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THE

# CANADIAN

# Naturalist & Geologist,

AND PROCEEDINGS OF THE

# NATURAL HISTORY SOCIETY

OF MONTREAL,

CONDUCTED BY A COMMITTEE OF THE NATURAL HISTORY SOCIETY.

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THE

# Canadian Naturalist & Geologist.

This Magazine will appear bi-monthly, and be conducted by the following Committee, appointed by the Natural History Society of Montreal:—



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☞ Authors of original articles can have 12 copies of them by giving timely notice; it is too late when the forms are broke up.

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☞ On page 81 this No. is erroneously dated March; it should be April. The next number of this Journal will be published June 15.

# Geological Survey of Canada.

Sir W. E. Logan Director

## Graptolithus

*Lower Silurian* — *Hudson River Group*

2

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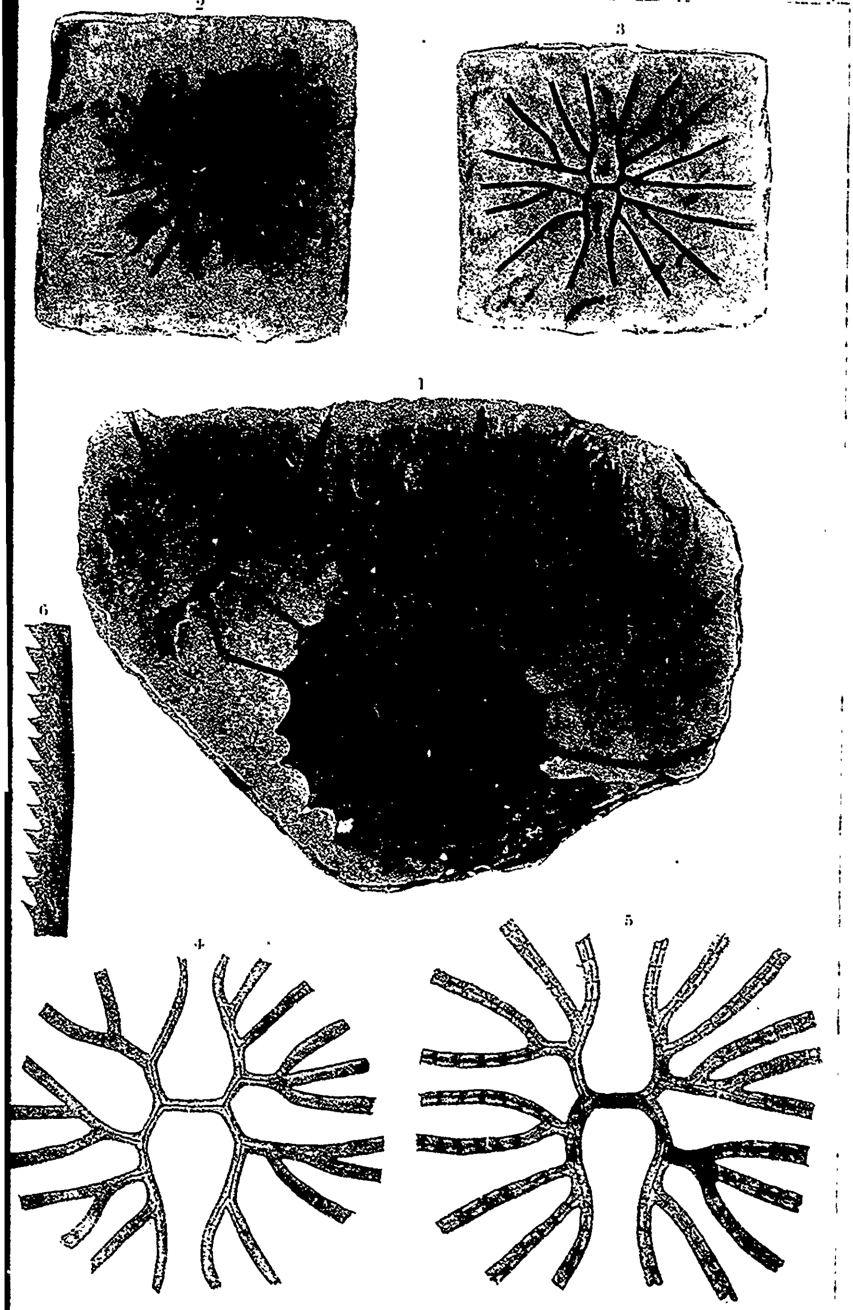
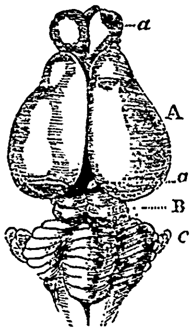
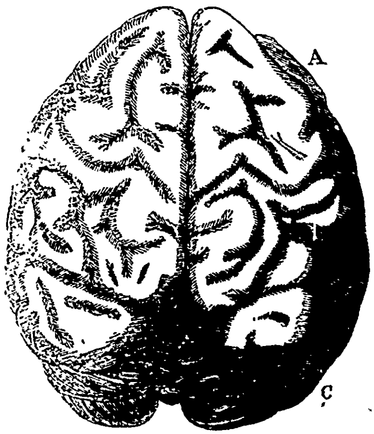


PLATE TO ILLUSTRATE PROFESSOR OWEN'S ARTICLE ON THE CLASSIFICATION OF THE MAMMALIA. PAGE 52, VOL. III.

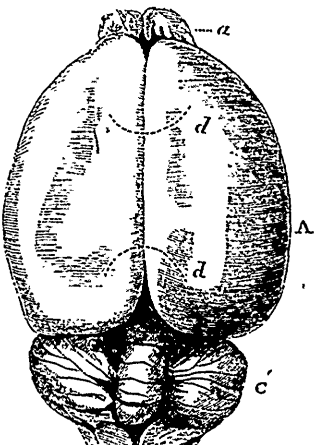
1.—Brain of Opossum.



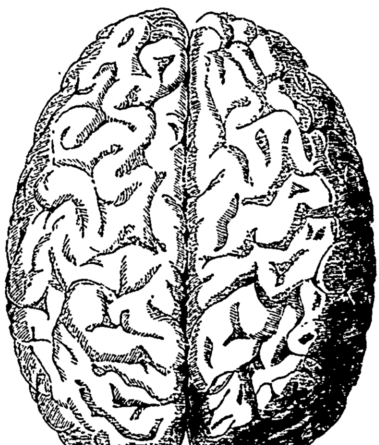

4.—Chimpanzee.




2.—Brain of Beaver.




5.—Negro.



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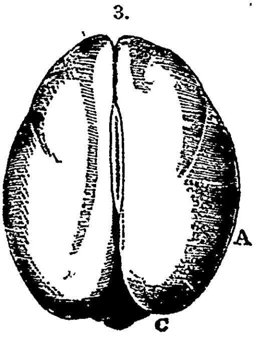


6.—Side view Negro.

THE

CANADIAN

# NATURALIST AND GEOLOGIST.

VOLUME III. MARCH, 1858. NUMBER 2.

ARTICLE X.—*Geological Survey of Canada. Reports of Progress for the Years* 1853–1856.

(SECOND ARTICLE.)

In the previous article, the able Report of Mr. Murray, Assistant Geologist, was passed over with a very short notice. the region traversed by him being of comparatively small geological interest. It is however a region of some economical importance. Lying in the route which many Canadian public men have marked out as probably destined to be one of the great lines of communication between the Upper Lakes and the Ocean, the country between Lake Huron and the Upper Ottawa may by its topographical facilities or difficulties. or by its fertility or sterility, aid or oppose the establishment of such communication, while, by its mineral or other productions, it may offer inducements to enterprise that may give it other claims than those of a mere way of transit. Based almost entirely on rocks of the Laurentian system, it presents a rugged though not very elevated surface, and abounds in lakes, streams, and swampy hollows; and its soils, with the exception of those on the bands of limestone and other calcareous rocks, must on the whole be of inferior quality. Its agricultural capabilities alone therefore cannot be regarded as likely to promote its speedy settlement. We must not however follow the practice too common in new countries, of absolutely condemning every region that is not naturally as level as a meadow and as fertile as a garden. There can be no doubt, that, in the present state of this country, the narrow glens and scattered alluvial flats of a hilly and broken region are not likely to be very inviting to settlers; but if other inducements than those of agriculture alone can be offered, such districts may be profitably occupied. The river alluvia and the sheltered valleys of such regions are often very fertile; the black peaty swamps, when drained, afford inexhaustible crops of grass; and the stony hill-sides are well adapted for orchards, and yield good pasturage. Experience shows also that the energy and force of character of the population of such districts rise to meet the difficulties that surround them; and thus these regions become nurseries of the patriotic feeling and of the mental and bodily energy, that are too apt to die out on the more fertile plains. If therefore by placing the seat of government on the confines of the Laurentian region, by opening new lines of traffic, or by developing the mineral resources that may be present, an effectual stimulus can be given to the settlement of these vast wastes, the object is well worthy of the attention of Canadian statesmen.

Into the consideration of the two first of these means of improvement it is not the province of the Geological Survey directly to enter, but the last falls within its scope. Unfortunately the present state of the district presents many obstacles to its exploration, but everywhere Mr. Murray met with indications of magnetic iron ore, which probably occurs in workable quantity in many places, while abundance of wood for its reduction exists in the territory. The Huronian formation also, which has proved so productive of copper on the shores of Georgian Bay, is extensively distributed, and small quantities of copper ore were found in it in several places. On this subject Mr. Murray says:—

"The existence of the ores of copper and iron, which are known to be more or less characteristic of the Huronian rocks, invests the geographical distribution of the formation with much economic importance. These ores were repeatedly observed in the region explored last season, and, although nowhere seen in large amount or to a large extent, the indications were sufficient to establish their pretty general distribution. Small specks and patches of the yellow sulphuret of copper were frequently found in the blackish and dark-gray slates, on the lower lakes of the Maskanongi; and at the southern turn of these lakes there is a quartz vein of from six to eight feet wide, with copper pyrites, cutting slate conglomerate and an intrusive mass of compact flesh-red feldspar. In the feldspathic dyke, small narrow veins of specular iron ore occur, which appear to run either parallel with the dyke or slightly oblique to it, and the quartz vein and its subordinate *droppers* cut across both. Were this vein as conveniently situated as those of somewhat similar character on Lake Huron, it is fully as well worthy of trial as many that were selected by explorers there, some years ago, upon which to found claims for mining locations."

Mr. Richardson was fortunate in having as his field for exploration the remarkable and interesting island of Anticosti, which he found to consist of limestones representing the middle formations of the Silurian period, and dipping to the southward, giving a high and bold outline by their outcropping edges to the north coast, while at the south they dip gently, with a low shore, under the waters of the Gulf of St. Lawrence. These rocks are arranged by Mr. Richardson in six divisions, of which the following may serve as a general summary in ascending order:

| | ft. | in. |
|---|---|---|
| (A) Grey limestone and argillaceous limestone, with greenish shale and conglomerate limestone, the highest bed containing some very singular impressions or animal tracks.......................................... | 229 | 0 |
| (B) Gray, greenish-gray, and reddish-gray limestone, with shale and limestone conglomerate. In one of the limestones occurs a singular trunk-like fossil named *Beatricea* by Mr. Billings, along with corals and marine shells.......................................... | 730 | 0 |
| (C) Argillaceous limestones, argillo-arenaceous shales, coral limestones. *Beatricea* occurs in these also.... | 306 | 3 |
| (D) Ash-gray and reddish-gray limestones, bituminous limestones and shales, and measures unseen. Some of the limestones contain *Pentamerus*.............. | 480 | 0 |
| (E) Gray and drab argillaceous and bituminous limestones, abounding in *Pentamerus*, *Atrypa reticularis*, *Calymene Blumenbachii*, and many other mollusks and trilobites.......................................... | 550 | 0 |
| (F) Gray and yellowish granular limestone, with quantities of crinoidal remains and corals ............... | 69 | 0 |

Mr. Billings, on the evidence of the fossils, refers divisions A and B to the Hudson River groups, many of the most characteristic fossils of which are contained in them; but the presence of the genera *Catenipora*, *Favosites*, and *Ascoceras* indicates an approach to the Upper Silurian. Divisions C and D afford several additional Upper Silurian forms; and in divisions E and F the prevailing forms are those of the Clinton group of the New York geologists. Great palæontological interest attaches to these rocks, in consequence of the numerous new species contained in them; and in a geological point of view they are especially important as affording a regular succession of fossiliferous beds connecting the Lower and the Upper Silurian in America into one great system. In New York, and in other parts of Canada beside that under notice, the continuity of the series is broken by the intervention of the Oneida conglomerate and the Medina sandstones, and even locally by unconformability. To Anticosti the physical changes which led to the spreading out of great beds of sand and pebbles at the close of the Lower Silurian did not extend. In this favored spot therefore of the old Silurian world, we have the records of the slow changes of organic life which went on independently of the direct action of these physical changes, including probably the introduction of many species which were not able to extend themselves over the sandy bottoms which prevailed at the time under a great part of the ocean then representing America.

On the one hand these Anticosti formations point to the local character of those physical changes which form breaks in the series of stratified deposits, as compared with the more general extension of animal life and its comparative permanence. On the other hand, they show that, perhaps very gradually and slowly, the extinction of some species and the introduction of others were proceeding, even in this comparatively undisturbed locality. Such facts still leave unsettled the great question, to what extent these changes were determined by the plan of succession established by the Creator in organic life, and to what extent by the new conditions of existence established by the operations of his physical laws. That both were in harmony we cannot doubt, but their precise relations are only beginning to be elucidated by the accumulation of new facts like those above referred to, and by the careful examination of each form of life included in these transitional deposits, in connection with the evidences of physical change which they afford.

Among the new fossils from Anticosti, one of the most curious is that already mentioned under the generic name *Beatricea*, proposed by Mr. Billings, who describes two species, *B. nodulosa* and *undulata*. They are rough cylindrical trunks, one specimen obtained being ten feet in length and eight inches to six and a half inches in diameter. They consist of carbonate of lime, presenting concentric rings, like the growth-rings of exogenous trees, in the transverse section, and in the centre is a cylindrical tube crossed by transverse septa. At first sight they resemble exogenous trunks with chambered piths, like the West Indian *Cecropia peltata.* Taking their probably marine habitat into account, we are struck by the general resemblance of their structure to that of the rare and curious *Arthrocladia villosa* of the deeper parts of the Atlantic. These may however be mere analogies, and the appearance of the fossils also suggests affinities to the transversely septated corals, such as *Cyathophyllum* and *Zaphrenitis.* The real nature of the fossil can only be settled by its minute structure, which has not yet been examined. In the mean time Mr. Billings regards it as a plant.

The tracks referred to in the section are also very curious objects, and appear to occur only in one thin bed. They consist of two parallel rows of semi-circular pits, arranged alternately, about half an inch apart. The pits are each about half an inch in diameter. Their alternate arrangement and their great depth prevent them from being attributed to marine worms. They rather resemble the marks which might be made in soft mud by the longitudinally cleft feet of some gasteropodous mollusks, as for instance the *Phasianellæ.* Possibly some of the gasteropods which have left their shells in these beds, may have had the cleft foot and the ambling gait of that genus.

