on suspending the mineral in water in a vacuum, until no further escape of air bubbles took place, the true specific gravity proved to be 2·514.

On drying in vacuo over sulphuric acid the mineral lost 1·584 per cent. of its weight, but further drying in the steam-bath gave an additional loss of only 0·08 per cent. Under I is given the analysis of the undried material, and under II. the analysis calculated for the dried material :—

	I.	II.
Silica	42·42	43·13
Magnesia	41·36	42·05
Ferrous Oxide	0·36	0·37
Manganous Oxide	tr.	tr.
Nickel Oxide[1]	"	"
Lime	"	"
Water	15·29	13·88
	99·43	99·43

It will be seen that the substance has essentially the composition of serpentine, the figures for the dried material coming very near to those required by the formula $Mg_3 Si_2O_7 + 2H_2O$ (Silica 43·48, Magnesia 43·48, water 13·04.) The proportion of iron is much lower than that commonly met with in serpentine, and in fact of the 78 analyses given in Dana, there are only two showing as small a quantity. As a rule, the serpentine rocks of the Eastern Townships contain a considerable proportion of iron, and this we should expect if we regard them as alteration products of basic eruptive rocks. In the veins under consideration, however, we have serpentine of later origin, deposited by aqueous agencies, and presenting, as might be expected, striking differences from the parent rock, both in appearance and composition. Such differences of origin are too frequently lost sight of in the study of serpentines.

The mineral described above resembles in some respects such varieties of serpentine as retinalite and porcellophite.

[1] The presence of nickel was ascertained with the blowpipe, and no attempt was made to estimate the quantity.

3.—Garnet.

A number of varieties of this interesting species are known to occur in Canada, but as yet few of them have been made the subject of careful investigation. Dr. Hunt analysed a specimen from Lake Simon on the River Rouge which proved to be an iron-alumina garnet (almandine) containing 8.85 per cent. of magnesia. He also showed that a curious white rock associated with some of the serpentines of the Eastern Townships had the composition of lime-alumina garnet. The beautiful green garnet of Orford in the Eastern Townships was also analysed by him and found to contain 6.20 per cent. of chromic oxide.[1] Another green garnet from one of the apatite-bearing veins of Wakefield was analysed by the writer, and contained 4.95 per cent. of chromic oxide.[2] The garnet from lot 7, range 1 of Wakefield, which varies from "colourless to yellow and brown," was found by C. Bullman to be a true lime-alumina garnet.[3]

Spessartite occurs at the Villeneuve mica mine in this province[4] and andradite (lime-iron garnet) at the Malaspina copper mine on Texada Island, British Columbia.[5] A black isotropic mineral occurring in some of the nepheline-syenites of Montreal is also probably an iron garnet. A variety of the mineral having the colour of cinnamon-stone has been met with at a number of localities, including Orford, St. Jerome (in crystalline limestone) and Grenville. Fine specimens have also been found in the apatite region of Ottawa County (Wakefield, Range 1, lot 6 ?) and the following description and analysis refer to a specimen from this locality, obtained from the collection of the Peter

[1] Geology of Canada, 1863, pp. 496, 497.

[2] Canadian Naturalist, N. Series, ix., p. 305.

[3] G. F. Kunz, Am. Jour. of Sci. Ser. iii., vol. xxvii., p. 206.

[4] Since this paper was read the Villeneuve garnet has been analysed, and the analysis will be given in a future paper.

[5] G. M. Dawson, Report Geol. Survey, 1886, p. 34 B.

Redpath Museum. The garnet is associated with calcite, quartz, vesuvianite, &c., crystals of the last-named mineral often penetrating those of garnet. The latter occurs both massive and crystallised in rhombic dodecahedrons, one of which, in the Redpath Museum, is over 2½ inches in diameter. The specimen examined was of a cinnamon-brown colour and had a specific gravity of 3·58. The analysis was made by Mr. James C. Brown, a student in the chemical laboratory, and gave the following results :—

Silica	36·22
Alumina	18·23
Ferric Oxide	7·17
Manganous Oxide	0·63
Lime	37·39
Magnesia	tr.
Loss on ignition	0·70
	100·34

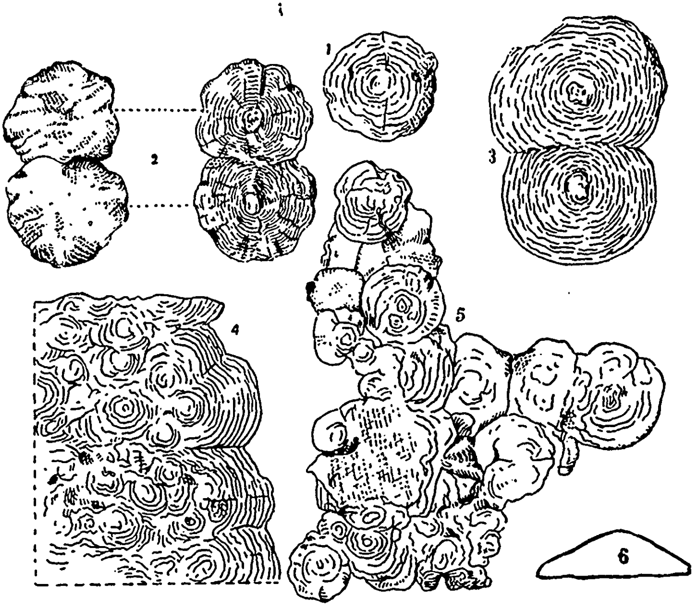
Visitors to Murray Bay, below Quebec, are familiar with the deep rose-red garnet which occurs abundantly in the Laurentian gneiss of that region. A specimen with a specific gravity of 4·047 has been analysed by Mr. R. H. Jamieson, chemistry student, with the following result :

Silica	37·97
Alumina	22·44
Ferric Oxide	2·39
Ferrous Oxide	26·12
Manganous Oxide	1·18
Lime	5·27
Magnesia	5·43
	100·80

The mineral is, therefore, almandine, and this is no doubt the variety of garnet which commonly occurs in the Laurentian gneisses.

4.—Chalcedony Concretions.

The exact locality from which these curious concretions were obtained is not known to the writer, but they are said to have been found embedded in clay in the region between Irvine and the Cypress Hills in the North-West. They consist of a greyish-white, opalescent chalcedony with hardness of 7 and specific gravity 2·592. The person who found them supposed they were fossils, and some of them certainly remind one of nummulites. In some cases they are flat on both sides, in others flat on one side and convex on the other. The convex sides are mostly smooth, and in some cases exhibit slight radial depressions or furrows. The flat sides, however, show marked concentric furrows. When viewed by transmitted light, the concretions are seen to have a radiated as well as a concentric structure, and the radiated structure is made much more apparent by grinding down



until the concretion has become transparent. This is especially true if the section be examined in polarised light when it is also seen to be doubly refracting. The concretions are from a-quarter of an inch or less in diameter up to nearly an inch, and mostly a sixteenth to an eighth of an inch in thickness. They occur as single individuals (fig. 1), or in pairs (figs. 2 and 3), or aggregated in groups (figs. 4 and 5). Figure 4 is from a specimen $2\frac{1}{2}$ inches square and less than $\frac{1}{8}$th of an inch in thickness. Figure 6 gives the outline of a transverse section of one of the convex concretions. Some of the specimens are crusted over by a dull white mineral whose composition has not been determined.

5.—Dawsonite.

$$(Na_2O + Al_2O_3 + 2\ CO_2 + 2\ H_2O \text{ or } Na_2Al_2\ C_2O_8 + 2\ H_2O).$$

It is worthy of record that this species has been found by Mr. E. T. Chambers at the Corporation quarry on the west side of Montreal mountain. It there occurs in thin radiating blades along the walls and in the joints of a grey trap dyke which cuts the nepheline-syenite, and also in joints in the nepheline-syenite itself. In app arance it closely resembles the mineral from the original localities (McGill College grounds and Montreal Reservoir), but as yet it has not been analysed quantitatively.

6.—Ittnerite.

A grey mineral occurring in the nepheline-syenite of the Corporation quarry has the blow-pipe characters of ittnerite. It contains both chlorine and sulphuric acid, but has not yet been fully examined.

Scolecite from a Canadian Locality.

By J. T. Donald, M.A.

This interesting mineral has recently been found at Black Lake, Megantic Co., Que., in one of the granitic dykes which are so abundant in the serpentine of that locality. The writer's attention was called to it by Mr. Matthew Penhale, Superintendent of the Scottish-Canadian Asbestus Co. It occurs in transparent, glassy needles filling minute veins, and in masses of gray, white, and colorless radiating fibres.

Before the blowpipe its conduct is highly characteristic, the heated portion quickly curling up in worm-like forms. A portion was analysed by the writer, and the results are stated below, together with the analysis as given in Dana's Mineralogy of a specimen from Iceland and of one from Chili, for comparison :—

	Black Lake.	Iceland.	Chili.
Silica....	46.24	46.76	46.30
Alumina	26.03	26.22	26.90
Lime....	14.09	13.68	13.40
Water..........	13.88	13.94	14.00
	100.24	100.60	100.60

This Scolecite from Black Lake is of considerable interest, being, it is believed, the first Zeolite found in the dykes cutting the serpentine of the Eastern Townships, and also because, so far as can be learned, it had not hitherto been known to occur in Canada.

NOTES ON ASBESTUS AND SOME ASSOCIATED MINERALS.

By J. T. DONALD, M.A.

Asbestus mining operations which are now extensively carried on at various points on the great serpentine belt, which extends "north-eastward from the Vermont boundary for some distance beyond the Chaudiere river," afford excellent material for the study of the problems as to the origin and nature of the serpentines and associated rocks.

On this subject much has been written, and the majority of those who have studied the rocks of this region consider, in most cases at least, the serpentine an alteration product of some form of dioritic rock rich in olivine. The asbestus, which is found throughout the serpentine in irregular veins varying greatly in width, appears to be a still later product of alteration. In many places the serpentine contains magnetic iron disseminated in fine particles; the associated asbestus shows the same iron, not disseminated, but usually concentrated toward the middle of the veins. It seems evident that both the serpentine and iron oxide have been dissolved by percolating water and redeposited in the crevices of the rock, the less soluble silicate first and lastly and in the middle of the vein, the more soluble iron.

Asbestus or chrysotile is commonly regarded as a fibrous variety of serpentine, and undoubtedly the two are very similar in composition. Dr. T. Sterry Hunt[1] has pointed out that asbestus is distinguished from serpentine by its lower specific gravity. There are, however, other points in which it appears that asbestus differs from ordinary serpentine. As a rule the former contains a higher percentage of water. The average water in five samples of Canadian serpentine chosen at random was found to be 13.49 per cent., while for four samples of chrysotile the water averaged 14.25 per cent. Alumina appears to be more frequently present in asbestus than in serpentine. In this respect, and in the degree of hydration, Italian asbestus is similar to its Canadian rival, but a greater number of analyses must be made before much stress can be laid upon the presence of alumina in chrysotile.