Since however the creatures that lived in Anticosti in the Silurian era, may not be so interesting to many of our readers as the question, What lives or can live in it now? we give nearly in full Mr. Richardson's very intelligent notes on the appearance and productions of the island :—

"The south side of the island, in its general aspect, is low ; the most elevated points close on this coast are at the mouth of Jupiter River, where cliffs rise on the east side to the height of from eighty to a hundred feet ; and on the west side to a hundred and fifty feet. On no other part of the south coast were they observed to rise more than from thirty to sixty feet, but the general height above the sea is from ten to twenty feet.

From the south-west end, the hills inland are more elevated than they are to the eastward ; in general they rise gradually and more continuously from the shore, attaining the height of from a hundred and fifty to two hundred and fifty feet, at about the distance of from one to thre miles. From this however are to be excepted certain localities on the coast, where plains are met with having a superficial area of from a hundred to a thousand acres underlaid by peat partly bare of vegetation, but over considerable spaces, supporting a heavy growth of wild grass from four to five feet high.

From a position a few miles east of South-west Point to Wreck Bay, which is at the east end of the island, between Heath Point and East Point, the elevation of the coast above high water is from seven to fifteen feet, with the exception of the neighbourhood of South Point and Cormorant Point, which rise to the height of from twenty to thirty feet on the shore; but very little rise takes place inland for from one to three miles, and this flat surface is bounded to the north by a gradual slope, rising to the height of from one hundred to two hundred feet, probably becoming more elevated still further inland. The low country is a succession of peat plains, occasionally bare, but often covered with wild grass; the whole being varied with strips and clumps of trees, as well as dotted with small lakes, on which ducks, geese, and other wild fowl breed in considerable numbers.

The whole of the north side of the island is a succession of ridge-like elevations of from 200 to 500 feet above the sea, separated by depressions. From English Head, three miles east from the West Cliff, a distance of fifty-eight miles in a straight line, each successive ridge and valley occupies a breadth of from four to six miles; the ridges form a somewhat rounded end, facing the sea on the north; their rise is first well marked at from a quarter of a mile to a mile from the shore, and in about a mile more inland they attain their greatest elevation; continuing this elevation to the south and widening, they narrow the intermediate valley, until, as far as known, the country becomes in appearance of a gently undulating character. The run of the valleys with some exceptions is from S. 10° W. to S. 30° W.

Macastey Ridge or Mountain, eleven miles east from the west end, rises upwards of four hundred feet at about a mile inland. High Cliff, eighteen miles further east, is probably 500 feet, one quarter of a mile from the shore; these are in some respects the most conspicuous ridges. High Cliff is a bold head-land, while Macastey Mountain is separated by a broader valley than usual from its neighbour to the east, and is higher than any other to the west. Macastey Mountain is a conspicuous object when viewed even from the south side of the island, in the neighbourhood of Ellis, or Gamache Bay; sailing up this natural harbour, it is observed in front a little to the right about five or six miles distant.

The succession of ridge and valley from English Head all the way to West Cliff, is regular and characteristic, and produces a pleasing and beautiful effect. From West Cliff to Observation Bay, a distance of about twenty miles, there is a similar succession, but on this part the ridges rise to their full elevation nearer to the shore. West Cliff rises immediately over the sea to an elevation of between 200 and 400 feet. Charleton Point has an elevation of 100 feet over the sea, and a quarter of a mile inland rises to between 300 and 400 feet; from Charleton Point to Observation Bay the coast is somewhat lower, Observation Bay forming an indentation on the coast of a mile and a quarter deep, and five miles across; from the head of this bay a well marked valley bears S. 10° W.

From Observation Bay to Gull Cape, a distance of fifty-three miles, the cliffs become prominent on the coast, rising almost perpendicularly at the points to the height of from 100 to 300 feet; and the indentations are more numerous, producing more sharply defined valleys.

Between Bear Head and Cape Robert, a distance of five miles and a-half, the greatest indentation from a straight line is about a mile and a-half; but this is subdivided into Easton Bay, Tower Bay, and White Bay, the last being the largest.

Salmon River Bay, east from Cape Henry, is five miles wide, and its greatest depth is one mile. Salmon River runs through a well-marked valley, of which the general bearing up-stream is S. 65° W. for nearly six miles, where a transverse valley, in the bearing N. 77° W. and S. 77° E. (about parallel with the coast) meets it, and gives it two streams running from opposite directions. From the middle of the valley the land gradually rises on each side to the height of from 400 to 450 feet, and the bed of the valley must rise pretty fast; for though the current of the stream is without leaps, it is rather rapid.

Prinsta Bay, further east, is an indentation of about one mile in depth, with a width of a mile and a-half; perpendicular cliffs surround this bay to the height of from 100 to 150 feet, except at the very head, where two creeks cut through the rock. On the west side of Prinsta Bay is Cape James, 150 feet in height; and on the east is Table Head. Table Head has a face of from 150 to 160 feet perpendicular, and gains almost at once an additional height, from the summit of which there is a gradual descent on the opposite side, the surface forming on that side a rough outline to the valley through which Fox River passes to Fox Bay, which affords the second important harbour on the Island. The upward course of the valley of the Fox River is N. 72° W.

From Fox Point on the west side of the bay to Gulf Cape, upwards of a mile on the east side, there is a distance of six miles, in which the coast is low, Fox Point, the highest part of this, not being more than from thirty to forty feet above the sea.

From Gulf Cape to Wreck Bay, a distance of eleven miles, the cliffs are in general perpendicular, and from 100 to 130 feet, while the surface back from them gives, as far as observed, a slightly rolling country.

Excepting the valley of Jupiter River, there are no well-defined valleys on the south side of the island.

In respect to the soil of the Island, the plains on the south side, as has been stated, are composed of peat, but the general vegetation of the country is supported by a drift composed for the most part of a calcareous clay, and a light grey or brown colored sand. The elements of the soil would lead to the conclusion of its being a good one, but the opinion of most persons, guided by the rules derived from the description of timber which grows on it, would not be favorable, as there is almost a complete absence, as far as my observation went, of the hard-wood trees supposed to be the sure indication of a good settling country.

The most abundant tree is spruce, in size varying from eight to eighteen inches in diameter, and from forty to eighty feet in length. On the north coast, and in some parts of the south, it is found of good size in the open woods close by the beach, without any intervening space of stunted growth. The stunted growth was occasionally met with on the north side; but it is only on the tops of cliffs, and other places exposed to the heavy coast winds, where spruce, or any other tree on the island, is stunted. In these situations there is oftentimes a low, dense, and almost impenetrable barrier of stunted spruce, of from ten to twenty feet across, and rarely exceeding a hundred feet; beyond which open woods and good comparatively large timber prevails

Pine was observed in the valley of the Salmon River, about four miles inland, where ten or twelve trees that were measured gave from twelve to twenty inches in diameter at the base, with heights varying from sixty to eighty feet. White and yellow birch are common in sizes from a few inches to two feet in diameter at the base, and from twenty to fifty feet high. Balsam-fir was seen, but it was small and not abundant. Tamarack was observed, but it was likewise small and scarce. One of our men, however, who is a hunter on the island, informed me he had seen groves of this timber north from Ellis, or Gamache Bay, of which some of the trees were three feet in diameter, and over a hundred feet in height. Poplar was met with in groves, close to the beach, on the north side of the island.

Of fruit-bearing trees and shrubs, the mountain-ash, or rowan, was the largest; it was most abundant in the interior, but appeared to be of the largest size close on the beach, especially on the north side, where it attains the height of forty feet, with long extending and somewhat slender branches, covered with clusters of fruit. The high cranberry (*Viburnum opulus*) produces a large and juicy fruit, and is abundant. A species of gooseberry bush from two to three feet high is met with in the woods, but appears to thrive best close to the shingle, on the beach, where strips of two or three yards across and half-a-mile long were occasionally covered with it. The fruit is very good, and resembles in taste the garden berry; it is smooth and black colored, and about the size of a common marble. The shrub appeared to be very prolific. Red and black currants are likewise abundant. There appear to be two kinds of each, in one of which the berry is smooth, resembling both in taste and appearance that of the garden; the other rough and prickly, with a bitter taste.

Strawberries are found near the beach. In size and flavor they are but little inferior to the garden fruit. They are most abundant among the grass in the openings, and their season is from the middle of July to the end of August. Five or six other kinds of fruit-bearing plants were observed, some of which might be found of value. The low cranberry was seen in one or two places in some abundance, but I was informed that it was less abundant than in many other past seasons. The raspberry was rarely met with.

The most surprising part of the natural vegetation was a species of pea which was found on the beach, and in open spaces in the woods; on the beach the plant, like the ordinary cultivated field-pea, often covered spaces from a-quarter of an acre to an acre in extent. The stem and the leaf were large, and the pea sufficiently so to be gathered for use. The straw when required is cut and cured for feed for cattle and horses during the winter.

But little is yet known of the agricultural capabilities of the island. The only attempts at cultivation that have been made are at Gamache Bay, South-west Point, and Heath Point. South-west Point and Heath Point are two of the most exposed places in the Island; and Gamache Bay, though a sheltered position, has a peat soil: the whole three are thus unfavourable.

On the 22nd July potatoes were well advanced, and in healthy condition at Gamache Bay; but a field under hay, consisting of timothy, clover, and natural grass, did not shew a heavy crop. At South-west Point, Mr. Pope had about three acres of potatoes planted in rows three feet apart. He informed me he expected a yield of 600 bushels, and at the time of my arrival on the 5th of August, the plants were in full blossom, and covered the ground thoroughly. Judging from the appearance, they seemed the finest patch of potatoes I had ever seen. About half-an-acre of barley was at the time commencing to ripen. It stood about four feet high, with strong stalk and well-filled ear. I observed oats in an adjoining patch. These had been late sown, being intended for winter feed for cattle. Their appearance indicated a large yield.

On the day of my arrival at Heath Point, the 23rd August, I accompanied Mr. Julyan about a mile from the light-house, to a piece of ground composed of yellowish-brown loam, which he had cleared in the wood, and planted in about the middle of June with potatoes and peas. Of the potatoes he procured a bucket-full of good size and middling good quality. The peas were in blossom, yet a few pods were found to be fit for use. In this patch I discovered three ears of bald wheat, the seed of which had been among the peas when sown. They were just getting into blossom, and probably would ripen. The ear was an average size, and the straw about three and a-half feet high.

I observed frost only once; it was on the 18th September, but not sufficiently severe to do injury to growing crops; and I was informed by Mr. Julyan that the lowest temperature of the previous winter was only seven degrees of Fahrenheit below zero. On the coast, as might be expected, the atmosphere is damper, and the temperature from ten to fifteen degrees below that of the interior, during June, July, August, and September, and probably May and October.

During the three months of my stay on the island, fogs prevailed for ten days, five of which were the 31st July and the 2nd, 3rd, 4th, and 5th of August, while we were at South-west Point. Mr. Pope told me it was an unusual occurrence. I observed that frequent openings in the fog were seen towards the land, leading to the idea that it was less dense in the interior.

I observed some cattle at South-west Point, belonging to Mr. Pope and Mr. Corbet. They appeared to be in good condition, although they had been left to provide for themselves in the wood openings, or along the shore. A horse belonging to Mr. Pope was in equally good condition.

Gamache or Ellis Bay and Fox Bay are the only two harbors on the island that are comparatively safe in all winds. The former is eight and a-half miles from West-end Lighthouse, on the south side; the latter is fifteen miles from Heath Point Lighthouse, on the north side. From Cape Eagle to Cape Henry, across the mouth of Gamache Bay, the distance is two miles, with a breadth of deep water of three quarters of a mile, extending up the bay a mile and a-half, while the depth of the indentation is two miles and a-half. Fox Bay is smaller, and has less depth of water than Gamache Bay. The distance across its mouth is a mile and a-half, with half a mile of deep water in the centre, extending up the bay nine-tenths of a mile; the whole depth of the indentation being one mile and two-tenths. These two harbours occur in the same geological formation, while the rock presents a very regular and comparatively level surface, over which a road could be easily constructed from one harbour to the other, the distance being 120 miles. By such means the whole island would be brought to within a moderate distance of a road having a natural harbour at each end.

The wild animals met with on the island, as far as I am aware, are the common black bear, the red, the black, and the silver fox, and the marten. Bears are said to be very numerous, and hunters talk of their being met with by dozens at a time; but on my excursion I only observed one at Ellis Bay, two near Cormorant Point, and one in the neighbourhood of Observation Cape. I came upon the last one on a narrow strip of beach at the foot of a high and nearly vertical cliff. Seen from a distance, I took the animal for a burnt log, and it was only when within fifty yards of him that I perceived my mistake. He appeared to be too busily engaged in making his morning meal, on the remains of a seal, to pay any attention to me; for although, with a view of giving him notice to quit, I struck my hammer upon a boulder that was near, and made other noises which I conceived might alarm him, he never raised his head to show that he was aware of my presence, but fed on until he had finished the carcase, obliging me, having no rifle, to remain a looker-on for half-an-hour. When nothing of the seal remained but the bones, the bear climbed in a leisurely way up the face of the naked cliff, which could not be many degrees out of the perpendicular, throwing down as he passed considerable blocks of rock, and disappeared over the summit, which was not less than a hundred feet above the sea.

Foxes and martens are very abundant. The marten was frequently heard during the night in the neighbourhood of our camp, and foxes were seen on several occasions. Of the silver-grey fox, the skin of which frequently sells for from twenty-five to thirty pounds currency, from four to twelve have been obtained by the hunters every winter. Mr. Corbet the lessee of the island employs several men during that season to hunt these animals for their fur, and I understand he makes some profit by the trade.

I heard of no animals of any other description, with the exception of wild fowl, and I saw no frogs nor reptiles of any description, and I was informed by the hunters that there were none."

The portion of the Report specially due to Mr. Billings contains the notices of Anticosti fossils to which we have already referred, and also descriptions of a number of new species found in other parts of Canada. In the *Crinoids* and *Cystideans*, in particular, large additions are made to our knowledge, and these will be rendered still more valuable when the engravings of fossils, now we believe in progress in Great Britain, are published. To the *Cephalopoda* also Mr. Billings has directed much attention, and has described many new forms.

Mr. Hunt's portion of the Report embraces so much matter, both of scientific and practical interest, that we must confine ourselves to notices of a few subjects. Analyses of mineral waters are given in considerable numbers; but we prefer considering those of the two greatest drains of the Canadian territory, the St. Lawrence and the Ottawa :—

"The plan proposed for supplying the city with water from one of these rivers, having made a knowledge of their chemical composition a matter of considerable interest, I proceeded, agreeably to your desire, to make a careful analysis of their waters. The results, independent of their local value, are important, as showing the composition of two immense rivers which drain so large a portion of the continent.

The time chosen for collecting the waters was in the month of March, before the melting of the snows had commenced. The river waters were then unaffected by the rains and the drainings of the surface, which tend to make their composition variable during the summer season.

The water of the Ottawa was collected on the 9th of last March at the head of the lock at Ste. Anne, where the position and the rapid current assured me the water of the river free from all local impurities. The river was here unfrozen, owing to the rapidity of the current, and its temperature was found to be 33° F., that of the air being the same.

The water, which was free from all sediment or suspended matter, had a pale amber-yellow color, very distinct in masses of six inches. When heated this color deepens, and by boiling there separates a bright brown precipitate, which, when the volume of the water is reduced to one-tenth, is seen to consist of small brilliant iridescent scales. These are not gypsum, of which the water does not contain a trace, but consist of carbonates, with silica and organic matter. Meanwhile the water becomes more highly colored, and now exhibits an alkaline reaction with test papers.

The recent water, mingled with hydrochloric acid and a salt of baryta remains clear for a time, but after an hour a faint turbidness appears indicating a trace of sulphate. With nitrate of silver and nitric acid, a slight milkiness from the presence of chlorids is perceptible. The amounts of sulphuric acid and chlorine were determined onportions of two or four litres of the water reduced by evaporation to a small volume, and acidulated. The precipitate obtained by the addition of a few drops of nitric acid and nitrate of silver, was scanty and reddish colored. After twelve hours of repose it was collected, dissolved from the filter by ammonia, and the pure chlorid of silver thrown down by a large excess of nitric acid, while the silver-salt of an organic acid remained in the solution.

When the precipitate obtained during the evaporation of the water is boiled with a dilute solution of potash, the organic matter is dissolved, and the akaline solution assumes a bright brown color which becomes paler on the addition of acetic acid; acetate of copper produces no precipitate in the liquid thus acidulated; but on adding carbonate of ammonia and heating the mixture, a minute white flocculent precipitate separates, having the characters of crenate of copper. Another portion of the precipitate by evaporation was dissolved in hydrochloric acid, and decolorized by boiling with chlorate of potash; on evaporating the solution a portion of silica separated, and the liquid gave with ammonia a colorless precipitate, which was chiefly composed of alumina; re-dissolved in hydrochloric acid however, it gave with a sulphocyanid, evidence of the presence of oxyd of iron, and with molybdate of ammonia an abundant yellow precipitate indicating phosphoric acid. The aluminous precipitate heated on silver foil with caustic potash gave a slight but decided reaction of manganese.

When the concentrated water, with its precipitate, was evaporated to dryness in a platinum capsule with excess of hydrochloric acid, and the residue treated with acidulated water, a large amount of silica was obtained, equal to one-third of all the solid matters present. This silica was white after ignition, and perfectly pure. A portion of the water was evaporated to one-fortieth and filtered; the residue being farther evaporated to one-fourth, deposited on the platinum capsule an opaque film, which was but imperfectly soluble in hydrochloric acid. The concentrated liquid was dark brown and alkaline, reddening turmeric paper; it was now evaporated to dryness, ignited and treated with water. The soluble portion was strongly alkaline to test papers, and perceptibly so to the taste. The residue insoluble in water was treated with strong hydrochloric acid, which dissolved a portion of lime without effervescence, and left a residue of pure silica; the acid solution contained no magnesia.

The dried residue from the evaporation of this water is of a deep brown color, when ignited, the organic matter which it contains burns like tinder, diffusing an agreable vegetable odour, and leaving a little carbon. The water was not examined for nitrates; but the absence of any deflagration during the ignition of the residue, showed that if present they were in very small amount. The season moreover at which the water was collected (being at the end of a winter of four months of unremitting frost), would not be favorable to the formation of nitrates

The following numbers are deduced from the means of two or more concordant determinations made upon quantities of two and four litres of the Ottawa, and calculated for ten litres or 10·000 grammes.

| | | |
|---|---|---|
| Carbonate of lime,.............................. | 0·2480 | grms. |
| " " magnesia,........................ | ·0696 | " |
| Chlorine,........................................ | ·0076 | " |
| Sulphuric acid,.............................. | ·0161 | " |
| Silica,.............................................. | ·2060 | " |
| Chlorid of sodium,.......................... | ·0607 | " |
| " " potassium,........................ | ·0293 | " |
| Residue dried at 300° F.,.................. | ·6975 | " |
| " ignited,................................ | ·5340 | " |

The amounts of silica remaining dissolved in the water evaporated to one-twentieth and one-thirtieth, were found to be 0·019 and 0·020 for four litres, giving for the ten litres a mean of 0·046 grammes of silica thus retained in solution. The amount of lime remaining dissolved in this quantity of the water thus evaporated, was equal to 0·023 of carbonate of lime.

The chlorine and sulphuric acid present in this water are sufficient to neutralize only about one-half of the alkaline bases present. The remaining portion may be regarded as existing in combination either with silica or with the organic acids present; and it is probably in a similar state of combination that a portion of the lime remains dissolved in the evaporated water.

In the following table the lime and the excess of alkalies are however represented as carbonates, and we have for 10·000 parts,

| | |
|---|---|
| Carbonate of lime,.................................. | 0·2480 |
| " " magnesia,............................ | ·0696 |
| Silica,.................................................. | ·2060 |
| Chlorid of potassium,.............................. | ·0160 |
| Sulphate of potash,........................ ...... | ·0122 |
| " " soda,.................................. | ·0188 |
| Carbonate of soda,.................................. | ·0410 |
| Alumina and oxyd of iron, ..................(traces) | |
| Manganese and phosphoric acid,.............. " | |
| | 0·6116 |

The water of the St. Lawrence was collected on the 30th of March, on the south side of the Pointe des Cascades (Vaudreuil). The rapid current had here left an opening in the ice, from which the water was taken at a distance of six feet from the shore. It was clear and transparent, and, unlike the water of the Ottawa, exhibited no color in vessels several inches in diameter. The recent water gives a considerable precipitate with salts of baryta, and a slight one with nitrate of silver. When boiled it lets fall a white crystalline precipitate which adheres to the sides of the vessel, unlike the deposit from the Ottawa water. A little yellow flocculent matter appears suspended in the concentrated liquid, which is only slightly colored, and the dried residue contains much less organic matter than that from the last mentioned water. The residue from two litres, when dissolved in hydrochloric acid, sufficed to give distinct reactions of iron and maganese. The ammoniacal precipitate from this solution was in great part soluble in potash, and was alumina. From a second portion of two litres a precipitate of phosphate was obtained by molybdate of ammonia, less abundant however than from the same quantity of the water from the Ottawa The determinations were made as in the previous analysis, and gave for 10,000 parts,

| | |
|---|---|
| Carbonate of lime,................................ | 0·8033 |
| " " magnesia,.......................... | ·2537 |
| Chlorine,.............................................. | ·0242 |
| Sulphuric acid,...................................... | ·0687 |
| Silica,................................................. | ·3700 |
| Chlorid of potassium,............................ | ·0220 |
| " " sodium,................................ | ·1280 |
| Residue dried at 300° F.,........................ | 1·6780 |
| " ignited,.................................... | 1·5380 |

When evaporated to one-fortieth this water still contains in solution a portion of silica and some lime. The silica thus dissoved was found equal to 0·075, and the lime-to 0·050 of carbonate of lime for 10,000 parts. The proportions of sulphuric acid and chlorine are much larger than in the Ottawa water, but were found not quite sufficient to saturate the whole of the alkaline bases present. The small portion of lime is probably held in solution by the concentrated water in the form of silicate, which, as is well known, possesses a certain degree of solubility; while from the insolubility of the silicate of magnesia, this base is completely separated during the evaporation.

I subjoin the calculated results for 10,000 parts of the St. Lawrence water, the lime and magnesia and the slight excess of alkalies being represented as carbornates.

| | |
|---|---|
| Carbonate of lime,................................ | 0·8083 |
| " " magnesia,.......................... | ·2537 |
| Silica,................................................. | ·3700 |
| Chlorid of potassium,............................ | ·0220 |
| " " sodium,................................ | ·0225 |
| Sulphate of soda,.................................. | ·1229 |
| Carbonate " ......................................... | ·0061 |
| Alumina, phosphoric acid,..................(traces.) | |
| Oxyds of iron and manganese,.............. " | |
| | 1·6055 |

The ignition of the dried residue expels a portion of carbonic acid from the earthy carbonates, and hence the calculated results exceed the weight of the residue, besides which considerable portions of the lime and magnesia are combined with silica, and not with carbonic acid as in the calculated table.

The comparison of the water of these two rivers shows the following differences:—The water of the Ottawa, containing but little more than one-third as much solid matter as the St. Lawrence, is impregnated with a much larger portion of organic matter derived from the decomposition of vegetable remains, and a large amount of alkalies uncombined with chlorine or sulphuric acid. Of the alkalies determined as chlorids, the chlorid of potassium in the Ottawa water forms 32 per cent. and in that of the St. Lawrence only 16 per cent., while in the former the silica equals 34 per cent., and in the latter 23 per cent. of the mineral matters. The Ottawa drains a region of crystalline rocks, and receives from these by far the greater part of its waters; hence the salts of potash liberated by the decomposition of these rocks are in large proportion. The extensive vegetable decomposition, evidenced by the organic matters dissolved in the water, will also have contributed a portion of potash. It will be recollected that the proportion of potash salts in the chlorids of sea-water and saline waters generally, does not equal more than two or three per cent. As to the St. Lawrence, although the basin of Lake Superior, in which the river takes its orign is surrounded by ancient sandstones and by crystalline rocks, it afterwards flows through lakes whose basins are composed of palæozic strata which abound in limestones rich in gypsum and salt, and these rocks have given the waters of this river that predominance of soda, chlorine, and sulphuric acid which distinguishes it from the Ottawa. It is an interesting geographical feature of these two rivers that they each pass through a series of great lakes, in which the waters are enabled to deposit their suspended impurities, and thus are rendered remarkably clear and transparent.

The presence of large amounts of silica in river waters is a fact only recently established, by the analyses by H. Ste. Claire Deville of the rivers of France.* The silica of waters had generally been entirely or in great part overlooked, or had, as he suggests, from the mode of analysis adopted, been confounded with gypsum. The importance in an agricultural point of view of such an amount of dissolved silica, where river waters serve for the irrigation of the soil, is very great; and geologically it is not less significant, as it marks a decomposition of the silicious rocks by the action of water holding in solution carbonic acid, and the organic acids arising from the decay of vegetable matter. These acids combining with the bases of the native silicates, liberate the silica in a soluble form. In fact silica is never wanting in natural waters, whether neutral or alkaline, although proportionately much greater in those surface waters which are but slightly charged with mineral ingredients. The alumina, whose presence is not less con-

* Annales de Chimie et de Physique, 1848, vol. xxiii., p. 32.

stant, although in smaller quantity, equally belongs to the soluble constituents of the water. The quantity of silica annually carried to the sea in solution by the St. Lawrence and similar rivers, is very great, and doubtless plays an important part in the silicification of organic remains, and in the formation of silicious deposits, both directly and through the intervention of silicious infusorial animals.

As regards the question of a supply of water for the city of Montreal, it is to be remarked that the composition of these waters will be subject to considerable changes with the different seasons. The waters from the melting of the snows and autumnal rains, will give to the river a character somewhat different from that presented after the long droughts of summer, or after several months of continued frost, when we may suppose that the water will contain the largest amount of soluble matters.

The waters of the St. Lawrence meeting those of the Ottawa below Vaudreuil, the two flow side by side, and may, as is well known, be distinguished by their difference in color. The clear greenish-blue of the larger river contrasts strongly with the amber-brown color of its tributary. The agitation of the current however gradually mingles the two streams; and even the brown water along the front of the island of Montreal is already mixed with a considerable portion of the St. Lawrence water, as will be evident from the analyses given below. As but a portion of the Ottawa enters the channel of the St. Lawrence at the head of the island, and as the volume of the former river is very variable, it happens that the proportions of the mixture at a given point in front of the island are subject to considerable changes. At the close of the summer and winter seasons the waters of the Ottawa are comparatively low, and then it may be observed that the water supplied by the City Water Works is but slightly colored, the water of the St. Lawrence predominating; while during the spring floods its deep color shows the larger proportion of Ottawa water. It hence follows that the purity of our supply of water is in an inverse ratio with its color, and that in obtaining an uncolored water we exchange a small proportion of organic matter for a much larger amount of calcareous salts."

Several years ago Mr. Hunt announced the remarkable fact, that shells of the genus *Lingula* consist in great part of phosphate of lime. He has since analysed several additional species, with the same results; and also the recent *L. ovalis*, which was found to contain 61 per cent. of earthy matter, consisting of,—

| | |
|---|---|
| "Phosphate of lime | 85.79 |
| Carbonate " | 11.75 |
| Magnesia | 2.80 |
| | 100.34 |

This is very nearly the composition of calcined human bones." Similar characters are found in fossil and recent *Orbicula*, and also in *Conularia*, a shell probably belonging to the *Pteropoda*, a very different group of mollusks. On the other hand, species of *Atrypa*, *Leptæna*, and other genera belonging, like *Lingula*, to the *Brachiopoda*, were found to have the composition of ordinary shells. This selection of phosphate of lime by some of the lower animals, no doubt points to peculiarities in their food and habits, to which both zoologists and geologists would do well to direct their attention.

The present Report contains a collected and condensed statement of the valuable remarks of Mr. Hunt on the composition and origin of metamorphic rocks. To attempt any summary of them would be unjust to their author; but we earnestly commend them to the careful study of all geologists who desire to understand the chemical principles involved in the conversion of sediments deposited in water into crystalline and metamorphic masses,—a very important subject, hitherto too much neglected.

Mr. Hunt's Report also contains several essays on highly important practical points. Two of these, on the manufacture of Iron and on the extraction of Salts from sea-water, have been transferred to this Journal; and there are others equally valuable, on Magnesian Mortars and the manufacture of Magnesia from Canadian rocks, on the preparation of Plumbago, and on Peat and the products from it.

This Report, from its more compact and readable form, will be more extensively read and consulted than any of the previous Reports of Progress; and with the accompanying maps, it will still further establish and extend the reputation of the Canadian Survey for accurate and able work.

J. W. D.

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## ART. XI.—*On the Extraction of Salts from Sea-Water.**

The manufacture of salt from the ocean has, from an early period, been a most important branch of industry for the south of Europe. Without reverting to high antiquity, we may cite the salines of Venice, to which that republic owed the commencement

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* From the Reports of the Geological Survey of Canada for 1853–56, pp. 404–419.

of its greatness and its wealth. The lagoons which surrounded that city were enclosed, and set apart for the breeding of fish, and for the manufacture of salt. Making a monopoly of this staple of life, the policy of Venice was to obtain possession of all those salines which could compete with her, and we find the Venetians destroying such as they could not make use of, and ex acting from the neighbouring princes, treaties to the effect that they would not re-establish the suppressed salines. It was only two or three centuries later that this powerful republic ordered, in the interest of her commerce, the suppression of the salines of her own lagoons, and augmented the produce of those of Istria and of the Grecian Islands, which had become hers by right of conquest, still retaining in her own hands the trade in salt for all southern Europe. But with the downfall of Venitian power, we find the salines of Provence and Languedoc growing into importance, while those of Venice had fallen into decay, so that when the Emperor Napoleon I. created the kingdom of Italy, he had recourse to a French engineer from Marseilles to re-establish the salines of Venice, which are now once more organised on a vast scale.

It is however in France, and especially upon the shores of the Mediterranean, that we shall find the most extensive salines, and the most intelligent system of working these great sources of national wealth. On the western coast of France, the salt marshes of Brittany and La Vendée are wrought to a considerable extent, but the cool, moist and rainy climate of these regions is much less favorable to this industry than that of the southern shores of the empire, where dry and hot summers offer great facilities for the evaporation of the sea-water, which is effected in all the salines of which we have spoken, by the sun and wind, without artificial heat.