A question of interest, and one of great practical importance to those engaged in the asbestus industry, is, as to the cause of the difference in texture of various veins of the mineral. In some cases we find the fibres very soft and possessed of great flexibility; in other cases they are extremely harsh and brittle, the latter being of course much less valuable than the former. Analysis shows that harsh and brittle asbestus contains less water than the softer kind. The writer found 14.05 per cent. of water in very flexible fibre, whilst in a harsh-fibred sample only 12.62 per cent. was present. It is well known that if soft fibres be heated to a

[1] Mineral Physiology and Physiography, p. 324, s. 59.

temperature that will drive off a portion of the water of combination, there results a substance so brittle that it may be readily crumbled between the fingers. Wherever asbestus is found in rock that is faulted and shattered, the fibre is almost certain to be harsh at or near the surface, although at greater depth softer fibre may be found.

If the aqueous orgin of asbestus be admitted, it seems reasonable to suppose that all the fibre when first deposited was soft and flexible, containing a maximum amount of water, and that movements of the rock producing heat have driven off a portion of the water of the contained asbestus and thereby destroyed the softness of the original fibre. Veins at considerable depths may have been subjected to the heat produced by these movements and yet not deprived of any portion of their original water, because of the resistance of overlying rocks.

It is probable, too, that movements of the rocks and resulting heat have been intimately connected with the formation of picrolite,[1] a "columnar variety of serpentine, with fibres or columns not easily separable." In all the asbestus mines picrolite is found along the lines of faulting, and at one point near Broughton Station on the Quebec Central Railway, where there is abundant evidence of faults, picrolite abounds. Here mining was formerly carried on and large quantities of rock have been removed. Hundreds of tons of picrolite of most fantastic forms constitute one of the dumps, the whole forming a remarkable sight.

Associated with the chrysotile are found some singular forms of serpentine. At the Megantic mine, Coleraine, there occur narrow seams of material so soft that it may be compressed between thumb and finger, and varying in color through white, blue, green and yellow; when exposed to the air it gradually becomes hard and assumes a waxy lustre. Dr. B J. Harrington has already referred to the green variety, and his analysis shews it to be simply a variety of serpentine.

[1] Dr. Hunt gives 12.45 as the percentage of water in a picrolite from Bolton, Quebec. Geo. Survey Report, 1863, p. 499.

At the Thetford mines, also, there are found veins of a soft white mineral. On exposure to the air it hardens but does not acquire a waxy lustre, but has much the appearance of unglazed white earthenware, and absorbs water with avidity. On analysis its composition was found to be :—

Silica	43.191
Alumina	1.463
Ferrous oxide	.293
Magnesia	41.520
Water	14.000
	100.467

The Laurentian serpentine also contains seams of soft silicates. A Montreal gentleman who determined to ascertain the character of the Laurentian asbestus at some distance from the surface, in blasting the rock at a point some miles north of Lachute, met with a soft mineral, in physical characters much resembling those already described. The writer received a small sample which was laid aside in a warm and dry room, and examined from time to time. It gradually hardened, then crumbled to powder. After two months of exposure to warm and very dry air, it was found to lose no less than 6.05 per cent. moisture at 100° C. In composition this mineral is closely related to sepiolite or meerschaum, as the following analysis shows :—

Silica	61.585
Carbonic acid	1.290
Alumina	......
Lime	4.037
Magnesia	25.980
Water	6.600
	99.492

Fragments of light greenish-yellow serpentine were scattered through this specimen, whilst particles of a darker variety are disseminated through the Thetford mineral and through some of the material from Coleraine.

Other minerals found associated with the asbestus are soapstone, magnetic iron, chromic iron, mica and enstatite. The first mentioned occurs abundantly in veins and bedded masses; whilst magnetite, as already stated, is found disseminated through the serpentine, and forming veins in the asbestus; chromite is much less frequently met with, although the asbestus miners persist in calling all the iron found in their workings, chromic. Small particles of mica are found in the serpentine at various points. It is fairly abundant at Coleraine, and in Garthby township[1] it occurs in curious association with picrolite, plates of mica being arranged in columns which alternate with the picrolite columns.

Enstatite, conspicuous because of its bronze lustre, is found in the serpentine at the Calvin-Carter mine, Black Lake.

The Lower Helderberg Formation of St. Helen's Island.

By William Deeks, B.A.

The existence of Upper Silurian fossils on St. Helen's Island was first discovered in the autumn of 1856 by Sir William Dawson, on the occasion of a Geological excursion to the Island with his class, when *Atrypa reticularis,* a species of *Favosites,* and other fossils sufficient to establish the age of the limestone were obtained. These fossils were handed over to Sir William Logan and more extensive collections subsequently made by Mr. Billings. Reference was made to these in 1857, at the meeting of the American Association, when its members visited the Island. This was the first publication of the facts.

The structure of St. Helen's Island was described in the Geology of Canada (1863), and the following facts stated:— "The outlier appears to repose on the Utica formation, the shales of which, with some of their characteristic fossils, are

[1] Lots 5 and 6, Range I, south.

visible at the upper extremity of the Island. The deposit consists principally of a conglomerate, the enclosed masses of which are sometimes rounded, but chiefly angular. They consist of fragments of Laurentian gneiss; of white quartzose sandstone resembling that of the Potsdam formation; of dark grey limestone in some cases holding Trenton fossils; of black shale resembling that of the Utica formation; and of red sandstone and red shale similar to those of the Medina. With these fragments are associated others of igneous rocks. All of these, varying in size from a quarter of an inch to five and six inches, are enclosed in a paste of a light grey dolomite, which weathers to a reddish-yellow." . . . "About two-thirds of the distance down the east side of the Island, there occur two masses of dark-grey fossiliferous limestone, weathering to a light grey. . . . They have a breadth of scarcely more than ten feet, and appear to run under the dolomitic conglomerate. . . . The fossils observed in the limestone are *Favosites Gothlandica*, *Strophomena rhomboidalis*, *S. punctulifera*, *Orthis oblata*, an undetermined species of *Rhynchonella* with *R. Wilsoni*, *Athyris bella*, *Atrypa reticularis*, and two undetermined species of *Spirifera*."

Exposures indicating the same kind of agglomerate were discovered at Round Island, Isle Bizard, Rivière des Prairies, and near Ste. Anne, but no limestone.

In addition to the localities mentioned a small patch of similar agglomerate has been found on the McGill Grounds, immediately behind the Medical building, and probably many others may eventually be found on the Island of Montreal.

Sir William Dawson has in papers, and addresses to the Natural History Society of Montreal, stated reasons for regarding the agglomerate as a portion of the fragmental ejecta of the old Silurian volcano of Montreal, which continued active up to and beyond the time of the deposition of the Lower Helderberg limestone. Some of these trappean dykes are found cutting and altering the limestone. This conclusion is supported by the angular character of the greater part of the fragments in the agglomerate, by the irregularity of deposition and want of regular bedding, by the fact that nearly all the material of the agglomerate belongs to rocks known to include the locality, and by the character of the paste, which may be regarded as volcanic ash and debris cemented by dolomite. It is also to be observed that Helderberg fossils occur not only in the limestone, but also occasionally in the paste of the agglomerate itself.

In 1880 Mr. Donald, now Prof. Donald, who had collected at St. Helen's Island, and had access to the collection in McGill College, determined and published a list of these fossils, comprising sixteen genera and thirty-six species.[1]

Since that date annual Geological excursions have added a few more species, and better specimens of others personally known, to the McGill collection; and the object of the present paper is to summarize all the work that has been done in connection with this isolated patch of Silurian rock.

The following is a list of the fossils so far determined, also for comparison, those which are common to the New York, Gaspé and Nova Scotia fauna. These are denoted by asterisks:—

LOWER HELDERBERG LIMESTONE OF ST. HELEN'S ISLAND.	New York.	Gaspé and Bay des Chal'urs	Nova Scotia.
Crinoid stems	*	*	*
Stenopora	*	—	*
Chaetetes abruptus	*	—	—
Callopora incrassata	—	—	—
Favosites Helderbergiæ	*	*	—
Favosites Sp. ?	*	—	—
Zaphrentis corticata	*	—	—
Zaphrentis Roemeri	*	*	—
Zaphrentis Sp. ?	*	*	*
Heliolites	*	*	—

[1] Canadian Naturalist. Vol. IX., p. 302.

LOWER HELDERBERG LIMESTONE OF ST. HELEN'S ISLAND.	New York.	Gaspé and Bay des Chal'urs	Nova Scotia.
Fenestella (allied to) perangulata	*	—	—
Ptilodictya acuta	—	—	—
Atrypa reticularis	*	*	*
Chonetes Sp. ?	—	*	—
Zeptaena Sp. ?	—	—	—
Lingula perlata	*	—	—
Orthis deformis	*	—	—
Orthis discus	*	—	*
Orthis eminens	*	—	—
Orthis hipparionyx	—	—	—
Orthis oblata	*	—	—
Orthis tubulostriata	*	*	—
Pentamerus galeatus	*	—	*
Pentamerus pseudogaleatus	*	—	—
Pentamerus berneuilli	*	—	*
Rhynchonella æquivulois	*	—	—
Rhynchonella formosa	*	—	*
Rhynchonella mutabilis	*	—	—
Rhynchonella (allied to) mutabilis	—	—	*
Rhynchonella nucleolata	*	*	—
Rhynchonella vellicata	*	—	*
Rhynchonella ventricosa	*	—	—
Spirifer (allied to) Sp. arenosus	—	*	—
Spirifer concinnus	*	*	—
Spirifer cyclopterus	*	*	*
Stricklandinia Gaspensis	—	*	*?
Streptorhynchus radiata	*	—	*
Strophodonta profunda	—	—	*
Strophodonta punctulifera	*	—	*
Strophodonta varistriata	*	*	*
Strophomena rhomboidalis	*	*	*
Avicula Sp. ?	—	—	*
Platyostoma depressa	*	*	*
Tentaculitis Helena	—	—	—

Our present knowledge justifies us in drawing the following conclusions, which embody those stated by Prof. Donald:

1st. The fossils determined belong to 24 genera, comprising 44 species. Of these 33 are common to New York, 16 to Gaspé, and 19 to the Nova Scotia series.

2nd. *Atrypa reticularis*, *Pentamerus pseudo-galeatus*, *Rhynchonella formosa*, *Rhynchonella nucleolata*, *Spirifer concinnus*, *Spirifer cyclopterus*, *Strophodonta varistriata* and *Strophodonta punctulifera*, from their abundance, may be called the most characteristic fossils of the deposit.

3rd. They are closely related to the New York series, and are probably the continuation of the same beds. This is the more striking when we consider the small number that has been collected from St. Helen's Island, and yet many of these are typical New York species.