The salt-works of the lake of Berre, near Marseilles, were those whose products attracted the most attention at the Exhibition, not only on account of the excellent method there pursued for the manufacture of sea-salt, but from the fact that the important processes of Mr. Balard for the extraction of potash, sulphates and other valuable materials from the mother liquors, are there applied on a large scale. Having had oc asion to examine carefully these products in the course of my duties as Juror at the Exhibition, and having afterwards visited the saline of Berre, I propose to give here some account of its construction and mode of operation, as well as of the method employed for the working of the mother liquors. I have to express my great obligations to my distinguished colleague, Mr. Balard, of the Academy of Sciences, who most kindly furnished me with every information respecting the processes of his invention which are there applied, and also Mr. Agard, the enlightened and scientific director of the saline.

The first condition for the establishment of a salt work is a low, broad, level ground on the border of the sea, which can be protected by dykes from the action of the tides, and as these are considerable on the Atlantic coast and insignificant in the Mediterranean, the arrangements required in the two regions are somewhat different. In both cases however the high tides are taken advantage of to fill large and shallow basins with the sea-water, which there deposits its sediments, becomes warmed by the sun's rays and begins to evaporate. From these reservoirs it is led by a canal to a series of basins from ten to sixteen inches in depth, through which it passes successively, and where by the action of the sun and wind the water is rapidly evaporated, and deposits its lime in the form of sulphate. It then passes to another series of smaller basins where the evaporation is carried to such a point that the water becomes a saturated brine, when its volume being greatly diminished, it is transferred to still smaller shallow basins called *salting-tables*, where the salt is to be deposited. In the salines of the Atlantic coast, the different basins are nearly on the same plane, and the water flows from one series to the other as its level is reduced by evaporation. In the large establishments of the Mediterranean, the system is different; the basins are constructed at different levels, and the waters having passed through one series, are raised by wooden tympans or drums from eight to sixteen feet in diameter (moved by steam or horse power), and conducted into the other basins. These differences of level establish a constant current, and in this way greatly promote the evaporation.

But in whatever manner the process is conducted, the concentrated brines, making 25°of Beaumé's areometer, are finally conducted to the salting tables, where they begin to deposite their salt in the form of crystalline crusts, which are either collected with rakes as soon as they form, or as at Berre, allowed to accumulate at the bottom, until they form masses six or eight inches in thickness. The concentration of the brines must be carefully watched, and their density never allowed to exceed 28°5, otherwise a deposit of sulphate of magnesia would be formed, rendering the sea-salt impure. The mother liquors, as they are called, are run off so soon as they have reached the above density, and reserved for operations to be detailed further on. When the salt has attained a sufficient thickness, it is broken up and piled upon the sides of the basins in large pyramids, which are covered with clay on the western coast of France, but left unprotected during the summer season, in the dry climate of the south. In these heaps, the salt undergoes a process of purification; the moisture from the clay or from occasional rains penetrates slowly through the mass, removing the more soluble foreign matters, and leaving the salt much purer than before. In the south, it is taken directly from these heaps and sent into the market, but in the less favorable conditions presented on the western coast, the thin layers of salt there collected are more or less soiled with earthy matters, and for many uses require a process of refining before they are brought into commerce. For this purpose two methods are employed; the one consists in simply washing the crude salt with a concentrated brine, which removes the foreign salts, and a large portion of the earthy impurities The other more perfect, but more costly process, consists in dissolving the impure salt in water, and adding a little lime to precipitate the salts of magnesia always present, after which the filtered brine is rapidly boiled down, when a fine-grained salt separates, or is more slowly evaporated to obtain the large-grained cubic salt which is used in the salting of provisions. The masses of coarsely crystalline salt from the salines of the south have no need of these refining processes.

In practice, the evaporation of the brines for sea-salt at Berre is carried as far as 32°, and the salt separated into three qualities, Between 25° and 26° the brine deposits one-fourth of its salt, which is kept apart on account of its great purity, and sold at a higher price than the rest. In passing from a density of 26° to 28°5, sixty per cent. more of salt of second quality are deposited, and from this point to 32° the remaining fifteen per cent. are obtained, somewhat impure and deliquescent from the magnesian salts which it contains, but preferred for the salting of fish, on account of its tendency to keep them moist. The average price of the salt at the salines is one franc for 100 kilogrammes, (220 pounds avoirdupois,) while the impost upon it was until recently, thirty times that sum, and is even now ten francs the 100 kilogrammes.

The waters of the Mediterranean contain, according to the analysis of Usiglio, about three per cent. of common salt, while those of the Atlantic contain from 2.5 to 2.7 per cent. In the waters of the Mediterranean there are besides, about 6.8 per cent. of sulphates and chlorids of calcium, magnesium and potassium. The quantity of water which it is necessary to evaporate in order to obtain a small amount of salt, thus appears to be very great, but under favorable circumstances this is a small consideration, as will appear from the following fact. The saline of Berre is situated upon a small lake, communicating with the ocean, but fed by streams of fresh wat r, so that while the waters of the open sea have a density of 3°5, those of the lake have only 1°5, or scarcely half the strength of sea water. Nevertheless, the advantages of the position offered by the shores of the lake for the establishment of a saline, are sufficient to compensate for the deficiency of salt in the water, and to make of Berre one of the most flourishing salines of the south of France. The evaporating surfaces here cover 3,300,000 square metres, equal to 815 English acres; of this area one-tenth is occupied with the salting tables, but with sea-water, where less evaporation is required to bring the brine to the crystallizing point, one sixth of the area would be thus occupied. The amount of salt annually produced at the saline of Berre is 20,000,000 of kilogrammes.

Owing to the dilution of the water of the lake of Berre, the proportion of salt there manufactured is small when we consider the area, and compare the produce with that of other salines where pure sea-water is evaporated. According to Mr. Balard, 2,000,000 square metres may yield 20,000,000 kilogrammes annually; and Mr. Payen states that the same amount of salt is produced at Baynas from a superficies of 1,500,000 metre. As a cubic metre of sea-water contains about 25 kilogrammes of salt, the evaporation required to produce the above amount corresponds to 800,000 cubic metres, equal in the second estimate given above, to a layer of water 0.40 metre, or 15¾ English inches in thickness.

The plan hitherto adopted in the salines of the European coasts, has been to commence the evaporation of the sea-water with the spring time of each year; in this way some three or four months elapsed before a sufficiently large amount of strong brine was accumulated to enable the manufacturer to commence the deposition of salt on the salting tables, and as this latter operation can only be carried on in fine weather, the rainy season of autumn soon came to interrupt the process, so that during a large part of the year the labours of the salines were suspended. The enlightened director of the works of Berre, Mr. Felicien Agard, has however introduced a very important improvement in the management of the salines, by means of which he carries on the works throughout the whole year, and is enabled to increase the produce by 50 per cent. During the months of the autumn, the evaporation, which is still carried on, though more slowly, enables him to obtain brines marking 8°, 10°, and even 20°. These are stored away in large pits, where the depth of liquid being considerable, the diluting effect of the spring rains is but little felt, and at the commencement of the warm season these brines are raised into the evaporating basins, so that the summer's labours are commenced with concentrated liquors, and the salt is all harvested in the months of August and September.

In selecting the site for a saline it is of great importance to choose a clayey soil, an earth of this character being required to render the basins and dykes impervious to water. In the saline of Berre, a coriaceous fungous plant, to which botanists have given the name *Microcoleus corium*, was observed to vegetate upon the bottom of the basins, and this being carefully protected, has finished by covering the clay with a layer like felt, which protects the salt from contamination by the earth, and enables it to be collected in a state of great purity.

The conditions of exposure to sun and wind offered by the locality chosen for a saline are also to be carefully considered, for upon these will of course greatly depend the rapidity of evaporation. The salines of the lagoons of Venice, to which we have already alluded, have recently been re-organised by Baron S.M. Rothschild and Mr. Chas. Astric, and cover an area nearly twice that of Berre. The tides of the Adriatic are considerable, and from the lowness of the ground, the labour of constructing the basins and dykes could only be carried on at low water. The moist and rainy climate of Venice also offers serious obstacles to the manufacture of salt; to overcome these, two plans are adopted. The salting tables are so arranged that in case of heavy rains, the concentrated brines can be rapidly run off into deep reservoirs, while other reservoirs of saturated brine at higher levels serve not only to feed the salting tables, but to cover with a thick layer those tables which may contain a large amount of salt, and thus protect them from the atmospheric waters.

We may mention here a process which, although unknown in France, is applied in Russia on the borders of the White Sea, and may, perhaps, be advantageously employed on our own shores. It consists in applying the cold of winter to the concentration of the sea-water. At a low temperature a large quantity of ice separates but all the saline matters rest in the liquid portions, so that by separating the ice, a concentrated brine is obtained, which may afterwards be evaporated by the summer's sun or by artificial heat.

*Treatment of the Bittern or Mother Liquors.*—The waters which have reached a density of 32° in the salting tables, have already deposited the greater part of their common salt, and now contain a large amount of sulphate and hydrochlorate of magnesia, together with a portion of chlorid of potassium. The admirable researches of Mr. Balard have taught us to extract from these mother liquors, sulphate of soda, and salts of magnesia and potash, so that although formerly rejected as worthless, these liquors are now almost as valuable as the salt of which they are the residue.

The production of sulphate of soda, which is directly employed in the manufacture of glass, and as a manure, and still more largely as a material for the fabrication of carbonate of soda, is the most important object of the working of the mother liquors. Immense quantities of sulphate of soda are now prepared in France and England by decomposing sea-salt with sulphuric acid, which is manufactured with sulphur obtained chiefly from foreign sources. In view of this immense consumption of sulphur, it becomes important, especially in time of war when this substance is required for the fabrication of gunpowder, to find some source of sulphate of soda other than the decomposition of sea-salt by sulphuric acid. This process is besides objectionable from the vast amount of hydrochloric acid disengaged, which in most localities cannot be entirely consumed, and is very pernicious to both animal and vegetable life in the vicinity.

It had already been observed that under certain conditions the reaction between sulphate of magnesia and chlorid of sodium could give rise to sulphate of soda; and Mr. Balard has shown that by taking advantage of this decomposition, the sulphate of soda can be advantageously prepared from the bittern of the salting tables.

When the liquors of 32° are evaporated by the summer's heat, they deposit during the day a portion of common salt; but the coolness of the nights causes the separation of crystals of sulphate of magnesia, and the quantity of this latter salt goes on increasing as the evaporation advances toward 35°. This mixture of salts (A) is carefully collected, and reserved for the manufacture of the sulphate of soda.

When the bittern at 35° is still further evaporated by the heat of the sun, it deposits a mixture which is called *sel d'eté*, and contains a large amount of potash. By a second crystallization of this product, a double sulphate of potash and magnesia is obtained, which holds 24 per cent. of potash; but this mode of treating the mother liquors of 35° is less advantageous than the following, which is now adopted. The liquors are placed in large basins and preserved until the first frosts, when at the temperature of 35° or 40° Farenheit, they deposit the greater part of their sulphate of magnesia in large crystals. This sulphate, which is pure Epsom salt, is either sold to the apothecaries, or used to prepare sulphate of soda by the process about to be described. When the sulphate of magnesia has been thus separated, the liquid is run off into large reservoirs, and preserved until the next summer, when it is again evaporated in shallow basins by the sun's rays. It now deposits a large amount of a fine granular salt, which is a double chlorid of potassium and magnesium. This double salt can only be crystallized from solutions containing a large quantity of chlorid of magnesium, and when re-dissolved in pure water gives pure chlorid of potassium by evaporation. The double chlorid is raked up from the tables and placed in piles on the earth, where the moisture causes the salt to decompose; the magnesian salt deliquescing drains off, and the chlorid of potassium remains behind.

The mother liquors having acquired a density of 38°, have deposited all their potash, and are now evaporated by artificial heat to 44°; during this evaporation they still deposite a portion of common salt mixed with sulphate of magnesia (B), and on cooling, the liquid becomes a solid mass of hydrated chlorid of magnesium, which may be employed to furnish caustic and carbonated magnesia by decomposition. When calcined in a current of steam, it is completely decomposed into hydrochloric acid and an impure magnesia, still containing some sulphates and chlorids, which may be removed by water.

By mingling in proper proportions the solution of chlorid of magnesium at 44° with brine at 24°, nearly the whole of the sea-salt is precipitated in the form of minute crystals of great pureness and beauty; the mother liquors are then removed by washing with a saturated brine, and in this way a very fine quality of table salt may be advantageously manufactured,

During these successive concentrations the volume of the water has become greatly diminished, 10,000 gallons of sea-water reduced to 25°, (the point at which it begins to deposit salt,) measure only 935 gallons; at 30°, 200 gallons; at 31°, 50 gallons; and at 34°, are reduced to a volume of only 30 gallons.

*Preparation of Sulphate of Soda.*—For this process the cold of autumn and winter is required. The mixtures of sea-salt and sulphate of magnesia, (A and B.) together with the pure sulphate of magnesia obtained from the mother liquors at 32°, are dissolved in water heated to 95° F., with the addition of such a quantity of common salt as shall make the proportions of the two salts equal to 80 parts of chlorid of sodium to 60 of anhydrous sulphate of magnesia. The warm saturated solution is exposed in shallow basins to a cold of 32° F., when it deposits 120 parts of hydrated sulphate of soda, equal to 54 of anhydrous sulphate, or three-fourths of the sulphuric acid of the mixture. In theory, about equal weights of the two salts are necessary for their mutual decomposition, but an excess of common salt diminishes the solubility of the sulphate of soda, and thus augments the product. From the residual liquid, which contains chlorid of magnesium mixed with common salt and a portion of sulphate of magnesia, the latter salts may be separated by evaporation. The sulphate of soda is converted into carbonate of soda by the usual process of calcination with carbonate of lime and coal.

*The Potash Salts.*—The chlorid of potassium obtained by the process already indicated, is decomposed by sulphuric acid, and the resulting sulphate at once converted into carbonate of potash by a process similar to that employed for the manufacture of carbonate of soda. The carbonate of potash thus prepared is free from sulphate and chlorid, as well as from silica and alumina, and those metallic impurities which like iron and manganese, are always present in the salt obtained from wood-ashes, and render the potashes of America and Russia unfit for the fabrication of fine crystal glass. The double sulphate of potash and magnesia may be at once decomposed like the sulphate of potash, by limestone and coal, and both it and the chlorid may be directly employed in the fabrication of potash-alum, a salt which contains nearly ten per cent. potash, and of which five thousand tons are annually manufactured in France. The high price of the salts of potash has led the manufacturers of alum to replace this alkali wholly or in part by ammonia, but the potash salts from sea-water will furnish potash so cheaply as to render the use of ammonia no longer advantageous.

The greater part of chlorid of potassium as yet produced in the salines in the south of France is now however, employed chiefly in the Imperial manufactories of saltpetre or nitrate of potash. The nitrate of soda which is so abundant in some parts of South America, is decomposed by chlorid of potassium, yielding common salt, and pure nitrate of potash for the fabrication of gunpowder.

*Yield of the Mother Liquors.*—According to a calculation of Mr. Balard the proportion of sulphate in sea-water corresponds to a quantity of anhydrous sulphate of soda equal to one-eighth that of the common salt, but on a large scale the whole of this cannot be economically extracted; the saline of Baynas yields annually besides 20,000 tons of sea-salt, 1550 tons of dried sulphate of soda, or 7·75 per cent., instead of the 12·50 per cent. indicated by theory. Estimating the yield at 7·0 per cent. according to Payen, the cost of the sulphate will be 30 francs the ton, which will make the cost of the crude carbonate of soda 50 francs, while it brings in France from 80 to 120 francs the ton.

The amount of chlorid of potassium obtained is equal to one-hundredth, or to 200 tons for the above amount of sea-salt, and the value of this salt is 360 francs the ton. By its decomposition it will yield 185 of pure carbonate of potash, which sells for 1000 or 1100 francs the ton. Thus it appears that for 20,000 tons of sea-salt, worth at 10 francs the ton, 200,000 francs, there is obtained chlorid of potassium for the value of 72,000 francs. The potash being a secondary product from the residues of the processes for sea-salt and sulphate of soda, is obtained almost without additional cost. It has been shown by careful calculations that the sulphate of soda and the potash from the waters of the Mediterranean, will alone repay the expense of extraction, the sea-salt first deposited, being re-dissolved and carried back to the ocean. A powerful company is now erecting works on a great scale in the vicinity of Marseilles, where the marshes of the Camargue offer a great extent of waste lands, valueless for cultivation, but well adapted for this manufacture. Here it is proposed to evaporate the sea-water solely for the sake of the sulphates, the potash and the magnesia which it contains. Basins which are already covered with a layer of sea-salt, are very advantageously employed for the evaporation of the mother liquors, from the ease with which the potash and magnesia salts may be collected from it in a state of purity.

The amount of salt produced in France in 1847 was about 570,000 tons, of which 263,000 were from the salt-marshes of the Mediterranean, 231,000 from those of the western coast, and 76,000 from salt-springs and a mine of rock-salt; there were employed in these 16,650 workmen. If we estimate the produce of the salt marshes in round numbers at 500,000 tons, the amount of chlorid of potassium to be obtained from the mother liquors, at one per cent., will be 5000 tons, and that of the sulphate of soda at seven per cent. will be 35,000 tons. The amount of sulphate of soda annually manufactured in France is 65,000 tons, requiring for this purpose 54,000 tons of sea-salt, and nearly 14,000 tons of sulphur, which is completely lost in the manufacture of carbonate of soda.* If now the mother liquors from an area twice as great as is now occupied by all the salines in France, were wrought with the same results as at Baynas, they would yield besides 70,000 tons of sulphate of soda, or more than is required for the wants of the country, 10,000 tons of chlorid of potassium, equal to 9,250 tons of pure carbonate of potash, a quantity far greater than is consumed in France, and would enable her to export potash salts. According to Mr. Balard the consumption of potash in France amounted in 1848 to 5,000 tons, of which 3,000 were imported, and 1,000 tons extracted from the refuse of the beet-root employed in the manufacture of sugar.

The production of the two alkalies, potash and soda, offers some very interesting relations. Previous to the year 1792, soda was obtained only by the incineration of sea-weed and maritime plants, but it was at that epoch, when France was at war with the whole of Europe that her necessities led to the discovery of a mode of ex-

* The soda manufactory of Chaunay, established in connection with the glass works of St. Gobain, consumes above 5,000 tons of sulphur yearly, and the immense establishment of Tennant, at St. Rollox, near Glasgow, employs annually 17,000 tons of salt, 5,550 of sulphur, and 4,500 tons of oxyd of manganese. It produced in 1854, 12,000 tons of soda-ash, 7,000 of crystallized carbonate of soda, besides 7,000 tons of chlorid of lime, prepared with the chlorine obtained by decomposing the waste hydrochloric acid from the soda process by the oxyd of manganese. The cost of sulphur in England in 1854 was about twenty-five dollars the ton.

tracting soda from sea-salt. Obliged for the purposes of war to employ all the potash which the country could produce, for the manufacture of saltpetre, it became necessary for the fabrication of soaps and glass to replace this alkali by soda, and therefore to devise some more abundant source of it than was afforded by sea-weed. It was then that the Government having offered a prize for the most advantageous method of extracting the soda from sea-salt, Leblanc proposed the process above alluded to, which consists in converting the chlorid of sodium into sulphate, and decomposing this salt by calcining it with a proper mixture of ground limestone and coal, thus producing carbonate of soda and an insoluble oxy-sulphuret of calcium. This remarkable process, perfect from its infancy, has now been adopted throughout the world, "and those who thought to annihilate the industry of France were soon obliged to borrow from her those great resources which French science had invented." (*Payen, Chimie Industrielle*, p. 209.)

Soda has now replaced potash to a very great extent in all those arts where it can without prejudice be substituted for the latter; potash is however indispensable for the manufacture of fine crystal and Bohemian glass, for the fabrication of saltpetre, as well as for the preparation of various other salts employed in the arts. The country people in France having been accustomed to employ the crude American potash for the bleaching of linen, were unwilling to make use of the purer soda-ash, and the result is that a great part of what is sold as American potash in France, is nothing more than an impure caustic soda, coloured red with sub-oxyd of copper, and fused with an admixture of common salt, which serves to reduce its strength, and give it the aspect of the crude potash of this country.

But notwithstanding the soda from sea-salt is now replacing potash to so large an extent, the supply of this alkali is scarcely adequate to the demand, and the consequence is that while the price of soda has greatly diminished, that of potash has of late years considerably augmented, and it has even been proposed to extract this alkali from feldspar and granitic rocks, by processes which can hardly prove remunerative. The rapid destruction of the forests before the advancing colonization of this continent, threatens at no distant day to diminish greatly the supplies of this as yet important production of our country, and it was therefore a problem of no small importance for the industrial science of the future, to discover an economical and unfailing source of potash. The new process of Mr. Balard appears to fulfil the conditions required, and will, for the time to come, render the arts independent of the supplies to be derived from vegetation.

In more ways than one, this result will be advantageous for our country; the importance of potash salts as a manure, is now beginning to be understood, and it is seen that the removal from the land in the shape of ashes, of the alkali which during a century has been taken up from the earth and stored in the growing forest, is really an unwise economy, for the same alkali restored to the soil becomes a fertilizer of great value. It is to be feared too that in many parts of the country, the colonist wishing to render the forest available as an immediate source of gain, has thought rather to cut down and burn the wood for the sake of its ashes, than to cultivate the land thus cleared. The effect of this short-sighted policy in thus destroying our forests, is already beginning to be seriously felt in some parts of our country, where the early settlers looking upon the forest as their greatest enemy, sought only to drive back its limits as fast and as far as possible, and have thus left the borders of the St. Lawrence nearly destitute of wood, so that the cultivator is often obliged to bring from a distance of many miles that fuel, which in a country like ours, is such an important necessary of life, and now commands in our large towns a high price, which is annually increasing. But apart from their value as sources of fuel, the importance of occasional forests in breaking the force of winds, and tempering both the cold blasts of winter, and the heat and dryness of the summer, should not be overlooked in a country which like ours, is exposed to great extremes of temperature. The unwise policy which formerly levelled with an unsparing hand the forests of Provence, has rendered portions of that country almost a desert, exposed to the strong winds which descend from the Alps. Future generations may plant forests where we are now destroying them.

But to return from this digression; it is worthy of consideration whether the extraction of salt from sea-water, for the internal consumption of the province, as well as for the supply of the immense fisheries on our coasts, might not be made a profitable branch of industry. The shores of the lower St. Lawrence, or of the Bay of Chaleurs, would probably afford many favorable localities, for the establishment of salines; the heat of our summers which may be compared to those of the south of France, would produce a very rapid evaporation, while the severe frosts of our winters might be turned to account for the concentration of the water by freezing, as is practised in northern Russia. Experiments would enable us to determine how far the concentration can be carried during the winter months, and whether this process could be advantageously employed during the cold season, in preparing strong brines for the summer. The sulphates of magnesia and soda, and the potash salts, would find a ready market in England, if the consumption of carbonate of soda and soda-ash in the province should not be found sufficient to warrant the establishment of furnaces for the manufacture of these alkalies in the country.

In the construction of a saline it would be necessary to choose a locality where there is a considerable extent of nearly level surface between the lines of high and low water. High embankments would be necessary to protect the evaporating ground against the tides of our coasts, but these once constructed, the high tides would enable us to fill reservoirs at such an elevation as would carry the water by its own gravity through a series of basins, and thus dispense, in a great measure at least, with the elevating machines employed in the salines of the Mediterranean.

I have given these suggestions, and have entered into many details of the process of working the salines, from a conviction of the great importance of this industry as now developed in France, and from a hope that some persons may be induced to inquire whether these processes may not be economically applied upon our own coasts.

T. S. H.

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ARTICLE XII.—*Contributions to Meteorology, reduced from Observations taken at St. Martins, Isle Jesus, County of Laval, Canada East.* By CHARLES SMALLWOOD, M.D., L.L.D., Professor of Meteorology, University of McGill College.

These observations extend over the past year (1857). The geographical co-ordinates of the place are, latitude 45° 32′ north, and longitude 75° 36′ west from Greenwich. The cisterns of the barometers are 118 feet above the mean sea-level. The instruments are standard ones, and are verified at suitable seasons. The results are reduced from tri-daily observations, taken at

6 A.M., 2 P.M., and 10 P.M., (by which the civil day is divided into 3 equal divisions of 8 hours each,) and the observations are subjected to the usual corrections for the construction of instruments and for temperature. The self-registering principle has been applied to some of them; and it is matter of regret that more of our observations are not thus supplied, for how *scientifically* incorrect must be observations on the currents of the wind, for example, (and which subject is at the present time forming an important point for meteorological investigation in all parts of the world,) unless something better than the mere empirical formula of tenths is adopted? However vigilant the observer may have been, it is not possible that he can approach even to an approximate estimate of its force or velocity.

*Atmospheric Pressure.*—The highest reading of the barometer during the year was at 10 P.M. on the 20th December; and indicated 30.346 inches, and the lowest occurred also in December, on the 31st day, and indicated 28.880 inches, giving a range for that month of 1.466 inches. The average mean range for some years gives the greatest amount in January, next in December. *July*, for a like period, gives the *least* range; and July the past year (1857) gave a range of 0.569 inches, which is rather less than the average for some years. The *mean* annual pressure was 29.758 inches, which gives 0.082 inches more than the annual mean of the last seven years. The atmospheric pressure for January was 29.915 inches, for February 29.915 inches, for March 29.718 inches, for April 29.691 inches, for May 29.682 inches, for June 29.615 inches, for July 29.754 inches, for August 29.723 inches, for September 29.812 inches, for October 29.824 inches, for November 29.681 inches, and for December 29.743 inches.

The greatest barometric range within twenty-four hours with a rising column, was 0.679 inches, on the 8th of February; and the greatest range with a falling column was 0.877 inches, on the 27th February. Both these variations occurred at Toronto; the latter happened twenty-four hours sooner there.

The *Symmetrical Wave of November* was marked by its usual fluctuations. The final trough terminated at noon on the 23rd day.

*Temperature.*—The mean temperature for the year was 40.57 degrees, which shows it 0.99 degrees colder than the mean annual temperature of the last seven years. The month of January was scarcely ever equalled for the low reading of the thermometer, and indicated 9.21 degrees lower than the mean temperature of January for the last seven years, and is the coldest January on record here. The mean temperature of the month was 4.05 degrees.

February was the warmest February on record, the mean temperature being 21.61 degrees, and 8.30 degrees higher than the mean of February for the last seven years. The highest temperature observed in February was 46.1 degrees, which exceeds by 5 degrees the mean highest temperature of the month of February for the last seven years.

The lowest temperature was observed on the 18th January, and was —31.8 degrees (below zero), and the highest reading of the thermometer was on the 14th of July, indicating 98 degrees; making a yearly range of 130.5 degrees, which is less by 6.2 degrees than the greatest absolute range for the past seven years. July was the warmest month, the mean temperature being 71.57 degrees, which is 3.21 degrees less than the mean annual temperature for July for the last seven years. The mean temperature for each month was as follows: January 4.05 degrees, February 21.61, March 23.79, April 37.19, May 51.90, June 61.44, July 71.57, August 65.07, September 57.47, October 44.19, November 33.69, and December 14.96.

The cold terms of January were felt generally in Canada, and through the Eastern and the Northern States. On the 18th January. at Missisquoi, the thermometer attained a minimum of 42 degrees below zero. This fact was kindly furnished me by Mr. J. C. Baker. At Sherbrooke, my friend Dr. Johnston writes me, the greatest cold observed was on the morning of the 24th January, when the mercury in the thermometer was frozen, in those instruments using it; and Professor Miles of Lennoxville College observed his spirit thermometer at 44 degrees below zero; while at Missisquoi on the 24th Mr. Baker's record showed a temperature of 24 degrees below zero, and at this place on the 24th day the mercury stood at 29.6 degrees below zero; the spirit thermometer stood also at the same temperature. At Watertown, N. Y., on the 18th, the temperature was 36 degrees below zero; and on the 24th, at the same place, frozen mercury was carried about in a vial for exhibition. At Harvard College, at 7 A.M. on the 24th, the thermometer indicated a temperature of 16°— (below zero), at Albany it reached 30°—, at

Providence it reached 32°—, at Quebec 39°.5—; while more south the weather was somewhat moderate, but was accompanied by very heavy snow-storms.

In Montreal the record of my friend Dr. Hall indicated on the 18th a temperature of only 20°— (below zero); on the 23d, 27°—; and on the 24th, 25 7—.

The *Mean of Humidity* for the year was 0.822, and indicated 0.008 of moisture above the average of the last seven years. The mean humidity for January was 0.925, for February 0.850, for March 0.826, for April 0.821, for May 0.753, for June 0.786, for July 0.800, for August 0.848, for September 0.823, for October 0.859, for November 0.871, and for December 0.800. Complete saturation occurred but at one observation during the year.

*Rain* fell on 105 days. It rained 556 hours 8 minutes, and amounted to 48.251 inches on the surface. This depth exceeds by 5.147 inches the mean yearly amount of the last seven years. On 19 days, the rain was accompanied by thunder and lightning.

*Snow* fell on 50 days. It snowed 273 hours 15 minutes, and amounted to 86 98 inches on the surface. This amount shows a decrease of 8.78 inches from the mean of the last seven years.

The greatest amount of rain fell in October, and indicated 6.823 inches; the least amount in January, and was inappreciable.

The greatest amount of snow fell in December, and reached 26.81 inches. The least amount fell on the 29th September, being the first snow of the autumn. The last snow in spring fell on the 27th of April.

*Evaporation.*—The amount of water evaporated from the surface during the months of April, May, June, July, August, September, and October amounted to 20.245 inches, which amount represents very nearly the average of the last seven years. The amount of ice evaporated during the remaining months gives an equivalent of 9.57 inches of evaporation from the surface. The monthly amount of evaporation bears a striking proportion to the humidity of the air, and to the velocity and the direction of the wind.

*Winds.*—The most prevalent wind during the year was the Westerly, and the least was the East. The whole amount of wind for the year was 54,425.10 miles, which shows an increase of 1,363.47 miles over the amount of last year. The mean velocity for the year was 6.18 per hour. The most windy hour was from 2 to 3 A.M. on the 25th of November, when the wind reached a velocity of 49.89 miles. January was the most windy month, and July the calmest. The mean velocity for the year exceeds by 1.10 miles the mean velocity of the Toronto anemometric observations. The N. E. by E. wind shows a great amount in miles, owing to its velocity being greater than the winds from any other point of the compass with the exception of the westerly.