4th. From the large number of St. Helen's Island species common to the Gaspé and Bay des Chaleurs series, and also to the Nova Scotia series, it must be inferred that these are closely related also, and particularly since five of the characteristic species of St. Helen's Island are characteristic also of these formations.

5th. In Canada no sharp line of demarcation can be drawn between the Lower Helderberg and Oriskany formations, as a number of specimens of Spirifer allied to arenosus, and *Orthis hipparionyx* have been found in the limestone.

6th. The species called *Tentaculites Helena* is different from any published by Dr. Hall as occurring in the Lower Helderberg, and as it has occurred only in loose fragments may possibly be of foreign origin and of Hudson River age. "Tube strong, somewhat rapidly enlarging from apex; varies in length from $\frac{7}{16}$ to $\frac{7}{8}$ of an inch; annulated by sharp elevated rings, extending to the apex, eight to nine in the eighth of an inch. Spaces between the elevated rings from two to three times the width of the rings. These spaces are marked by numerous very fine vertical striæ."

It closely resembles *Tentaculites Sterlingensis* which is described in Worthen and Meeks' reports on the Hudson

River formation of Illinois, except that it is straight, the raised rings are more angular, and it is a little less slender in general form.

Thus we have the picture presented of the old Silurian sea, in which flourished a very rich fauna, depositing limestone over a broad belt south of the St. Lawrence, as far west as the Adirondack Mountains, and east over Gaspé and a part of Nova Scotia. Contemporaneous with this the volcano, of which Mount Royal is the remains, poured lava and fragmental debris into the waters, hardening the limestone, and affording sufficient protection to preserve this small outlying patch from the denuding agencies which afterwards swept away all similar limestone between it and the New York series on the South-west and the Gaspé series on the East.

This outlier of Helderberg limestone constitutes an interesting feature in the local geology of Montreal, being the only example of Silurian strata with characteristic fossils in a district so rich in fossiliferous strata of the older Cambro-Silurian, or Ordovician age.

Notes on a Bird new to the Province of Quebec.

By F. B. Caulfield.

I have much pleasure in recording the fact that this winter has brought to us a very interesting addition to our list of birds occurring within the Province of Quebec, viz., the Evening Grosbeak, *Cocothraustes vespertina*, Coop., one of the most beautiful of a group, many of whose members, unite in a marked degree, brilliancy of tint, with bold contrasts of color.

The Evening Grosbeak was first described by Wm. Cooper in the Annals of the Lyceum of Natural History of New York. Audubon states that a few were observed by Schoolcraft in April, near the Sault Ste. Marie in Michigan, from which it was traced to the Rocky Mountains.

Dr. Richardson, in the Fauna Boreali Americana, states that it is common in the maple groves of the Saskatchewan, where it is known as the "sugar bird." Townsend found it abundant in the pine groves of the Columbia River, and from specimens obtained by him, Audubon re-described the species and drew his beautiful plate, figures of the adult male and female and young male. Townsend found that they were of social habits, keeping together in large flocks; he also states that they are noisy during the day, from sunrise to sunset.

McIlwraith, in his Birds of Ontario, 1886, gives the following record of its occurrence in that Province:—The first report of their appearance in Ontario was made by Dr. T. J. Cottle, of Woodstock, who, in May, 1866, observed a flock among the evergreens near his residence, and obtained one or two of them. In 1871 they were noticed near London, and several were obtained; and on March, 1883, Mr. McIlwraith, when passing through a swamp in West Flamboro', observed two in a bush by the roadside and secured both. He further tells us that he has also heard of a female having been obtained at Toronto by the Rev. Mr. Doel on the 15th of December, 1854. He gives its habitat as Western North America, east to Lake Superior, and casually to Ohio and Ontario; from the fur countries south into Mexico. The species is not mentioned in any of our Quebec lists, and the honor of obtaining the first specimen falls to Mr. Dodd, gardener to J. H. R. Molson, Esq., who on or about the 1st of February of the current year, secured a male in this neighbourhood; and Dr. Harrington noticed several of the birds in the McGill College Grounds on the 28th of January last. On February 5th, four specimens were obtained by Dr. Brousseau at Laprairie, one of which was brought to me for identification; and Mr. E. B. Audette, of the same place, secured one alive. I am indebted to the kindness of Mr. E. D. Wintle for the following additional records of its occurrence during the present season:—

New Hampshire and Massachusetts, Wm. Brewster.,
New York, A. K. Fisher.
Oswego, N. Y., J. Alden Loring.
Lockport, N. Y., J. L. Davidson.

All obtained between December 14th and February. I have not yet seen any notice of its appearance in Ontario during the present winter, but doubtless it has been there also. At all events the foregoing records are sufficient to prove that we have not been visited by a few stragglers only, but that there has been a widespread migration, extending much farther to the east than any point at which it had been observed in former years. The specimen examined was in excellent condition, plump and fat, the stomach being filled with vegetable matter.

Charles Frederick Hartt.[1]

By G. F. Matthew.[2]

It is now nearly twelve years since, to the surprise and sorrow of his friends, news came from Brazil of the sudden and untimely death of Prof. Charles Frederick Hartt; cut off in the midst of his noble work of making known to the world the Natural History and resources of the great Empire of Brazil.

He died in middle age with all the enthusiasm of youth upon him, with his life work giving promise of a glorious future. When we think of what he might have accom-

[1] Read before the Natural History Society of New Brunswick, 5th Nov. 1889.

[2] In the preparation of this paper I have quoted freely and verbatim from a sketch of the life of Professor Hartt written by Mr. G. V. Hay, and from the very excellent sketch prepared by Mr. Richard Rathbun, one of Prof. Hartt's assistants in Brazil. The present sketch is fuller, for his early life and a few incidents that have transpired since his death have been added.

plished, had his life been spared, we cannot repress a feeling of regret at the loss which science has sustained in the death of this talented and devoted man.

Prof. Hartt was the eldest son of the late Jarvis William and Prudence (Brown) Hartt and was born at Fredericton, New Brunswick, August 23, 1840.

His father, Jarvis Hartt, on the completion of his education was appointed Principal of the Baptist Educational Seminary in Fredericton. He was noted for his earnest character and quiet devotion to educational work, and these qualities no doubt helped to mould the character of his son, and implant in him those habits of intense and continous application which he possessed. And to the fine temperament and high ideals of his mother we may believe that Prof. Hartt was largely indebted for the inspiration which carried him along in the study of Nature. Mrs. Hartt was educated at Cambridge, Mass., and came to Fredericton to take charge of one of the departments of the seminary where her future husband was teaching. Her intellectual training enabled her to appreciate her son's tastes, and in her he found a sympathetic and ready listener, when as school-boy and student he propounded to her his schemes for future study and work. Through her friends he found himself at home in later years in Cambridge, and frequently wrote to her of his plans and prospects.

Hartt's early education was carried on under the direct supervision of his father, who, for a long time was identified with the educational interests of Nova Scotia and New Brunswick. He studied at Horton Academy in Wolfville N.S. where his father was at the time professor, and afterward at Acadia College in the same town. In 1860 he graduated from the college with honor, receiving the degree of Bachelor of Arts, and later that of Master of Arts.

When still a boy, Hartt developed a strong taste for philology, and with the aid of transient people of the village near his home, would make vocabularies of Gaelic and Italian; and it was a day to be remembered by him when

Mr. Rand, the Micmac missionary, on his round visited Wolfville and taught him something of the Indian dialects.

Hartt's passion for Nature Science was not a late growth, for at the age of ten he showed a decided predeliction for Natural History and as he grew up took great delight in assisting Prof. Chipman of Acadia College in preparing and arranging his specimens. With the professor's aid and encouragement he made great progress in acquiring a knowledge of Mineralogy which, owing to the abundance of trap-minerals (zeolites &c.) in the vicinity, was a favourite study of the Professor of Acadia College and his pupils. Fortunately Hartt was not with Prof. Chipman when the latter made the trip by boat to the trap-cliffs of Blomidon, which cost him his life.

Hartt's versatility was shown in his talent for drawing, and for the acquisition of languages, and we are told that he became instructor in drawing in Acadia College when quite a youth. While at college he learned the elements of Portuguese from a shoemaker of the village, and this acquisition no doubt proved useful to him when he visited Brazil; he attained afterward such proficiency in this language that he lectured with great success to cultivated audiences in Rio Janeiro. His skill as a draftsman and his command of language always drew to his lectures interested hearers.

Already, while occupied with his college studies, he entered with zeal into the work of geological investigation. He explored the parts of Nova Scotia in the vicinity of the Annapolis Valley and the Basin of Minas, traversing the country on foot, and making large collections of specimens whenever the opportunity was afforded him. It was his intelligent eye and busy hands that selected in the Gaspereaux Valley the material which enabled Sir Wm. Dawson to establish the genus *Aneamites* on a remarkable fern of the Lower Carboniferous period, which, before that had been confounded with *Cyclopteris*. Many of the specimens of minerals and fossils which Hartt collected in those days, are to be found in the Museum of the Natural History Society at St. John, in the Peter Redpath Museum of McGill University in Montreal and at the Agassiz Museum in Cambridge. While engaged in his college studies, he also made a large collection of insects; and made meteorological observations for the Smithsonian Institution which have received much commendation.

While yet at Acadia College pursuing his studies, Hartt entered into correspondence with the author of this sketch, and before he graduated, we made a visit together to the mineral localities of Minas Basin and the adjacent shore of the Bay of Fundy, where the rich harvest of zeolites and showy varieties of quartz minerals, set free by the frost of winter, still attract numerous summer visitors. This visit was the beginning of a more intimate acquaintance, which was continued when Mr. Hartt moved to St. John.[1]

Later in this year (1860) Mr. Jarvis Hartt removed with his family to St. John for the purpose of establishing a Young Ladies High School, which he carried on successfully for many years. For some time his son aided him in conducting the school, but the son's love for his favourite studies was such, that every spare moment which could be snatched from the immediate duties of the school, was given to explorations in the neighborhood of the city, and the gathering of a rich harvest of fossils from the ballast of vessels, arriving from the west coast of Ireland, the Mediterranean and elsewhere.

When Mr. Hartt came to St. John, but little was known to the Scientific World of its geology. Some twenty years previously the late Dr. Abraham Gesner, then employed on the Geological Survey of New Brunswick, had traversed the neighborhood of the city of St. John, and had referred the rocks of that vicinity to the "Grauwacke Formation," with the reservation that certain portions near the city were "imperfect coal measures." He made the latter part of this statement in consequence of the discovery of a fossil tree in the sandstones East of the city. Dr. Jas. Robb of King's College, Fredericton, the successor of Dr. Gesner in the study of the geology of New Brunswick, pronounced the same rocks some years later to be Upper Silurian. It remained for Mr. Hartt and his *collaborateurs* to amass the materials which, in the hands of the sagacious Principal of McGill University, were to show that these plant-bearing sandstones contained a Devonian flora.