The greatest intensity of the sun's rays for the year was 122°; and the lowest point of terrestrial radiation was 32°.4— (below zero).

The amount of *Dew* during the year was less than the usual average.

There were 31 days perfectly cloudless, which gives 26 more cloudy days than the mean amount of cloudy days during the last seven years. There were 113 nights suitable for astronomical purposes.

The winter of 1856 fairly set in on the 14th December.

The Song Sparrow (*Fringilla melodia*), the harbinger of spring, first made its appearance on the 25th March. Swallows (*Hirudo rufa*) first seen 19th April. Frogs (*Rana*) first seen 22nd April. Shad (*Alosa*) first caught 24th May. Fire-flies (*Lampyrus corusca*) first seen 19th June. Snow-birds (*Phlectrophanes nivalis*) first seen 22nd December, 1856. (Very few were seen during the past winter, 1857–8.)

Crows wintered here.

*Ozone.*—The amount of ozone during the year has shown a little increase on the amount of last year.

*Atmospheric Electricity.*—The amount present has been somewhat below the usual average. The electricity of serene weather has indicated very feeble intensity; and during the summer thunder-storms the amount has been varied both in intensity and kind. Maximum intensity 360°, in terms of Volta's No. 1 Electrometer.

A suitable instrument for collecting atmospheric electricity of *small expense*, is still a thing to be desired, to obviate the use and consequent expense of collecting and insulating lamps, which require constant attention. I have one constructed on the plan of Romershausen, but have not yet used it sufficiently to test its collecting powers.

The *Aurora Borealis* was visible at observation-hour on 24 nights; and *Lunar Halos* were visible at the same hour on 6 nights. The *Zodiacal Light* was unusually bright at the evening observations, but the morning observations did not show any such increased brightness.

St. Martin, Isle Jésus, 3d April, 1858.

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ARTICLE XIII.—*On the Packing of the Ice in the River St. Lawrence.*—By Sir W. E. Logan.

(From the Proceedings of the Geological Society of London, for June 15, 1842; vol. iii., p. 766.)

The island of Montreal stands at the confluence of the rivers Ottawa and St. Lawrence, and is the largest of several islands splitting up these mighty streams, which cannot be said to be thoroughly mingled until they have descended some miles below the whole cluster. The rivers first come in contact in a considerable sheet of water called Lake St. Louis, which separates the upper part of the island of Montreal from the southern main. But though the streams here touch, they do not mingle. The waters of the St. Lawrence, which are beautifully clear and transparent, keep along the southern shore, while those of the Ottawa, of a darker aspect, though by no means turbid, wash the banks of the island; and the contrast of colour they present strongly marks their line of contact for many miles.

Lake St. Louis is at the widest part about six miles broad, with a length of twelve miles. It gradually narrows towards the lower end, and the river as it issues from it becoming compressed into the space of half a mile, rushes with great violence down the Rapids of Lachine, and, although the stream is known to be upwards of eight feet deep, it is thrown into huge surges of nearly as many feet high as it passes over its rocky bottom, which at this spot is composed of layers of trap extending into floors that lie in successive steps.

At the termination of this cascade the river expands to a breadth of four miles, and flows gently on, until it again becomes cramped up by islands and shallows opposite the city of Montreal. From Windmill Point and Point St. Charles above the town, several ledges of rock, composed of trap lying in floors, which in seasons of low water are not much below the surface, shoot out into the stream about 1000 yards; and similar layers pointing to these come out from Longueuil on the opposite shore. In the narrow channel between them, the water, rushing with much force, produces the *Sault Normand*, and cooped up a little lower down by the island of St. Helen and several projecting patches of trap, it forms St. Mary's Current.

The interval between St. Helen and the south shore is greater than that between it and Montreal; but the former is so floored and crossed by hard trap rocks that the St. Lawrence has as yet produced but little effect in wearing them down, while in the latter it has cut out a channel between thirty and forty feet deep, through which the chief part of its waters rush with a velocity equal to six miles per hour. It is computed that by this channel alone upwards of a million of tons flow past the town every minute.

Between this point and Lake St. Peter, about fifty miles down, the river has an average breadth of two miles, and proceeding in its course with a moderate current, accelerated or retarded a little according to the presence or absence of shoals, it enters the lake by a multitude of channels cut through its delta, and forming a group of low flat alluvial islands.

The frosts commence about the end of November, and a margin of ice of some strength soon forms along the shores of the river and around every island and projecting rock in it; and wherever there is still water it is immediately cased over. The wind, acting on this glacial fringe, breaks off portions in various parts, and these proceeding down the stream constitute a moving border on the outside of the stationary one, which, as the intensity of the cold increases, is continually augmented by the adherence of the ice-sheets which have been coasting along it; and as the stationary border thus robs the moving one, this still further outflanks the other, until in some part the margins from the opposite shores nearly meeting, the floating ice becomes jammed up between them, and a night of severe frost forms a bridge across the river. The first ice-bridge below Montreal is usually formed at the entrance of the river into Lake St. Peter, where the many channels into which the stream is split up greatly assist the process.

As soon as this winter barrier is thrown across (generally towards Christmas) it of course rapidly increases by stopping the progress of the downward-floating ice, which has by this time assumed a character of considerable grandeur, nearly the whole surface of the stream being covered with it; and the quantity is so great, that to account for the supply, many, unsatisfied with the supposition of a marginal origin, have recourse to the hypothesis that a very large portion is formed on and derived from the bottom of the river, where rapid currents exist. But whatever its origin, it now moves in solid and extensive fields, and wherever it meets with an obstacle in its course, the momentum of the mass breaks up the striking part into huge fragments that pile over one another; or if the obstacle be stationary ice, the fragments are driven under it and there closely packed. Beneath the constantly widening ice-barrier mentioned, an enormous quantity is thus driven, particularly when the barrier gains any position where the current is stronger than usual. The augmented force with which the masses there move, pushes and packs so much below, that the space left for the river to flow in is greatly diminished, and the consequence is a perceptible rise of the waters above, which indeed from the very first taking of the bridge gradually and slowly increase for a considerable way up.

There is no place on the St. Lawrence where all the phenomena of the taking, packing and shoving of the ice are so grandly displayed as in the neighbourhood of Montreal. The violence of the currents is here so great, and the river in some places expands to such a width, that whether we consider the prodigious extent of the masses moved or the force with which they are propelled, nothing can afford a more majestic spectacle, or impress the mind more thoroughly with a sense of irresistible power. Standing for hours together upon the bank overlooking St. Mary's Current, I have seen league after league of ice crushed and broken against the barrier lower down, and there submerged and crammed beneath; and when we reflect that an operation similar to this occurs in several parts from Lake St. Peter upwards, it will not surprise us that the river should gradually swell. By the time the ice has become stationary at the foot of St. Mary's Current, the waters of the St Lawrence have usually risen several feet in the harbour of Montreal, and as the space through which this current flows affords a deep and narrow passage for nearly the whole body of the river, it may well be imagined that when the packing here begins the inundation rapidly increases. The confined nature of this part of the channel affords a more ready resistance to the progress of the ice, while the violence of the current brings such an abundant supply, and packs it with so much force, that the river, dammed up by the barrier, which in many places reaches to the bottom, attains in the harbour a height usually twenty, and sometimes twenty-six feet above its summer level; and it is not uncommon between this point and the foot of the current within the distance of a mile, to see a difference in elevation of several feet, which undergoes many rapid changes, the waters ebbing or flowing according to the amount of impediment they meet with in their progress, from submerged ice.

It is at this period that the grandest movements of the ice occur. From the effect of packing and piling and the accumulation of the snows of the season, the saturation of these with water, and the freezing of the whole into a solid body, it attains the thickness of ten to twenty feet, and even more; and after it has become fixed as far as the eye can reach, a sudden rise in the water, occasioned no doubt in the manner mentioned, lifting up a wide expanse of the whole covering of the river so high as to free and start it from the many points of rest and resistance offered by the bottom, where it had been packed deep enough to touch it, the vast mass is set in motion by the whole hydraulic power of this gigantic stream. Proceeding onward with a truly terrific majesty, it piles up over every obstacle it encounters; and when forced into a narrow part of the channel, the lateral pressure it there exerts drives the *bordage* up the banks, where it sometimes accumulates to the height of forty or fifty feet. In front of the town of Montreal there has lately been built a magnificent revêtement wall of cut limestone to the height of twenty-three feet above the summer level of the river. This wall is now a great protection against the effects of the ice. Broken by it, the ice piles on the street or terrace surmounting it, and there stops; but before the wall was built, the sloping bank guided the moving mass up to those of gardens and houses in a very dangerous manner, and many accidents used to occur. It has been known to pile up against the side of a house more than 200 feet from the margin of the river, and there break in at the windows of the second floor. I have seen it mount a terrace garden twenty feet above the bank, and crossing the garden enter one of the principal streets of the town. A few years before the erection of the revêtement wall, a friend of mine, tempted by the commercial advantages of the position, ventured to build a large cut-stone warehouse 180 feet long and four or five stories high, closer than usual upon the margin of the harbour. The ground-floor was not more than eight feet above the summer level of the river. At the taking of the ice, the usual rise of the water of course inundated the lower story, and the whole building becoming surrounded by a frozen sheet, a general expectation was entertained that it would be prostrated by the first movement. But the proprietor had taken a very simple and effectual precaution to prevent this. Just before the rise of the waters he securely laid against three sides of the building, at an angle of less than 45°, a number of stout oak logs a few feet asunder. When the movement came the sheet of ice was broken and pushed up the wooden inclined plane thus formed, at the top of which meeting the wall of the building, it was reflected into a vertical position, and falling back, in this manner such an enormous rampart of ice was in a few minutes placed in front of the warehouse as completely shielded it from all possible danger. In some years the ice has piled up nearly as high as the roof of this building. Another gentleman, encouraged by the security which this warehouse apparently enjoyed, erected one of great strength and equal magnitude on the next water lot, but he omitted to protect it in the same way. The result might have been anticipated. A movement of the ice occurring, the great sheet struck the walls at right angles, and pushed over the building as if it had been a house of cards. Both positions are now secured by the revêtement wall.

Several movements of the grand order just mentioned occur before the final setting of the ice, and each is immediately preceded by a sudden rise of the river. Sometimes several days and occasionally but a few hours will intervene between them; and it is fortunate that there is a criterion by which the inhabitants are made aware when the ice may be considered at rest for the season, and when it has therefore become safe for them to cut their winter roads across its rough and pinnacled surface. This is never the case until a longitudinal opening of considerable extent appears in some part of St. Mary's Current. It has embarrassed many to give a satisfactory reason why this rule, derived from the experience of the peasantry, should be depended on. But the explanation is extremely simple. The opening is merely an indication that a free sub-glacial passage has been made for itself by the water, through the combined influence of erosion and temperature, the effect of which, where the current is strongest, has been sufficient to wear through to the surface. The formation of this passage shows the cessation of a supply of submerged ice, and a consequent security against any further rise of the river to loosen its covering for any further movement. The opening is thus a true mark of safety. It lasts the whole winter, never freezing over even when the temperature of the air reaches 30° below zero of Fahrenheit; and from its first appearance the waters of the inundation gradually subside, escaping through the channel of which it is the index. The waters seldom if ever however fall so low as to attain their summer level; but the subsidence is sufficiently great to demonstrate clearly the prodigious extent to which the ice has been packed, and to show that over great occasional areas it has reached to the very bottom of the river. For it will immediately occur to every one, that when the mass rests on the bottom its height will not be diminished by the subsidence of the water, and that as this proceeds, the ice, according to the thickness which it has in various parts attained, will present various elevations after it has found a resting-place beneath, until just so much is left supported by the stream as is sufficient to permit its free escape. When the subsidence has attained its maximum, the trough of the St. Lawrence therefore exhibits a glacial landscape, undulating into hills and valleys that run in various directions, and while some of the principal mounds stand upon a base of 500 yards in length, by a hundred or two in breadth, they present a height of ten to fifteen feet above the level of those parts still supported on the water.

On the banks of the St. Lawrence, in the neighbourhood of Montreal, there is an immense collection of boulders, chiefly from rocks of igneous origin, and among them syenite greatly abounds. They are of all sizes, but many are very large, and multitudes must be tons in weight. From their appearance above the surface in shallow parts of the river it is very probable the bed of it teems with them also; and it is remarked by the inhabitants that the positions of these boulders, both in the river and on the banks, frequently appear changed after the removal of the ice in the spring. I spent several days in the autumn of last year examining the boulders along shore, all the way from Montreal to Lachine, a distance of nine miles; and on again looking at them in the spring I missed some which had particularly attracted my attention, but as I had not mapped their positions I may inadvertently have passed them over. But when we consider the manner in which the ice packs and subsequently moves, it cannot fail to appear a very probable agent in transporting these blocks. Closely jammed together down to the very bottom of the river over such extensive areas as have been mentioned, and there solidified by severe frosts around the projecting materials that present themselves to its grasp, the ice must seize a multitude of the loose boulders below; and not only will these be carried away, occasionally to very considerable distances, when it breaks up in the spring, but firmly set in their glacial matrix, they will, when in the course of the movements that occur, such masses as hold them are forced over shallow places, act as gravers to register in parallel grooves on the face of such rocks as they encounter, a memento of their progress as they pass along.

The boulders in the middle of the river may at once be occasionally carried to considerable distances; but it can scarcely be so with such as are stationed at or near the borders. For though these may become packed and imbedded in marginal ice, and by the force of a general movement or *shove*, as it is termed by the inhabitants, be driven obliquely up the bank, as soon as this ceases they will there be left; and as these general movements occur only three or four times during a season, and are never of long continuance, and even where the marginal ice is driven up the bank the friction it suffers soon causes succeeding portions to pile over one another, it is evident the boulders would not be carried by it to any very great distance. When a break-up occurs in the spring, it is the great body of ice in the middle of the river that is carried away, which, separating from the grounded portion on the margin, leaves this to be melted down by the increasing temperature of the season. The movements of succeeding winters may push marginal boulders farther and farther on, but they must at the same time have a tendency to carry all within a certain range gradually nearer to the bank, and at last place them in a position at the very limit of their influence. And it is certainly the case, that in the neighbourhood of Montreal there are in many places along the borders of the river collections of boulders sufficiently great to induce the supposition that their presence may be accounted for in this manner.

It is not however only on the immediate banks of the St. Lawrence that boulders abound. They are more or less spread over the whole island of Montreal, and over the plains on the opposte side of the river. I do not pretend to have ascertained their distribution with the precision necessary to permit the expression of an opinion as to the causes which placed them, but I may state that they appeared to me more abundant in the upper part of the island than in the lower, and that proceeding down the valley of the St. Lawrence they ceased altogether not many miles below the island in question: and it may be further remarked, that they did not seem of less weight at the limit of their range than elsewhere.

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## ARTICLE XIV.—*Geological Gleanings.*

*Prof. Wyman on Carboniferous Reptiles.*—Silliman's Journal, No. 74.—One result of the progress of geological inquiry is that of carrying back the higher forms of life farther and farther into geological time. Mammals are now represented by a number of secondary species, and the reptiles, in their amphibian forms, occur in the Palæozoic series as far back as the upper Devonian. Still the multiplication of such instances serves only farther to convince us that we are nearing the periods of the introduction of these forms, for the reptiles of the coal period are all amphibian, and therefore among the lower members of the class, though high among these lower members, while the Mesozoic mammals are chiefly marsupial, and otherwise deficient in the more specialized characters of the higher members of that group.

"One of the most interesting subjects presented to the palæontologist for investigation, is that relating to the determination of the period when the Creator gave forms to organized beings, and placed them in definite relations with the earth and its atmosphere, and made them living things. But the history of geology shows, that generalizations as to the time and circumstances of the creation of given animal forms have approached precision, only as the depths of the ancient lakes and oceans have been faithfully explored, and the shores and dry lands which co-existed with them have been accurately examined.

"It was during the deposition of the Oolite that reptilian life reached its culminating point; below this, the deeper explorations are carried, the less numerous are the remains of reptiles found to be, and it has been assumed within a few years even, that their creation took place during the triassic period. The coal formations had been largely examined, thousands of fishes and still lower animals had been discovered, before the first traces of reptiles came to light in the remains of Apateon and Archegosaurus. After these, there were found the footprints and other remains of other reptiles, discovered or described by Goldfuss, Burmeister, Dr. King, Sir C. Lyell, Mr. Lea, H. Von Meyer, Profs. Dawson, Owen, H. D. Rogers, and E. Hitchcock. The Telerpeton, discovered by Dr. Mantell, was obtained from the upper layers of the Elgin sandstones; and these some of the leading English geologists have referred to the Old red. Doubts have recently arisen as to their real age, so that, in the present state of knowledge we cannot refer reptile life to a period older than the Coal. However, in view of our as yet imperfect knowledge of the Old red fauna, the question may still be raised whether we have even now reached the period of primoidal reptiles."

The reptiles of the Devonian are still limited to the little *Telerpeton Elginense* discovered by Dr. Mantell; but in the carboniferous period new forms have within the last few years rapidly increased in number. The coal measures of Germany, of the United States, of Nova Scotia and Great Britain, had between 1844 and 1854 afforded bones or other remains of seven species referred to five genera, and less distinct evidence perhaps indicating several additional species. Prof. Wyman has now described remains found by Prof. Newberry and Mr. Wheatley in the Ohio coal field, of three additional species of smaller size than some of those previously discovered, but one of them having its anterior limbs and vertebral column preserved along with the skull. To this species Prof. Wyman gives the name of *Raniceps Lyellii.* Like so many ancient animals it combines in one species characters now distributed between two groups, agreeing with the Anourous batrachians, (frogs, &c.,) in the form of the head, length of lower jaws, and absence of ribs, and with the *Urodela* (Newts, &c.,) in "the regular convex border of the lower jaw, and in the separation of the bones of the fore arm." The other species, though too imperfect for detailed description, are regarded as deviating still more widely from known forms and probably of higher rank in nature than the ordinary batrachia.

"If farther investigations should prove them to be the remains of Batrachians, with which they have some affinities, then we shall have a type of which there is no living representative. If they belong to a group higher in the series, they become still more interesting, and give evidence of the existence in the coal formation of animals hitherto referred to later periods."

The former of these suppositions is perhaps the more probable, as the sauriod characters of the batrachians hitherto found in the coal measures, point to the general assumption by the batrachians of that early period of structures, afterwards restricted by the Creator to nobler members of the class.

*Dr. Falconer on Extinct Elephantine Animals.* Jour. Geol. Society of London, No. 52.—Only two species of elephants exist in the modern world, but in the later tertiary era there must have been at least twenty-six species, and these were extensively distributed over North America, Europe, and Northern Asia, as well as India. What an addition it would be to the modern fauna, were these alone of all the great multitude of perished species restored to life, and thus widely diffused. These species, however, were not contemporaneous even in the tertiary period. Thirteen are stated to belong to the Miocene tertiary, one to the Miocene and Pliocene, eight to the Pliocene, and four to the Post Pliocene. It would thus appear that the Miocene period in which these giant proboscideans first appear, gives us also the greatest number of species. To the Miocene also belong two species of another great proboscidean, the Dinotherium.

The extinct elephants have hitherto been arranged in two genera only. 1. *Mastodon* (Cuvier), having the teeth comparatively simple, and divided on the crown into broad mammillæ or tubercles, arranged in transverse ridges. All the species of this genus are extinct. 2. *Elephas* (Lin.), having the teeth very complex, and the crown with numerous thin tranverse ridges, filled in with cement. The two recent elephants belong to this genus, as well as the well known extinct mammoth. Dr. Falconer divides the Mastodons into two sub-genera, as follows :—1. *Trilophodon* having three ridges on each of the true molars. 2. *Tetralophodon*, having 4 or more, rarely 5 ridges. The genus Elephas he divides into three sub-genera. 1. *Stegodon* with 7 to 8 ridges, obtuse like those of the mastodons. 2. *Loxodon* with 7 to 8 ridges, more elongated and acute than in the Mastodon. 3. *Euelephas* having 12 to 18 acute and thin-plated ridges. The genus Trilophodon includes our American Mastodons, which are the latest representatives of this form, and extend to the Post Pliocene period. The Tetralophodons occur principally in the Miocene, and none of them in the new world. The genus *Stegodon* is Miocene, and hitherto found only in India. The genus *Loxodon* is represented by one Miocene and two Pliocene species, and by the recent African

Elephant. *Eulephas* includes the semi-Arctic mammoth, and several other species of Post Pliocene, Pliocene, and Miocene date, as well as the existing Indian Elephant. Dr. Falconer will follow up this subject by descriptions of all the species occurring in Great Britain.

*Prof. Hall's New Volume on the Palæontology of New York.*—Silliman's Journal.—"We have received some sheets of Prof. James Hall's forthcoming (third) volume on the Palæontology of New York; and learn that it is making rapid progress towards completion. The volume will include the fossils of the Lower Helderberg Rocks or the upper part of the Upper Silurian, and the Oriskany Sandstone, generally regarded as Devonian. The author remarks that the sub-divisions of the Lower Helderberg beds (into Upper Pentamerus limestone and Tentaculite or water limestone) are distinguishable only for a short distance, while the formation as a whole reaches widely from the north-east to the south-west. The Oriskany Sandstone appears in some places to pass into the Helderberg rocks below, and in Maryland some of the fossils of the latter beds occur in it; and they may yet prove to blend intimately. But the separation of them in successive groups, is fully justified by their physical condition in the State of New York.

"In the south-west, the Oriskany sandstone contains many Crinoids similar in genera to those of the Lower Helderberg limestones. Among the peculiar forms in both, is the genus *Edriocrinus* (Hall)—a crinoid which is sessile in its young state and firmly attached to other bodies by the base of its cup, but becomes free as it advances and gradually loses all evidence of a cicatrix; the base becoming rounded and smooth, or very rarely preserving a depression or pit near the centre, which marks the original point of attachment"

*Wollaston Medals*—At the Annual Meeting of the Geological Society, a Wollaston medal was awarded to the veteran Palæontologist, Herman Von Meyer, of Frankfort-on-Maine, and a second, with the balance of the fund, to Prof. James Hall, State Geologist of New York. We have much pleasure in recording this deserved recognition of Prof. Hall's long, able, and to a great extent unrequited labours, in American geology and palæontology.

*Distribution of Animals in Australasia.*—Many facts in the distribution of animals and plants, point to ancient differences of level which have disconnected lands or seas formerly united. In Silliman's Journal we find some facts of this kind, in relation to Australia, New Guinea, and the Aru Islands, from a paper by Mr. Wallace in the American Magazine of Natural History. Shallow seas we are told, about 30 to 40 fathoms in depth, connect all these islands.

"But there is another circumstance still more strongly proving this connexion: the great island of Aru, 80 miles in length from north to south, is traversed by three winding channels of such uniform width and depth, though passing through an irregular, undulating, rocky country, that they seem portions of true rivers, ough now occupied by salt water, and open at each end to the entrance of the tides. The phenomenon is unique, and we can account for their formation in no other way than by supposing them to have been once true rivers, having their source in the mountains of New Guinea, and reduced to their present condition by the subsidence of the intervening land."

Nearly one half of the Passerine birds of New Guinea hitherto described are contained in the author's collections made in Aru, and a number also of species in the other tribes.

The author farther observes on the absence of the peculiar East Indian types. "In the Peninsula of Malacca, Sumatra, Java, Borneo and the Philippine Islands, the following families are abundant in species and in individuals. They are everywhere *common birds.* They are the *Buceridæ*, *Picidæ*, *Bucconidæ*, *Trogonidæ*, *Meropidæ*, *Eurylaimidæ ;* but not one species of all these families are found in Aru, nor, with two doubtful exceptions, in New Guinea. The whole are also absent from Australia. To complete our view of the subject, it is necessary also to consider the Mammalia, which present peculiarities and deficiencies even yet more striking. Not one species found in the great islands westward inhabits Aru or New Guinea. With the exception only of pigs and bats, not a genus, not a family, not even an order of mammals is found in common. No Quadrumana, no Sciuridæ, no Carnivora, Rodentia, or Ungulata inhabit these depopulated forests. With the two exceptions above mentioned, all the mammalia are *Marsupials ;* while in the great western islands there is not a single marsupial! A kangaroo inhabits Aru (and several New Guinea), and this, with three or four species of *Cuscus*, two or three little rat-like marsupials, a wild pig and several bats, are all the mammalia I have been able either to obtain or hear of."

*Fossil plants of Pennsylvania Coal Field.*—We are glad to observe that M. Lesquereux and Professor Rogers have commenced the publication of the new species of coal plants from Pennsylvania. 106 new species have been described in the Journal of the Boston Society of Natural History. The results of comparison with European species are, that out of 200, 100 " are identical with species already recognized in the European coal-fields, and some 50 of them shew differences so slight that a fuller comparison with better specimens may result in their identification likewise." This is a result very similar to that previously deduced by Mr. Bunbury and Sir C. Lyell from the comparison of specimens from Nova Scotia and other parts of America, with the European forms. The coal flora of the whole Northern hemisphere was remarkably uniform, indicating great facilities for extensive migrations of plants from west to east, along with a very equable climate. The geographical forms corresponding to such conditions would be very different from those now existing.

*Supposed remains of Domestic Animals in Post-Pliocene Deposits in South Carolina.*—Prof. Holmes of Charleston College has published a paper on this subject, which has attained some celebrity, owing to its introduction into that eccentric piece of ethnology, the "Indigenous races of the earth." The nature of the points maintained by Prof. Holmes may be learned from the following sentences:—

"Now the evidence herein to be adduced will shew that among the fossils in South Carolina from beds of this age—Post Pleiocene—some of which are exposed at Ashley Ferry, Goose Creek, Stono, John's Island, and other localities, a number have been found apparently belonging to animals having specific characters in common, with recent or living species not considered indigenous to this country, such as the horse, hog, sheep, ox, etc.

"A large collection of fossils from this interesting formation were submitted by me about three years ago, to Prof. Leidy, of Philadelphia, the eminent palæontologist, for determination; of these a number were returned with the remark, that they appeared to belong to recent species which had become accidental occupants of the same bed with the true fossils. I held the opposite opinion, and believed that these relics were indeed true fossil remains, as they were obtained not only from the banks and deltas of rivers, but a large number from excavations several feet below the surface, and at a distance from any stream, creek, pond, bog or ravine;

and in some cases from excavations below the high sandy land of cotton fields."

Professor Leidy's explanation of the occurrence of these remains is as follows:—

"The interesting collection of remains of vertebrated animals, which form the subject of the following pages, for the most part have been submitted to the inspection of the author, by Professor Holmes and Capt. A. H. Bowman, U. S. A., who collected them from the eocene, post-pleiocene, and recent geological formations, in the vicinity of Charleston, South Carolina.

"The collections of these gentlemen consist of a most remarkable intermixture of remains of fishes, reptiles and mammals, of the three periods mentioned; and in many cases perhaps we may err in referring a particular species to a certain formation, more especially in the case of the fishes. The remains usually consist of teeth often well preserved, but frequently in small fragments, more or less water worn; and most of the fossils are stained brown or black.

"By far the greater portion of the fossil remains are obtained from the post-pleiocene deposit of the Ashley river, about ten miles from Charleston. The country in this locality is composed of a base of whitish eocene marl, containing remains of *squalodon—sharks and rays*—above which is a stratum of post-pleiocene marl, about one foot in thickness, overlaid by about three feet of sand and earth mould.

"The post-pleiocene marl contains great quantities of irregular water worn fragments of the eocene marl rock from beneath, mingled with sand, blackened pebbles, water-rolled fragments of bones, and more perfect remains of fishes, reptiles and mammals, belonging to the post-pleiocene and eocene fossils.

"On the shores of the Ashley river, where the post-pleiocene and eocene formations are exposed, the fossils are washed from their beds, and become mingled with the remains of recent indigenous and domestic animals, and objects of human art, so that when a collection is made in this locality, it is sometimes difficult to determine whether the animal remains belong to the formations mentioned or not. Generally, however, we have been able to ascertain where the fossils belong, which we have had the opportunity of examining, from the fact that the greater number were obtained from the deposits referred to in digging into them some distance from the Ashley river.

"The collections contain remains of the horse, ox, sheep, hog and dog, which I feel strongly persuaded, with the exception of many of those of the first-mentioned animal, are of recent date, and have become mingled with the true fossils of the post-pleiocene and eocene formations, where these have been exposed on the banks of the Ashley river and its tributaries. In regard to the remains of the horse, from the facts stated in the accounts given of them in the succeeding pages, I think it will be conceded that this animal inhabited the United States during the post-pleiocene period, contemporarily with the *mastodon*, *megalonyx*, and the great broad-fronted bison."

In the subsequent part of his paper, Prof. Leidy proceeds to state the grounds on what he distinguishes the modern horse from the really extinct species, which with its allies of the genus *Hipparion*, did certainly inhabit post-pleiocene America, but had become extinct before its colonization by man—a very remarkable fact to which the researches of Prof. Holmes have added farther confirmation.

Prof. Holmes, dissenting from Dr. Leidy's view as to the recent origin of the bones of the sheep, hog, dog, ox, and common horse found with the undoubted fossils, proceeds to state his reasons for believing them to be post-pleiocene. He attempts to show that some of the bones are scarcely better preserved than those of extinct animals found with them, and argues from the state of preservation of shells, and the per centage of these known to be recent, as well as the fact of some species still existing in a wild state in America, having left their bones in these deposits. These arguments, however, afford merely presumptive proof, and are liable to many solid objections ; and he does not attempt to show, what alone could establish his position, that the disputed bones have actually been found in undisturbed tertiary beds. Since, therefore, the evidence fails in this essential point, we cannot accept the conclusions of Prof. Holmes; but must believe this to be one of these cases, rather numerous in the history of American tertiary geology, in which comparatively modern relics have been mixed with those of more ancient date. We were somewhat surprised to find in the end of the paper a letter from Prof. Agassiz, in which that eminent naturalist appears fully to endorse its conclusions. Comparing the confident tone of this letter with the evident weakness of the case as stated by Prof. Holmes, it is scarcely possible to avoid the inference that the great zoologist is too ready to grasp at any semblance of fact, that tends to support that strange doctrine of the diverse origin of the individuals of the same species, with which in a manner so unworthy of his acute mind, he endeavors to cut the knot of the difficulties in the geographical distribution of animals and plants, the legitimate solution of which forms one of the most interesting problems of geology and its allied sciences.