The writer had already found in these beds a sufficient number and variety of species to enable Sir Wm. Dawson to pronounce upon their Devonian age, but the rich harvest of fossils—exquisitely preserved ferns, asterophyllites, and psilophyta were not discovered until Mr. Hartt entered the field. To the collection and observation of these plants he gave the whole of his vacations during the years 1861, '62 and '63; and the result of this work has been of the most enduring value to science. Every bed of the unique section at the "Fern ledges" in Lancaster, West of St. John, was carefully studied, its fossils collected and its remains recorded. Such a work had not been done before in the Maritime provinces of Canada. The thoroughness of the work will be seen from the fact that while Hartt discovered scores of species in these beds, no new species of plants have been added to those which crowned his researches, and remains of only two insects beside those he found.

The discovery of insects of such great antiquity was perhaps the most striking result of these investigations. A few insects mostly related to the cockroaches had previously been found in the Coal Measures in several countries, but Hartt's discovery of insect wings in these older rocks threw a new light upon the history of insect life in the first geological ages. These insects were of five species, and were placed in the hands of Dr. S. H. Scudder of Boston for study. He referred them all to the Neuroptera; in part to new, in part, doubtfully, to old families, and suggested that some of the forms were synthetic types. But their important bearing on the history of insect-life was not then fully reached by that sagacious and experienced student of insects, for he has since referred them all to a great Palæozoic order, now quite extinct, the Palæodictyoptera of Goldenberg, from which he conceives that all the modern orders of insects have arisen.

Plant remains and insects, however, were not the only organisms discovered by Mr. Hartt in these interesting beds, for crustaceans also were found. These were of peculiar types and others found since in the same beds are not less remarkable.

Hartt's restless energy would not allow him to be content with field work alone, so in conjunction with several other young men of kindred tastes, in the city of St. John, he formed the "Steinhammer Club" an association devoted to the study of Geology. Subsequently at the suggestion of Sir Wm. Dawson of Montreal, this club was changed into a public society under the name of the Natural History Society of New Brunswick, whose meetings have been the means of sustaining an interest in the natural sciences in St. John, and in whose publications are recorded much that is of value relating to the Natural History of the Province of New Brunswick.—In this society Mr. Hartt took the warmest interest, attending its meetings, reading papers germain to its object, and devoting much material and time to the enlargement and arrangement of its museum.

Absorbed as he was in geological studies Mr. Hartt could not long remain content with his work in the High School. Accordingly he resolved to seek a larger field for study and work. Prof. Louis Agassiz had then recently come to America, and had already become widely known on this continent, as a successful teacher and instructor in Natural History. To his Zoological museum Mr. Hartt resolved to go in order to complete his studies. He sold his Devonian collections to the Natural History Society of New Brunswick, and proceeded to Cambridge to avail himself of the great stores of material for study in Agassiz Museum, and to obtain instruction from that talented and most attractive teacher of Natural History. Here, with such kindred spirits as Verrill, Morse, Putnam, Hyatt, Scudder and St. John, he devoted himself for several years to the investigation of Nature under the intelligent eye of Agassiz.

The writer of this sketch had meanwhile commenced the study of the older slates at Saint John, whose age hitherto had not been determined, but which were supposed to be a downward continuation of the measures which contained the Devonian plants. At first only some badly preserved trilobites were found, which, on account of their long thoraces were supposed to be of Lower Silurian age.[1]

Subsequently (1863) much better material of well preserved species of trilobites were found by the author in Portland (St. John) and these, with the collections of the Geological Survey of Southern New Brunswick, were placed in Mr. Hartt's hands for study. Taking advantage of the opportunities which he possessed at Cambridge, he gave these fossils a careful scrutiny, and was able to announce that they were equivalent in age to those of Etagé C. of M. Barrande and, therefore Primordial. After his first brief notice in the report of the Geological Survey of New Brunswick, announcing this discovery, Hartt continued his study of these organisms with the aid of additional material. Upon this material, together with what had been previously obtained, was based his fuller descriptions of the fossils, with many figures, which appeared in Dr. (now Sir Wm.) Dawson's Acadian Geology in 1868.

In 1864 Mr. Hartt and the author were invited by Professor L. W. Bailey, to take part with him in the Geological Survey of Southern New Brunswick instituted by the Provincial Government. The results of this survey were published in the following year, and were a very important addition to the knowledge of the geological structure of this part of New Brunswick. The results embodied in this report, formed the basis from which the Geological Survey of Canada in this region, after the confederation of the Canadian provinces, was carried on.

Beside his work on this survey in New Brunswick, Mr. Hartt did independent geological work in Nova Scotia. In 1864 he obtained proof of the pre-carboniferous age of the gold of Nova Scotia. His observations were made at Cor-

[1] At that time the Cambrian had not by common consent, been separated from the Lower Silurian.

bitt Mills, where the well-known auriferous slates are immediately overlaid, unconformably, by conglomerates, grits, and sandstones of Lower Carboniferous age. The lower portion of these rocks contains an abundance of gold, which was undoubtedly extracted from the underlying slates, while the former deposits were in process of formation, and was mixed with the loose gravelly material, which subsequently became consolidated into the conglomerate and sandstone.

We owe to Hartt also, the careful investigation of the relations of the different members of the carboniferous limestone deposits in the neighborhood of Windsor, Stewiacke, &c. in Nova Scotia. He collected and studied the fauna of each separate set of beds with much pains, and in this way was enabled to determine their sequence. The fossils which are marine, are very numerous, and some new species were described by him in the "Acadian Geology." Much interest attaches to the study of this formation at the above localities, where, in the upper beds, occur many forms common to both the Carboniferous and the Permian, and a great likeness is apparent to the upper members of the Carboniferous system in the western United States, called Permo-Carboniferous. Dr. Meek, who examined the fossils, suggested that we might have here what Barrande would call an upper Coal-Measure or even Permo-Carboniferous fauna, 'colonized' far back in the Sub-carboniferous period. Dr. (Sir Wm.) Dawson has enlarged on Hartt's results, and shows that the divisions made by him are of more general application than Hartt had known them to be.

As early as this, Hartt developed a constitutional tendency to asthma, which interfered with his field work in the cold and humid climate of this region, and which, after he entered on his professional work in the United States, prevented him from revisiting his native land. This, probably, was one of the causes which induced him to seek occupation in the warmer climate of Brazil.

Upon the organization of the Thayer Expedition to Brazil, by Prof. L. Agassiz, Mr. Hartt was appointed one of its two geologists, Mr. Orestes H. St. John being the other. This expedition left New York in April 1865 and returned in July 1866, having been absent a little more than a year. This was the strong and final inducement that called Hartt away from the geology of his own country. Although he was not fortunate in finding a very rich geological territory during his wanderings while connected with the Thayer Expedition, he saw enough to thoroughly interest him in returning again to Brazil, and in finally giving his whole attention to Brazilian studies.

The primary object of the Thayer Expedition was to investigate the distribution of the fresh water fishes of Brazil, but much time was also devoted to its geology. Prof. Agassiz limited himself mostly, in his geological work, to the examination of the superficial deposits at Rio de Janeiro and on the river Amazon, which were studied in connection with the question of glaciers. Hartt was retained near Rio for some time, in making examinations of the many Railroad cuttings around that city. After this work was completed, his field of exploration lay mostly between Rio and Bahia, where he carefully studied the geological and other features of the coast, and of the principal river basins leading to it. Large collections of the fresh water fishes of the rivers, and of the marine animals of the coasts and reefs were made. In consequence of the absence of fossils, no results in systematic geology were obtained, but, nevertheless, Hartt's studies of the geology of this monotonous tract were of great interest.

In the neighborhood of Porto Seguro he explored the coral and sandstone reefs, the latter of which is a prominent feature of the Brazilian coast. He was the first to carefully work out the structure and mode of formation of these sandstone reefs.

After Hartt had returned to the United States from the Thayer Expedition, he felt that he had left unfinished some of the more important investigations he had made in Brazil. He was unable to report as fully as he wished, on many subjects of interest which he had partly studied. So in 1867 he returned to Bahia, to perfect his former work and to continue his observations. He worked out the geology on the line of the Bahia railroad in detail, and collected some fossils from the Cretaceous terreins of that region. He also studied the structure of the Abrolhos islands and reefs which lie off the coast of Bahia. The islands are of stratified deposits, capped with trap, while the reefs, which had never been to any extent examined by a naturalist, are of coral, generally assuming curious tower-like forms, and often growing together to form a large connected expanse.

In addition to throwing new light on the formation of certain kinds of coral reefs, he also discovered a large number of species of corals of which the majority were new, but belonged to West Indian types. The absence of many prominent West Indian genera such as *Madrepora*, *Meandrina*, *Diploria* &c. was noted by him. The Cretaceous region of Sergipe was visited and yielded many fossils, which have been in part described by Prof. Alpheus Hyatt.

In the short interval which elapsed between his first and second trip to Brazil, he was engaged in scientific teaching and lecturing in and near New York city, at the Cooper Institute, Pelham Priory, Adelphi Academy and other places where he attained much success, and made many warm friends who aided him in his second Brazilian expedition. In 1868, soon after returning the second time, he was appointed Professor of Natural History in Vassar College; but he resigned this position in the autumn of the same year to accept the chair of Geology in Cornell University, where he was retained at the head of the department of Geology until the time of his death. In 1869 he was elected General Secretary of the American Association to serve at the meeting of 1870, but before that time he had departed on his third trip to Brazil.

It was in the year 1869 also, that he was married to Miss Lucy Lynde of Buffalo, N. Y., by whom he had two children, a son and a daughter. Both his widow and children are living. His son, now in his twenty-first year, is studying at Williams College, Mass., and his daughter at the

Buffalo Seminary, Buffalo, N. Y., of which her mother, for several years past, has been the principal.

While at Cornell University, when not occupied with college duties, he was engaged in working up the results of his Brazilian explorations, and in preparing his report as geologist of the Thayer Expedition. This report, however, grew to so great a size, and was so complete in itself, that it was found advisable to publish it separately in 1870 as "The Geology and Physical Geography of Brazil." It forms a large octavo volume of over six hundred pages, and contains in addition to an account of his own researches, a *résumé* of our previous knowledge of the natural history of the country. It is thus not limited to a discussion of the subject indicated by the title, but treats of the topographical and general features of the country, of its flora and fauna, both marine and terrestrial, and of its mining, agricultural, commercial and manufacturing interests. The numerous maps and sketches which illustrate it, were drawn by Professor Hartt himself, and the greater part of them represent regions never before depicted. The volume closes with a valuable appendix on the Botecudo Indians.

In the year 1870, the same in which his book was issued, Professor Hartt organized the largest of his own expeditions from the United States. It was composed, beside himself, of Professor Prentice and eleven students of Cornell University. His object in taking so many young men was to give them thorough practical training, and to stimulate them to undertake original work. He says in his report of this expedition, that he did not expect to make scientists of them all, but hoped that some of them might thus be induced to accept this calling. The means for defraying the expenses of the trip were contributed by several parties, the most prominent of whom was Mr. E. B. Morgan of Aurora, N. Y. whose name has been given to this and the subsequent expedition.

Prof. Hartt determined on this occasion, to change his field of research, and explore the Amazonas. Accordingly he went with his party direct to Pará, and in the neighborhood of this city, spent some time in training his inexperienced assistants. The tributary rivers Tocantins, Zingú and Tapajos, were then examined throughout their lower courses, and many valuable geological facts ascertained. On the Tapajos were discovered highly fossiliferous carboniferous deposits.

At the falls on each of the above named rivers were found series of metamorphic rocks, which, from their position and lithological characters, have been referred to the Silurian system. Passing to the North side of the valley of the Amazonas they minutely investigated the geology of the vicinity of Monte Alegre and the Sierra Ereré. On the plain of Ereré were discovered sandstones and shales, with characteristic Devonian fossils, corresponding more or less with those of the Hamilton and Corniferous groups of New York State. These were the first Devonian fossils found East of the Andes in South America.

One of the party examined the ancient Indian mounds of the island of Marajó at the mouth of the Amazonas, at that time only imperfectly known, and discovered large quantities of richly ornamented pottery, mostly in fragments These have since been made the subject of considerable study by Prof. Hartt and others. The sea coast was examined at several points, from Pará to Pernambuco, and in the neighborhood of the latter city, the fossiliferous Cretaceous formations of the province of the same name, were studied for the first time. At all the localities visited, they made large collections in geology and zoology, which were sent to the United States, and are now contained in the museum of Cornell University.

Prof. Hartt's researches on the Amazonas did not tend to bring proof of the former existence of glaciers there. The sierra of Ereré was found not to belong to the series of table-topped hills, as Professor Agassiz had been led to suppose, but to consist of inclined strata of very irregular outline. The Devonian fossils of the plain were from a portion of the supposed "drift" material of Agassiz.

Professor Hartt returned to Ithaca, N. Y., January 1872, where he remained two years and a half, giving all the time he could spare from his college duties to working up the results of his two Amazonian trips, with the aid of his two assistants, Orville A. Derby and Richard Rathbun. His reports were published as soon as finished, in the journals of several scientific societies. During this time he also gave popular lectures on Brazil in New York, Boston and Syracuse.

But Professor Hartt was unable to continue long in this state of comparative quietude. In bringing together the result of his several trips to South America, with the object of explaining the geology of all Brazil, he saw how meagre were his data for this purpose, notwithstanding all that he and others had recently done toward elucidating the structure of this vast region. He wished to extend his researches and conceived the idea of organizing a survey of the whole Brazilian Empire, which has an area scarcely less than that of the United States. There was only one way of accomplishing such an undertaking; it must be supported by the government. Hartt ventured to bring the matter before some of his Brazilian friends, and his ideas met with such favour that in 1874 he received an unofficial invitation from the Brazilian minister of Agriculture, to submit a proposition for the systematic geological exploration of the Empire. In August of the same year, he accordingly went to Rio de Janeiro for the purpose of formally presenting his plans. Upon arriving at that city he was received with almost as much enthusiasm as was Prof. Agassiz nearly ten years earlier. His thorough acquaintance with the language of the country enabled him to communicate freely with the people, and he soon found himself encircled with friends, who gladly gave their influence in advancing his plans.

A Geological Commission of the Empire of Brazil was organized on the 1st May 1875 with Prof. Hartt as chief, and the following assistants E. F. de Jordão, Engineer, O. A. Derby and Richard Rathbun, Assistant Geologists and F. G. de Freitas, "Particante." Mr. John Branner, now in charge of the geological survey of Arkansas, was soon added to the staff, and a few other additions and changes were made.

The active work of the Commission began in June 1875, and the coast region North of Rio to Cape San Roque was explored. Here extensive cretaceous deposits were found, with remains of sharks, crocodiles and other reptiles; and large collections of recent marine animals were made along the coast.

In the next year, the work in the maritime provinces North of Rio was continued and abundant remains of reptiles, fishes, and other animals were found. The diamond-bearing gravels near Bahia were also examined for the purpose of discovering the source of these gems. In the province of Sergipe was gathered a rich harvest of cretaceous fossils for the museum at Rio.

In this and the following year (1877) explorations were carried on in the provinces South of Rio, where Carboniferous and Devonian or Silurian deposits were discovered, rich in fossils, and the gold regions of this part of the empire and of Minas Geraes were examined by Mr. J. E. Mills.

While this work was in progress in the South, Mr. Derby was arriving at important results on the Amazonas, where he proved the existence of an immense basin of Palæozoic rocks with carboniferous deposits occupying an extensive area in the centre, surrounded by Devonian and Silurian beds rich in fossils. Owing to the dense vegetation of the lowlands of the valley of the Amazonas, they were unable to discover whether these Carboniferous rocks held deposits of coal or not. Immense collections of geological, zoological and ethnological specimens were sent to the capital by the various exploring parties, and it was found necessary to set apart a large house to contain them.

In June 1877, prompted by motives of economy, and unacquainted with the amount and value of the work being done by the Commission, the Government gave orders for the temporary suspension of the Commission on the 1st of July. The Emperor, soon after returning to Rio, fresh from the Museums of the Old World and North America, carefully inspected the building and work of the Commission. He showed a just appreciation of the value of the new Museum of Geology, both to his own country and to the world at large; he was generous in his words of praise to the talented chief, who had so dearly earned them, and declared that the work should go on.

In the beginning of the following year, an entire change was made in the Ministry of Brazil, and before the several departments had been entirely re-organized, and the appropriations determined upon, Professor Hartt died. There was no one to succeed him, and his large collections were placed in the care of the National Museum at Rio de Janeiro. It is expected that steps will be taken by the Brazilian Government at an early date, toward publishing the many reports which were finished under the direction of Prof. Hartt.

It would appear that before the researches of Professor Hartt, the systematic geology of vast areas of Brazil, was an utter blank. The Carboniferous system was known to exist in the South of Brazil, and some Palæozoic fossils had been found on the Tapajos R. in the North of the Empire; the Cretaceous formation had been recognized on the eastern coast, but it remained for Hartt to exhibit the general geologic structure of extensive areas of the Empire, and to recognize wide spread formations of Upper Silurian, Devonian, Carboniferous and Triassic (?) age. He also divided the vast areas of metamorphic rocks in Central Brazil into Eozoic and Lower Silurian by their lithological aspect and other characters.

Nor did he confine his studies to Geology alone, for in addition to voluminous reports on this subject, he had the following works nearly or quite ready for publication

I. Brazilian Antiquities,—about 500 pages, 4 to.

II. Mythology of the Brazilian Indians,—about 300 pages 4 to.

III. Grammar, Dictionary &c. of the Tupé Language, 400 pages.

IV. An Album—of about 100 photographs, illustrating the country, people &c. of the Lower Amazonas. With about 100 pages of text.

Prof. Hartt's scientific career may be said to have covered a decade and a half, and one can only wonder at the marvellous industry which crowded what might well be considered the work of an ordinary life-time into this short period. Only those engaged in his enterprises knew the variety and excellence of his scientific work, or could appreciate the skill with which he directed the operations first of his exploring parties in Brazil, and then of the Geological Survey of that vast region. Judging from his brilliant beginning, we may confidently assert that, had he not been cut off in his prime, he would have accomplished a work that would have placed him beside the greatest of the geological investigators of the present century.

None but the hardiest constitution could stand the great strain which Hartt laid on his physical powers, and under the exhausting heat of a tropical climate he finally succumbed. Having been on an exploring expedition inland, he came out upon the coast at Rio de Janeiro tired and worn out by physical toil and mental anxiety; the latter due to the difficulties in which the Survey had been placed by changes in the administration of the country. Here he was attacked by that formidable scourge of the lowlands of tropical America—yellow fever. His exhausted system could not withstand the disease. His illness was of scarcely more than two days duration, and he suddenly (and unexpectedly to those who were watching him) passed away in the early morning of Monday 18th of March 1878.

Prof. Hartt was a man of winning manners, affectionate disposition and generous nature, and was greatly esteemed by his scientific associates. He was gifted with an original and inventive mind, and indefatigable industry. The Christian training of his early home, and the stimulating influences of the educational institutions where he spent the first years of his life, no doubt served largely to form his character. His death terminated the Geological Survey of Brazil, as no one was thought worthy of taking the mantle which fell from him. His assistants remained to work up the material which he had gathered; but the leading mind which had inaugurated the Survey was gone, and further investigation of the physical structure of Brazil with governmental aid is left to the enterprise of another generation.

Since Professor Hartt's death, two volumes of the Archives of the National Museum of Brazil have been published, which testify to the extent of his labors. The first (No. VI.) contains an account of the Archæology and Ethnology of the tribes of the Amazonas, based on observations made by Prof. Hartt and his assistants on the shell-heaps, the cemeteries and the artificial mounds of that region, and contains descriptions and figures of the articles found in these repositories of the relics of its pre-historic people. It contains also an essay on the origin of art, and the evolution of ornamentation as exhibited by their pottery &c.; as well as an account of certain tribes of the region and their mythology.

In the remainder of the volume the result of Prof. Hartt's work stands out on many a page, especially in the very interesting memoir by Dr. Ladislaus Netto on the Archæology of Brazil. The material collected under Prof. Hartt's direction at the island of Marajó and at Maracá, are largely used by Dr. Netto in illustrating his memoir.

The succeeding volume of the Annals of the Museum (No. VII.) is devoted to a description of the Cretaceous Mollusca of Brazil by Dr. C. A. White of the geological survey of the United States. This voluminous memoir, published in Portuguese and English, is also based on the material collected under Prof. Hartt, when in charge of the geological survey of Brazil.

Several years after his death, the remains of this devoted man were removed from Brazil to Buffalo, N. Y., the home of his widow, where they now lie in a cemetry on the shore of Lake Erie.

Since his death, a tablet to his memory has been placed in the library of Acadia College (his "alma mater"). This tablet was set up by his classmates in commemoration of his great services to Science. On the unveiling of the monument, June 1884, one of their number, Dr. Silas Alward, paid a high tribute to the character and worth of their deceased companion in an oration before the faculty and friends of the college.

The following is a list of the scientific writings of Professor C. F. Hartt as far as known to me:—

1. The Gold of Nova Scotia of Pre-Carboniferous Age. Canadian Naturalist, 1, No. 6, 459–461, 1864.

2. Observations on the Geology of Southern New Brunswick, made principally during the Summer of 1864, by Prof. L. W. Bailey and Messrs. George F. Mathew and C. F. Hartt; prepared and arranged, with a Geological Map, by L. W. Bailey, A.M. Contains the three following reports by C. F. Hartt:—

(a) Preliminary Notice of a Fauna of the Primordial Period in the vicinity of St. John, N. B., pp. 30–31. (Published also in Can. Nat., VII, 318-320 1865; and in Dawson's "Acadian Geology," 2nd Ed., 1868, 641–643.)

(b) On the Devonian Plant Locality of the "Fern Ledges," Lancaster, New Brunswick, with a detailed Section, and Notes on the Fossils, 131–141. (Includes report of S. H. Scudder on the Devonian insects. An abstract was published in "Acadian Geology," 1868, 513-523.)

(c) List of New Brunswick Fossils, 143-147.

3. The recent Bird-Tracks of the Basin of Minas. American Naturalist, I, 169.176, 234.243, 1867.

4. On a Sub-division of the Acadian Carboniferous Limestones, with a desciption of a section across these Rocks at Windsor, N. S. Can. Nat., III, 212-224, 1867. (A summary of the results recorded in this paper are given in "Acadian Geology," 1868, 279–280.)

5. [Descriptions and Notices of the Trilobites and other fossils of the Acadian Group, at St. John, N. B.] "Acadian Geology," 1868, 643–657, with many figures. (Prepared by Dr. Dawson from the MS. notes of Prof. Hartt.)

6. Résumé of a Lecture on the "Growth of the South American Continent," delivered before the Library Association, Ithaca, N. Y., Dec. 4. 1868. Cornell Era, Dec. 12, 1868. (Pamphlet reprint contains 8 pages.)

7. A Vacation Trip to Brazil. Amer. Nat., I, 642–651, 1868.

8. A Naturalist in Brazil. Amer. Nat., II, 1–13, with illustrations, 1868.

9. The cruise of the "Abrolhos." Amer. Nat., II, 85–73, with illustrations, 1868.

10. On the Botocudos of Brazil, (abstract). Proceed. Amer. Ass. Adv. Sci., 18th meeting, Salem, 1869, 273–274.

11. Thayer Expedition.—Scientific Results of a Journey in Brazil, by Louis Agassiz and his Travelling Companions.—Geology and Physical Geography of Brazil, by Charles Fred. Hartt, with illustrations and maps, 8°, pp. 620. Boston, Fields, Osgood & Co., 1870.

12. Discovery of Lower Carboniferous Fossils on the Rio Tapajos, (A letter written near Monte Alegre, Rio Amazonas, Oct. 5, 1870.) Amer. Nat. IV, 694–695, 1871.

13. Devonian Rocks in the Amazonian Valley. Amer. Nat., V. 121–122, 1871.

14. Amazonian Drift. Amer. Jour. Sci. and Arts, I, April 1871, 294–296.

15. Braz. Rock Inscriptions. Amer. Nat., V, 139–147, with 9 plates, 1871.

16. The Ancient Indian Pottery of Marajó, Brazil. Amer. Nat. V, 259–271, with numerous figures, 1871.

17. Recent Explorations in the Valley of the Amazonas, with Map. Jour. Amer. Geogr. Soc., N. Y., III, 1872, 231–252, (read May 16, 1871).

18. [The Origin of the Basin of the Amazonas (abstract).] Proc. Boston Soc. Nat. Hist., XV, 153–154, 1872.

19. On the Tertiary Basin of the Marañon. Amer. Jour. Sci. and Arts, IV, July, 1872, 53–58.

20. On the Occurrence of Face-Urns in Brazil. Amer. Nat. VI, 607–610, with one large figure, 1872.

21. Notes on the Lingoa Geral or Modern Tupí of the Amazonas. Trans. Amer. Philog. Ass., 1872, pp. 20.

22. O Mytho do Curupira. Aurora Brazileira, Ithaca, N. Y., Oct. and Nov. 1873. (Also separate reprint, pp. 12.)

23. Morgan Expeditions 1870–71.—Contributions to the Geology and Physical Geography of the Lower Amazonas. The Ereré-Monte-Alegre District and the Table-Topped Hills. Bull. Buffalo Soc. Nat. Sci., I, No. 4, 201–235, with maps and sketches. 1874.

24. Preliminary Reports of the Morgan Expeditions, 1870–71.—Report of a Reconnoissance of the Lower Tapajos. Bull. Cornell University Society (Science), No. 1, pp. 37, with map, 1874.

25. Evolution in Ornament. Popular Science Monthly, January, 1875, 266–275, with many figures.

26. Morgan Expeditions, 1870–71.—On the Devonian Trilobites and Molusks of Ereré, Province of Pará, Brazil; by Ch. Fr'd. Hartt, and Richard Rathbun. Ann. Lyc. Nat. Hist., N. Y., XI, 110–127, May, 1875.

27. The Indian Cemetery of the Gruta das Mumias, Southern Minas Geraes, Brazil. Amer. Nat., IX, 205–217 (illustrated), 1875.

28. Amazonian Tortoise Myths. Rio de Janeiro, Wm. Scully. Publisher. 1875, pp. 40.

29. Notes on the Manufacture of Pottery among Savage Races. Published at the office of the "South American Mail," Rio de Janeiro, 1875, pp. 70.

30. Exploraçoes Scientificas,—I. Commissão Geologica do Brazil. Catalogo da Exposição de Obras Publicas do Ministerio da Agricultura, Rio de Janeiro, 1876, 96–106.

31. Nota sobre Algumas Tangas de Barro Cosido dos Antigos Indigenas da Ilha de Marajó. Archivos do Museu Nacional do Rio de Janeiro, I. Trimestre I°, 21–25, Estampas III, IV & V, 1876.

32. Descripçao dos Objectos de Pedra de Origem Indigena Conservados no Museu Nacional. Arch. do Mus. Nac. do Rio de Janeiro, I, Trim. 2° & 3°, 45–53, Estampas VII & VIII, & 2 figuras, 1876.

33. The Geological Survey of Brazil. First Preliminary Report made to the Counselor Thomaz José Coelho de Almeida, Minister and Secretary of State for Agriculture, etc.; by Ch. Fred. Hartt. Chief of the Geological Commission of the Empire of Brazil, Rio de Janeiro, 1876. Translated and abridged by Prof. T. B. Comstock. Amer. Jour. Sc. and Arts, XI, June, 1877, 466–473.

(Posthumous).

34. Contribuições para a ethnologia do valle do Amazonas, par C. F. Hartt. In Archivos do Museu Nacional do Rio de Janeiro, Vol. VI, 1885.

Book Notices.

Fern Flora.[1]—*This little book, issued as an appendix to the* School Fern-Flora of Canada, is a useful contribution to Canadian Botany. The first seven pages are devoted to the structural characters of ferns, and taxonomic considerations. The remainder is occupied by a description of the various genera and species, together with an account of their geographical range, and special localities for the rarer species. The descriptions are clear and direct. The principal genera are illustrated by a plate of well-executed figures. The book is of a convenient size to be used in the field, but its usefulness for the ordinary student would be enhanced, had an analytical key been provided.—*D. P. P.*

[1] The Fern Flora of Canada: descriptions of all the native ferns of the Dominion, with the localities where they grow. By George Lawson, Ph. D., &c. Halifax, A. & N. MacKinlay, 1889, (pp. 29.)

PROCEEDINGS OF THE SOCIETY.

The regular monthly meeting was held on Monday evening, January 27th, Sir Wm. Dawson presiding.

The minutes of the previous meeting having been read and confirmed, Dr. Harrington reported that the Lecture Committee had arranged for the usual Sommerville course of seven lectures upon Food Supply and Food Adulterations.

The Curator reported the following donations:—

Chinese New Testament, Mr. C. Griffen.

Quartz Crystals from Mount Stephen, Mr. A. B. Chaffee, jr.

Olive-sided Fly Catcher and Black Crowned Night Heron, Mr. F. B. Caulfield.

Various papers relating to the Society, Mr. J. Ostell.

A New York newspaper under date of 1800, giving an account of the death of General Washington; also a portion of log, supposed to be Norway spruce, from an excavation on Commissioners street, on or near the site of Maisonneuve's fort, and supposed to have formed part of the same, Mr. F. W. Henshaw.

Some discussion followed respecting the last donation and its relation to the fort, and Messrs. J. A. U. Beaudry, J. S. Brown, Prof. Penhallow and J. McLachlan were appointed a committee to collect all available evidence bearing upon the character of the specimen, and present the same at a future meeting of the Society.

The balloting for new members resulted in the election of Messrs. E. P. Hannaford, G. H. McHenry, Thos. E. Hodgson, Edwd. H. Hamilton and M. H. Hersey.

The Curator drew the attention of the Society to the need of putting the Museum in a more attractive shape, and suggested that a sub-division into departments, each under an assistant curator, would greatly promote the usefulness of the collections.

The following papers were then presented and ordered to be printed in the RECORD OF SCIENCE:—

"Fossil fish from the Pleistocene of Green's Creek, Ottawa," Sir Wm. Dawson.

"Mineralogical notes on some Canadian Minerals from new Localities," Dr. B. J. Harrington.

"Notes on the flora of Cap à L'Aigle, Quebec," Rev. Dr. Campbell.

After the usual vote of thanks to the authors of papers, the meeting adjourned.

The regular monthly meeting was held on Monday, February 24th, Sir Wm. Dawson in the chair.

The Curator suggested the adoption of a by-law providing for the acceptance of specimens and the disposal of duplicate material. He also announced the following donations:—

Head of Maskinonge, Mr. C. E. Dawson.
Blue Heron, Hon. Edward Murphy.
Evening Grosbeak, Mr. F. B. Caulfield.

The thanks of the Society were tendered to the donors.

The following papers were read and accepted for publication in the RECORD OF SCIENCE:—

"Helderberg Fossils from St. Helen's Island," by W. E. Deeks, B.A.

"Notes on Asbestus and Some Associated Minerals," by Prof. J. P. Donald.

"Notes on a Bird New to the Province of Quebec," Mr. F. B. Caulfield.

After the usual discussions, the thanks of the Society were tendered to the authors for their valuable contributions.

Sir Wm. Dawson introduced Mr. J. Stevenson, who presented some statements bearing upon the past and present distribution of eider ducks in the Gulf of St. Lawrence. He showed that under the present system of egg gathering, the birds had greatly diminished in numbers of late years, and there was great danger of ultimate extermination. He urged the desirability of having the Government take some steps looking to the protection of the birds, and to the encouragement of the settlers along the shores of the Gulf, to engage in the industry of gathering their feathers. He made an earnest plea for the better protection of the birds against wanton destruction, and asked if the Society felt disposed to use its influence in the matter. After some discussion the following committee was appointed to take the matter into consideration and co-operate with Mr. Stevenson:—Messrs. J. A. U. Beaudry, J. S. Brown, Dr. Wesley Mills, F. B. Caulfield, J. S. Shearer and Alex. Henderson.

The ballot for new members resulted in the election of Messrs. A. P. Winn and W. A. Scott.

ABSTRACT FOR THE MONTH OF JANUARY, 1890.

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	31.70	38.7	16.3	22.4	30.4448	30.679	30.209	.470	.1563	84.8	27.8	S.	21.8	8.3	10	0	00	0.28	....	0.28	1
2	42.82	52.3	36.4	15.9	30.0345	30.207	29.893	.314	.2477	88.5	39.7	S.W.	32.3	6.8	10	0	00	0.17	....	0.17	2
3	22.42	37.0	14.5	22.5	30.5820	30.695	30.394	.301	.0792	63.2	12.3	N. W.	20.0	0.3	6	0	93	....	.. .	....	3
4	14.48	18.8	8.9	9.9	30.5453	30.679	30.343	.336	.0617	71.3	6.8	W.	10.5	8.3	10	0	00	....	0.2	0.02	4
SUNDAY........ 5	....	22.0	17.6	4.4	....	....	......	....	.....	....	....	N.E.	13.1	....	..	..	00	....	6.6	0.77	5 ....SUNDAY
6	26.22	35.0	19.6	15.4	29.6543	29.828	29.446	.382	.1303	91.3	24.0	E.	9.9	9.8	10	9	00	0.41	Inapp.	0.41	6
7	12.98	29.0	8.0	21.0	30.0228	30.091	29.931	.160	.0608	78.0	7.3	W.	12.4	3.5	10	0	87	....	Inapp.	0.00	7
8	20.90	29.2	13.9	15.3	29.5015	29.833	29.226	.607	.1023	89.0	18.2	S.W.	17.0	8.5	10	1	00	....	2.3	0.11	8
9	—7.57	14.6	—13.3	27.9	29.9925	30.138	29.804	.334	.0237	78.2	—12.8	W.	22.3	2.3	10	0	95	....	....	....	9
10	—15.73	—11.0	—21.6	10.6	30.2417	30.411	30.161	.250	.0205	96.7	—16.0	N.E.	26.3	5.3	10	0	12	....	Inapp.	0.00	10
11	—5.03	7.0	—14.5	21.5	30.2015	30.469	29.922	.547	.0345	96.5	—5.7	N.	24.3	8.3	10	0	00	....	6.4	0.82	11
SUNDAY........ 12	. ...	10.5	6.5	4.0	....	......	....	....	.....	....	....	N.E.	14.5	....	..	..	00	....	0.2	0.02	12 ....SUNDAY
13	30.77	50.8	9.0	41.8	29.5617	30.127	29.201	.926	.1413	74.7	23.3	S.W.	40.5	5.5	10	0	11	0.55	....	0.55	13
14	13.98	19.6	7.0	12.6	30.5822	30.678	30.372	.306	.0538	65.3	4.5	S.W.?	19.4	2.8	10	0	100	....	....	....	14
15	20.70	22.5	18.2	4.3	30.1458	30.438	29.908	.530	.1037	93.2	19.0	**N.**	6.1	10.0	10	10	00	0.04	2.5	0.25	15
16	16.15	24.9	—1.5	26.4	29.9030	30.286	29.699	.587	.0907	88.8	13.3	**N.W.**	20.5	7.8	10	0	00	....	6.7	0.39	16
17	—1.12	8.1	—11.5	19.6	30.5000	30.553	30.435	.118	.0328	76.7	—6.8	**W.**	17.6	5.0	10	0	81	....	0.3	0.01	17
18	4.13	8.9	—1.1	10.0	30.4675	30.490	30.439	.051	.0442	85.0	0.5	**N.**	**6.5**	6.3	10	0	64	....	0.3	0.02	18
SUNDAY........ 19	......	14.1	—4.9	19.0	...	......	......	....	.....	....	....	**N.**	**11.8**	....	..	..	00	....	....	....	19 ....SUNDAY
20	25.30	38.0	13.8	24.2	29.6297	30.010	29.356	.654	.1150	84.8	21.2	**N.**	**33.6**	9.8	10	9	00	0.18	1.0	0.28	20
21	15.23	24.3	9.4	14.9	29.8850	29.962	29.750	.212	.0670	76.8	9.3	**W.**	25.9	5.3	10	0	97	....	2.0	0.07	21
22	5.80	16.0	1.0	15.0	30.3747	30.628	29.954	.674	.0365	64.8	—4.2	**N.W.**	24.9	1.3	9	0	87	....	Inapp.	0.00	22
23	2.30	6.8	—2.0	8.8	30.3090	30.620	30.012	.608	.0380	79.5	—3.0	**N.W.**	11.3	8.3	10	0	00	....	1.5	0.09	23
24	7.30	11.1	1.0	10.1	30.2268	30.324	30.069	.255	.0457	75.5	1.0	W.	16.4	1.7	10	0	91	....	Inapp.	0.00	24
25	22.87	33.0	5.0	28.0	29.7867	30.165	29.605	.560	.1060	81.7	18.0	S.	23.9	8.3	10	0	00	....	1.0	0.10	25
SUNDAY........ 26	.....	33.0	23.8	9.2	....	......	......	....	.....	....	....	S.W.	15.9	....	..	..	84	....	....	....	26 ....SUNDAY
27	14.22	24.0	8.7	15.3	30.1415	30.411	29.904	.507	.0582	69.0	6.0	N.E.	17.6	6.8	10	0	54	....	0.1	0.01	27
28	3.65	11.9	—4.4	16.3	30.5852	30.717	30.389	.328	.0348	66.2	—5.5	S.W.	17.4	6.7	10	0	43	....	0.1	0.01	28
29	31.30	38.0	11.5	26.5	30.0913	30.215	29.956	.259	.1272	73.0	23.5	S.W.	27.0	9.8	10	6	42	....	....	....	29
30	13.43	29.9	9.9	20.0	30.3357	30.388	30.257	.131	.0602	74.8	6.8	N.E.	21.8	10.0	10	10	00	....	....	....	30
31	32.02	38.5	13.9	24.6	30.0303	30.286	29.885	.401	.1523	81.0	26.8	S.E.	24.8	7.5	10	0	07	0.01	0.1	0.02	31
....Means	14.86	23.76	6.42	17.34	30.1399	......	......	.400	.0824	79.6	9.5	....	....	6.46	..	..	33.8	1.64	31.3	4.40	Sums ....
16 yrs. means for & including this mo.	11.79	20.42	3.53	16.88	30.0659	......	......	.343	.0724	80.7	....	....	....	6.35	..	..	¶33.5	0.84	30.3	3.68	16 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...........	2473	1698	288	313	1757	2679	3144	2205	—
Duration in hrs..	170	89	26	13	78	119	149	93	1
Mean velocity...	14.5	19.1	11.1	24.1	22.5	22.5	21.1	23.7	

Greatest mileage in one hour was 67 on the 13th.
Greatest velocity in gusts 104 miles per hour on the 13th.
Resultant mileage, 5,070.
Resultant direction, N. 75° W.

Total mileage, 14,557.

NOTE.—The wind directions and velocities in heavy faced type are from the City Hall record. The mileage has been multiplied by 1.5 to reduce it to the Mountain Anemometer.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 52.3 on the 2nd; the greatest cold was 21.6 below zero on the 10th, giving a range of temperature of 73.9 degrees. Warmest day was the 2nd. Coldest day was the 10th. Highest barometer reading was 30.717 on the 28th; lowest barometer was 29.201 on the 13th, giving a range of 1.516 inches. Maximum relative humidity was 100 on 7 days. Minimum relative humidity was 44 on the 28th.

Rain fell on 7 days.
Snow fell on 21 days.
Rain or snow fell on 24 days.
Rain and snow fell on 4 days.
Hoar frost on 2 days.
Lunar halo on one night.
Fog on 3 days.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1890.

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	15.93	36.2	7 6	28.6	20.4885	30.676	30.087	.589	.0598	60.2	4.2	S.W.	21.9	0 7	2	0	96	....	....	....	1
SUNDAY........ 2	...	32 0	—6.0	38.0	.....	...	......	....	..	....	....	S.E.	17.0	....	..	..	46	....	....	....	2 ....SUNDAY
3	33.98	39.0	23 0	16.0	29.9530	30.220	29.831	.389	.1785	88.3	31.0	S.W.	28.3	8.3	10	0	00	0 12	...	0.12	3
4	16.43	34 5	8.8	25.7	29.9848	30.345	29.315	1.030	.0775	75 3	10.0	N.E.	14.8	6.7	10	0	33	0.28	0.3	0.31	4
5	27.95	45.0	10 0	35.0	29.5477	30.081	29.092	.989	.1377	75.5	21 3	W.	36.8	4.8	10	0	53	0.21	....	0.21	5
6	5.03	11.0	0 0	11.0	30.3887	30.567	30.205	.362	.0358	66.3	—4 3	W.	10.7	0.0	0	0	100	....	...	....	6
7	10.62	19.8	1.5	18.3	30.5090	30 683	30.142	.541	.0572	78.2	4.8	E.	9.1	6.7	10	0	57	....	1.7	0.09	7
8	25.23	30.0	18.7	11.3	29 7170	29.854	29.599	.255	.1237	90.5	23.0	S.	16.3	9.8	10	3	00	....	9.5	0.50	8
SUNDAY. 9	....	24.5	0 0	24.5	....	......	......	....	....	....	....	W.	13.0	....	..	..	99	....	....	....	9 ....SUNDAY
10	—2.03	2.3	—7.0	9.3	30.6583	30.702	30.603	.099	.0305	78.2	—7.5	N.E.	10.5	1.8	10	0	91	....	....	....	10
11	3.18	10.4	—6 4	16.8	30.4357	30.614	30.136	.478	.0412	82.0	—1.7	E.	5.3	4.7	10	0	80	....	....	...	11
12	24.57	30.1	6.9	23.2	29.8862	30.011	29 747	.264	.1113	81.2	19.5	S.W.	27.6	7.0	10	c	51	....	2.0	0.10	12
13	32.80	36.9	25 8	11.1	29.9638	30.045	29.896	.149	.1247	67.7	23.2	S.W.	27.8	6.8	10	0	50	...	....	....	13
14	34.75	39.9	26.8	13.1	29 6350	29.883	29.207	.676	.1695	82.3	29.5	S.	14.7	8.3	10	0	00	1.08	....	1.08	14
15	19.55	39 2	5.5	33.7	29.8002	30.180	29.277	.903	.0873	68.7	11.2	W.	35.6	2.8	10	0	76	0.20	....	0.20	15
SUNDAY.. 16	.....	13.2	—2.0	15.2	......	......	......	....	.. .	....	....	S.W.	19.9	....	..	..	71	....	1.6	0.05	16 ....SUNDAY
17	6.82	14.2	2.7	11.5	30.2070	30.332	30.051	.281	.0452	76.2	0.7	N.E.	19.4	7.0	10	0	41	....	1.0	0.10	17
18	8.92	11.0	7.0	4.0	29.8520	29.932	29.750	.182	.0587	91.0	6.7	N.E.	29.8	10.0	10	10	00	....	4.3	0.42	18
19	10.02	12.8	7.0	5.8	30.1517	30.284	29.922	.362	.0520	76.3	3.8	N. W.	7.3	3.7	10	0	90	....	0.3	0.02	19
20	13.13	26.7	—0.5	27.2	29 5957	29.835	29.299	.536	.0733	85.8	9.7	W.	27.8	8.0	10	0	00	....	5.3	0.23	20
21	—3.12	3 0	—9.1	12.1	29.9742	30.017	29 913	.104	.0272	73.0	—10.2	W.	33.1	3.5	10	0	61	....	....	....	21
22	0.80	6.8	—8.0	14.8	30.0602	30.123	39.976	.146	.0300	66.8	—8.5	S.W.	21.7	1.7	10	0	100	....	Inapp.	0.00	22
SUNDAY........23	.....	27.6	3.0	24.6	....	......	....	....	.....	...	....	S.	11.5	....	..	..	47	....	1.0	0.03	23 ....SUNDAY
24	33.15	40.2	13.9	26.3	29 8807	29.944	29.799	.145	.1655	86.3	29.5	S.	12.4	10.0	10	10	14	Inapp.	0.4	0.03	24
25	34.52	38.0	33.2	4.8	29.9060	29.985	29.793	.192	.1960	98.0	33.8	E.	10.4	10 0	10	10	00	0.11	....	0.11	25
26	34.93	37.0	32.7	4.3	29.8643	30.139	29.715	.424	.1968	96.8	34.0	S.W.	7.5	10.0	10	10	00	0.06	....	0.06	26
27	33.48	35.0	31.3	3.7	30.1620	30.226	30.096	.130	.1798	93.8	32.2	E.	8.3	10 0	10	10	00	0 01	....	0.01	27
28	37.20	39.0	34.2	4.8	29.8195	30.044	29.672	.372	.2005	90.3	34.5	S.E.	23.1	10.0	10	10	00	0.78	....	0 78	28
...........Means.	19.08	26.26	9 31	16.95	30.0184	......	......	.400	.1025	80.4	13.8	....	....	6.35	..	..	44.9	2.85	27.4	4.45	Sums ....
16 yrs. means for & including this mo.	15.48	23.95	6.79	17.16	30.0414	......	......	.323	.0821	78.6	....	....	....	5.84	..	..	¶41.7	0.90	22.6	3.07	16 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...........	453	1492	823	1192	2322	3217	3734	288	—
Duration in hrs..	22	92	69	74	78	146	144	20	27
Mean velocity ...	20.6	16.2	11.9	16.1	17.0	22.0	25.9	14.4	

Greatest mileage in one hour was 60 on the 5th.
Greatest velocity in gusts 72 miles per hour for 12 miles on the 5th.
Resultant mileage, 4,435

Resultant direction, S. 52° W.
Total mileage, 12,521.
Average mileage per hour 18.63.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 45 0 on the 5th; the greatest cold was 9.1 below zero on the 21st, giving a range of temperature of 54.1 degrees. Warmest day was the 28th. Coldest day was the 21st. Highest barometer reading was 30.702 on the 10th; lowest barometer was 29.092 on the 5th, giving a range of 1.610 inches. Maximum relative humidity was 100 on 5 days. Minimum relative humidity was 42 on the 1st.

Rain fell on 10 days.

Snow fell on 12 days.

Rain or snow fell on 20 days.

Rain and snow fell on 2 days.

Hoar frost on 2 days.

Fogs on 7 days.

Parhelic arcs on the 11th.

The rainfall of this month (2.85 inches) is the greatest for February in 16 years, the next highest being 2.18 in 1881.

ABSTRACT FOR THE MONTH OF MARCH, 1890.

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.	Percent of possible sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	25.05	40.8	7.0	33.8	29.8788	30.089	29.751	.338	1100	73.0	17.8	S.W.	31.5	5.5	10	0	23	...	...	...	1
SUNDAY........ 2	.....	14 1	2.0	12.1	. .		. ....	....	. .	....	....	N. W.	8.5	....	.	.	97	...	....	...	2 ....SUNDAY
3	12.22	20.0	4 0	16.0	30.0885	30.137	30 013	.124	.0412	54.3	—1.2	S.W.	19.5	2.0	8	0	95	...	....	....	3
4	23.93	31.8	10.9	20 9	30 0280	30.159	29 854	.305	.0795	61.3	12.5	S.E.	14.2	6 8	10	0	64	...	.	...	4
5	16.05	31.2	8 7	22.5	30.1093	30 243	29.918	.325	.0643	68.3	7 2	S.W.	20.0	4.7	10	0	84		Inapp.	0 00	5
6	2.78	9.9	—1.0	10.9	30.3550	30.410	30.299	.111	.0272	55.0	—10.2	W.	9.0	6.0	10	0	18	..		....	6
7	6.60	16.0	—4.0	20.0	30.3387	30 412	30 280	.132	.0368	59.5	— 4.5	S.W.	22.0	0.0	0	0	99	....	....	....	7
8	17.98	26.9	7.8	19 1	30 3498	30.432	30 307	.125	.0658	65.3	8.7	W.	19.4	0.2	1	0	98	....	....	...	8
SUNDAY. 9	. .	28.0	12 9	15.1	..... .	.....	......		. .	....	....	S.W.	11.5	...	.	.	100	....	....	....	9 ..... SUNDAY
10	28.12	37.0	14.1	22.9	30 3288	30.424	30.246	.178	.0990	63.8	17.7	S.W.	5.9	3 2	10	0	85			...	10
11	35.67	40.6	29 0	11.6	30.1168	30.271	29.952	319	.1672	79.3	29.8	S.E.	12.4	10.0	10	10	00	0 07		0 07	11
12	40.12	43.0	36 7	6.3	29.9875	30.045	29 952	.093	.2437	97.8	39.3	S.W.	10.0	10.0	10	10	00	0 20	....	0.20	12
13	36.90	41.0	35 5	5.5	30.1450	30.200	30 078	.122	.2083	94.7	35.3	S.W	12.4	10.0	10	10	00	0.03		0 03	13
14	35.48	40.2	32.7	7.5	30 0762	30.191	29.931	.260	.1840	89 2	32 7	S.	9.0	9 7	10	2	23			...	14
15	30.92	34 9	27.8	7.1	29.8168	29 913	29.680	233	.1098	62.3	19.5	S. W	11.8	8.0	10	0	17	....	Inapp.	0.00	15
SUNDAY.... ...16	....	28.0	15.9	12.1	. .....	.....	......		. .	....		S.W.	24.9	...		..	40		Inapp.	0.00	16 ....SUNDAY
17	23.33	32.4	10.9	21.5	29.4110	29 519	29.329	.190	.0860	66.0	13.8	S.W.	32.7	4.8	10	0	51	....	. . .	....	17
18	25 90	30 7	19.7	11.0	29 6112	29.831	29.434	.397	.0895	62 7	15.0	W.	19.8	2.2	10	0	83	....	0 1	0 00	18
19	19.48	25.0	12.9	12.1	29.8317	29.899	29 777	122	.0643	60.8	8.2	N.E.	7.9	5 0	10	0	57			....	19
20	31.65	39.1	18.8	20.3	29 8253	29.884	29.759	.125	.1310	73.5	23.8	S.W.	16.9	6.5	10	0	52	..	Inapp.	0.00	20
21	37.62	42.9	32.5	10.4	29.5202	29.683	29 359	.324	.1905	84.3	33.2	S.	22.7	8.3	10	0	03	0.17	0.2	0.21	21
22	35.98	40.4	33.6	6.8	28.7815	29.841	29.729	.112	.1518	72.2	27.7	S.W.	11.8	8 3	10	0	00	....	....	....	22
SUNDAY...... 23	....	34 7	19.5	15.2	....	.....	.....	....	.....	....	....	N.W.	18.9	...	..	..	51	...	...	....	23 .... SUNDAY
24	23.32	28.9	16.9	12.0	30 4257	30.505	30.288	.217	.0762	60.7	12.3	W.	18.3	1.8	9	0	85		...		24
25	30.32	36.2	21.8	14.4	30.1835	30.496	29.843	.653	.1252	73.2	22.7	S.E.	16.3	10 0	10	10	00	. .	0.7	0.07	25
26	36.15	41.1	33.5	7.6	29.5733	29.711	29 509	.202	.1830	85.8	32.2	S.W.	23.7	10.0	10	4	31	0 01	0 4	0.06	26
27	33.13	37.9	27.6	10.3	29.7692	29.971	29.553	.418	.1307	69.3	23.8	S.W.	28.6	6 8	10	0	62	......	Inapp.	0.00	27
28	24.65	28.8	21.9	6 9	29 7177	29.975	29.482	.493	.1093	82.3	20.0	N.E.	25.2	8.3	10	0	00	....	4.5	0 45	28
29	29.17	33.0	25.8	7.2	29.6178	29.775	29.475	.300	.1445	89.7	26.7	N.	23.5	10 0	10	10	00	...	4.0	0.33	29
SUNDAY........30	.....	33.0	25.8	7.2	....	......	......	. .	....	....	....	N.	7.3		..	..	29	....	1.8	0 11	30 ....SUNDAY
31	26.87	33.9	16 4	17.5	30.2370	30.301	30 194	.107	.0930	65.0	16.3	S.W.	9.5	5.3	10	0	75	....	...	....	31
....Means	26.51	32.30	18.63	13.67	29.9663	......	..	.243	.1158	71.9	18 5	.... .	16.94	6.28	.		45.9	0.48	11 7	1 53	Sums ....
16 yrs. means for & including this mo.	23.87	31.14	16.17	14.97	29.9578	......	......	.265	.1068	75.6	.	....	....	6 17	.	..	¶45.5	0 86	25 6	3 41	16 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............	854	913	78	1015	659	6497	1756	829	—
Duration in hrs..	66	45	8	65	56	311	107	66	20
Mean velocity...	12.9	20.3	9.7	15 6	11.8	20.9	16.4	12.6	

Greatest mileage in one hour was 46 on the 1st. Greatest velocity in gusts 48 miles per hour on the 29th.
Resultant mileage, 6,735

Resultant direction, S. 55° W.
Total mileage, 12,601.
Average mileage per hour 16.94.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 43.0 on the 12th; the greatest cold was 4.0 below zero on the 9th, giving a range of temperature of 47.0 degrees. Warmest day was the 12th. Coldest day was the 6th. Highest barometer reading was 30.561 on the 9th; lowest barometer was 29.329 on the 17th, giving a range of 1.208 inches. Maximum relative humidity was 100 on the 12th. Minimum relative humidity was 35 on the 9th.

Rain fell on 5 days.
Snow fell on 12 days.
Rain or snow fell on 15 days.
Auroras were observed on 4 nights.
Hoar frost on 5 days.
Lunar halo on 4 nights.
Lunar corona on one night.
Fogs on 1 days.