The following is a list of species collected by Prof. Holmes, which is sufficiently interesting, independently of those which *may* be the debris of modern beef and mutton:—

*Extinct Species.*—Mastodon, Megatherium, Megalonyx, Glyptodon, Mylodon and Hipparion, 2 species.

*Not now found on the Atlantic Coast, but indigenous to North America.*—Bison, Tapir, Peccary, Beaver, Musk-rat, and Elk.

*The Deer, Racoon, Opossum, Rabbit and the following Domestic Animals*—Horse, Hog, Sheep, Dog and Ox are not distinguishable from the living species.

*Devonian and Carboniferous Rocks of Ireland.*—The progress of Geology is continually sweeping into one, groups of rocks heretofore distinct, and it is becoming a most exciting question where will the breaks in geological time be ultimately left, or will there be any breaks. Our geological chronology is like that of the old Assyrian empire, where a few detached kings stand out on the page of history broadly separated by intervals of time; but just as new monuments are disinterred, new names fill up the gaps, and it is only as the list approaches completion that we can know how and where one dynasty rudely or quietly displaced another.

In Ireland a group of yellow and red sandstones, intervening between the carboniferous and silurian systems, have been variously referred to the former, and to the Devonian period. Some of the Irish Geologists even appear desirous of including the whole, and with them the greater part of the Old Red of Scotland, among the carboniferous rocks. The case is thus stated by Mr. Griffiths:—

"No difficulty hence arises in regard to the position of the Old Red series in the south of Ireland, it having been clearly ascertained to conform to the Carboniferous strata above, while resting unconformably upon the Silurian series beneath. The only question that will arise regarding it is, as to what system it will of right belong. And here I must enter upon an explanation of the principle of subdivision by which I have been hitherto influenced. Finding, in the course of my geological researches, that certain rocks below the lowest beds of the lower Carboniferous Limestone conformed to them, and contained the same fossils, I was led to add them to the Carboniferous system, the boundary at the base of the Mountain Limestone, as it had until then been termed, being found to be far too limited. These lower rocks I was ultimately led to consider as divisible into two groups, the upper of which I proposed to call Carboniferous Slate, and the lower, Yellow Sandstone. In respect to this latter and lower of the two series, it became a question as to where the line of division between them and the red beds lying conformably beneath should be drawn; and the discovery of certain plants, apparently of Carboniferous type, and at present known as *Sphenopteris Hibernica*, *Lepidodendron minutum* and *Griffithii* (the last of which was discovered by Dr. Carte in the course of the last year), led to the adoption of the lines of boundary which have been published on the last, as well as on previous editions of my geological Map.

"Subsequently, through the researches of my friends, Professors Haughton and Jukes, as well as those of myself, imperfect casts of these plants were found very far beneath the boundary which I had originally adopted, and hence the extent of the district which I had allotted to these lower Carboniferous rocks will be found much too circumscribed. The principle, however, upon which I set out, remains intact, and as often contended for, both by Professor Haughton and myself, in numerous papers, I would again say, that the base of the Carboniferous system will extend to any zone of these plants, no matter at what depth, or in connexion with what rocks soever, found. That this may have the effect of sweeping the whole of the fish beds of Scotland, with the similar rocks of Glamorganshire in Wales, hitherto considered to be Devonian, into the Carboniferous system, I am not prepared to deny, as it is only a natural inference from the principle which I have laid down. It is true that I have preserved the established territories of the Old Red Sandstone on my Map, curtailing it only of the Plant or Yellow Sandstone beds, as I was not prepared to risk a controversy, merely upon the grounds of the well-known conformity between the two series, without a sufficiency of fossil evidence,—statements founded upon the hypothesis, no matter how well grounded soever they may appear, but upon less than indisputable scientific principles, being still open to the charge of being mere speculation or guess; and especially as I found that up to the present time it has been as much as I could do to defend the innovations which I had already made, even though the Irish geologists generally, and especially Mr. Haughton and Mr. Jukes, who, I trust, will favour us with their views, have all arrived at similar conclusions.

"No means that could have been adopted to ascertain the age of these plants have been neglected; and besides the attention paid to their examination by Professor Haughton, I have consulted M. Adolphe Brongniart, as already mentioned, whose opinion may be seen in a translation of a letter which I lately communicated at one of the Scientific Meetings of the Royal Dublin Society. I may observe, that as I was not looking for plants with a view of including the Old Red Sandstone within my line of boundary, I did not originally discover them so low down as my friend Mr. Jukes has since done; besides that colour being the order of the day, I limited my researches mainly to the yellow beds, discontinuing my search upon reaching the underlying red beds. But I shall be ever ready to hear with pleasure of their discovery to the very bottom of these rocks, and to recognise them, with Mr. Jukes' and Mr. Haughton's concurrence, on my Geological Map, as a group of the Carboniferous system. I may here observe, that I do not wish to be understood as aiming at a subversion of the Devonian system, whether occurring in Devonshire or elsewhere, my present observations being strictly limited to the Old Red Sandstone of the south of Ireland."

It may be doubted if the evidence above given is sufficient fully to establish the conclusions reached, though it shews a remarkable extension of the coal flora. Both in America and Europe rocks containing plants of carboniferous genera are known to be associated with Devonian animal remains. The species, however, are different, and perhaps we should conclude rather that the peculiar type of flora having its largest development in the coal measures, is that of the palæozoic period generally, than that we should extend the carboniferous system downward as far as this peculiar flora extends. Plants closely allied to those of the carboniferous system have been found by the Canadian Survey in beds as low as the horizon of the Oriskany Sandstone, the base of the Devonian in America, and under marine fossils, altogether distinct from those of the carboniferous limestones.

*Earthquakes in Italy.*—In these quiet regions, we do not readily realise the shaky character of those portions of the world in which the earth's internal forces are still acting, making themselves felt at the surface. A letter from an eminent living geologist, who revisited Naples and Sicily in the past winter, informs us that after an interval of 28 years, both Vesuvius and Etna presented great and marked differences of aspect; and it would only be in accordance with past experience, if the recent earthquakes have permanently, if we may use the word, changed the levels of land and water in portions of the Neapolitan territory. The following extracts from the *Athenæum* forcibly describe the effects of these disturbances:—

"The phenomena which preceded and have followed the disastrous earthquake which has struck such a panic throughout this kingdom, have a remarkable and a separate interest from that of the afflicting details of the suffering occasioned by it, as many things occurred to show that before the event there was great subterranean agitation going on. Similar indications of existing agitation now continually manifest themselves. That Vesuvius has been in a state of chronic eruption for nearly two years, and the wells at Resina for the last few months nearly dried up, I have already noted; that the kingdom has been in this interval, in various parts, alarmed by minor shocks of earthquake, may not be so generally known, but such is the fact, and to those signs of impending danger the Official Journal of the 30th of December adds the following:—"The Syndic of Salandro (one of the communes which has suffered much from the recent scourge) reports that for nearly a month at about two miles distance from the town a gas has been observed to issue from a water-course; the temperature of it was about that of the sun. A few days since, too, from another similar fosse, the same kind of gas issued. These exhalations were observed only in the morning however; during the rest of the day they were not perceptible. On the 22d of December, they ceased altogether, and there was an expectation that hot mineral springs would burst forth from that spot." The Official Journal of the 2d of January relates another remarkable fact. In the territory of Bella, about two miles from the town, the earthquake on the night of the 16th of December, levelled the neighboring hills, rolled the earth over and over, and formed deep valleys. Half an hour before the shock, a light as bright as that of the moon was seen to hover over the whole country, and a fetid exhalation like sulphur was perceived. On the morning following the shocks, which were accompanied by loud rumblings, a large piece of land, full 600 moggia (a *moggia* is something less than an acre), and at about the same distance from the town, was found encircled by a trench of from ten to twenty palms in depth, and the same in width. A letter from Vallo, now lying before me, and written much in detail, speaks of "those two terrible shocks," and of the innumerable minor shocks which have continued from the 16th of December up to the present time—the letter being written on the 29th of December. "A few minutes before the first shock," adds the writer, "a hissing sound was heard in the river, as if vast masses of stones were being brought down by a torrent. It is to be noted, too, that all the dogs in the neighborhood howled immediately before the first awful shock."

"Let us visit some of the ruined places at the centre of the disaster;—and I will speak in the words of a gentleman who has just returned: "I found the country seamed with fissures, which had at first been wide, but which gradually closed. The ground was heaving during the whole time of my visit to Polla. Once a beautifully situated township, with 7,000 souls, it is now half in ruins, and the survivors were sitting or walking about, telling us of their misery, and lamenting more that there were no hands to take out the dead or rescue the living. Two country people were groping amongst the stones of a building; one found a body, and throwing a stone towards the face called the attention of the other, 'That perhaps is some relation of yours,' but the body was not recognized. I tried to get food at a *trattoria*, the only house standing, at the corner of a street; but the proprietor, who was by our side, repulsed me, and refused to go in, saying that the moon has just entered the quarter, and we should have another earthquake. In most of these places, as in Naples, the deep, heavy rumblings which preceded and accompanied the earthquake have been much dwelt upon." On the night of the 26th December, the little town of Sasso, near Castelabbate, consisting of one long street, was separated in two by the sudden opening of a fissure through its entire length, each side remaining separated from the other by a considerable interval—and so it stands. On the 28th and 29th of December, both in Sala and Potenza, strong shocks were felt, followed by many others of a less intense character, and these still continue. The consequences will be that even those houses which were only cracked will give way, and those which were feeble will be reduced to ruins. In Naples, too, the shocks continue producing vibrations of the doors and windows; and in one instance, I have heard ringing of the bells. The common report is, that since the 16th of December we have had eighty-four shocks in the capital. It is not at all improbable if every vibration is counted as one, and if the great subterranean agitation, which is now going on, be taken into account. Every one looks really with anxiety to Vesuvius, and prays, not for curiosity only, for an eruption. The indications of so desirable a result seem to be on the increase. A person who resides at Resina says, that on the night of the 29th, from 10 P. M. to 5 A. M. of the 30th ult., the whole town was in a state of continued vibration. Every three minutes a sound was heard as of a person attempting to wrench the doors and windows out of their places, followed by a quiver. The next morning the mountain was observed to vomit forth much smoke and a cloud of ashes. Friends, too, who reside at Capo di Marte, near the city, speak of the deep thunders which they hear from the mountain in the stillness of the night. The same pheuomena are observed at Torre del Greco. I must, also, advert to the manifest lowness of the sea, which seems today to have receded from the land. I noticed this fact in my last letter, and tried to explain it as consequent upon the neap tides: but the same thing continues; and unless it has been occasioned by the long continuation of a land wind, the conclusion is inevitable that there has been an upheaving of soil. It would be rash, however, to come speedily to so important a decision. How this state of things will terminate, it is impossible to say; bnt that some great change is pending, there is but too much reason for supposing."

"Some English gentlemen who have just returned from the scene of disaster give the following interesting though harrowing details:—"Before arriving at Pertosa, we found the houses on either side of the road thrown to the ground; the landlord of a tavern now abandoned told us that he had the good fortune to escape with his wife, but that his child and servant had been both killed. He himself bore the marks of a heavy blow on his face. The population of this place was about 3,000, and 143 bodies only had been dug out on the 1st of January; whilst 200 more were known to be missing. The whole town was destroyed, with the exception of six houses, which were in a falling state. Between Pertosa and Polla the strength and caprice of the earthquake were made manifest in a remarkable way. Crossing a deep ravine, we found the road on the opposite side carried off 200 feet distant from its former position : the mountain above it had been cleft in two, revealing to a great depth the limestone caverns in the bowels of the earth. The ground was seamed with fissures; and we could put our arms into them up to the shoulders. Polla has a population of 7,000 persons :—1,000 had fallen victims, of whom 567 had been dug up and buried; the work of disinterment was continuing slowly, but the stench here and elsewhere, from the bodies, was insufferable. Three shocks of an earthquake were felt on this day, January 1. The first was very early in the morning; the second about half-past 12. When we were standing on the ruins of a church, the ground began to heave under our feet and the subterranean thunders to roll. We immediately fled from the spot, but were nearly overwhelmed as the wall of a bell-tower fell close upon our heels, and a leaning house, in an inclining state, came down within twenty feet of us. The frightened people immediately formed a procession, and headed by the priests, bearing the crucifix and an image of the Madonna, lashed themselves with ropes as they walked. On leaving the town, we rested on the wall of a bridge just outside, where some priests begged us to rise, saying we were in danger, for the ground was continually trembling. Whilst sitting there, we felt the third shock, and required no other hint." At the last moment I add, from official documents, that upwards of 30,000 are returned as dead, and 250,000 living in the open air."

*Habits of the Beaver.*—To include an account of these among geological notices, is hardly an anachronism, since over a large part of the continent the beaver is an extinct animal, and it is rapidly becoming so wherever European colonization penetrates. The following interesting notes are from the Journal of the Academy of Natural Sciences, Philadelphia :—

"Mr. Harris observed, in relation to the specimens of cottonwood and chips cut by beavers, presented this evening, that they had been obtained by him from the Missouri River, between Fort Union, at the mouth of the Yellowstone, and Fort Clark, at the Mandan Village. He added, that in returning from a trip up the Missouri to the mouth of the Yellowstone, in company with the late J. J. Audubon and party, in the month of September, 1843, our Mackinaw boat was moored for the night on the right bank of the river, under shelter of timber on the bank, which was here about twenty feet above the water at its then rather low stage.

Our guide and pilot in descending the river, Prevost, who was an old trapper, hired by Mr. A. at St Louis for the trip, soon discovered signs of the beaver, and presently a newly constructed beaver-house about one hundred yards above the boat. It was too late to examine the premises, and after cutting wood, building a fire, and cooking our supper, we turned in for the night. Very early in the morning, before breakfasting, we hastened to examine w at had been the object of more than one expedition on the Yellowstone, and which had, heretofore baffled our search. Prevost assured us that the noise and smell of smoke, and cooking from our camp, must have driven the beaver to a place of safety soon after our landing the night before, and that we could only gratify our curiosity by the inspection of the building; whereas, had daylight permitted, we might, at first landing, have proceeded quietly and stopped the covered outlet from the house to the water, and thus secured the inmates, and this only by using the utmost caution in approaching without giving them the wind of us, or making the slightest noise, even the cracking of a dry twig under our feet; so religiously did he believe in their superhuman sagacity in discovering and avoiding danger. Thus assured, I took my gun, more from the influence of the habit of some months of seldom stirring from camp without it, than from any expectation of seeing a beaver. I followed the water to the outlet, while others took the bank; here I stood watching the operations of those above, who had commenced removing the branches of cotton-wood which formed the covering of the domicile. I was startled suddenly by the splashing of the water at my feet, and, looking down, I saw the dusky back of a beaver a few inches under the surface, gliding out into the deep water of the river, and before I could prepare and bring my gun into position, he was out of sight. Nothing could have been easier, had I been prepared, than to have shot him as he thus passed within three feet of the spot on which I stood. Thus, from too much reliance on popular tradition of the unerring instinct of this animal, was I prevented from adding the skin, and description, and measurements of a fresh specimen of the beaver to the trophies of our expedition. As the beaver passed down the stream he was seen to rise for air, abreast of our boat, by some of the men on board. We then proceeded to unroof the house by removing the cotton-wood branches, which covered it for several feet in thickness; they extended for a considerable width on each side, and covered the passage from the house to the water; this passage was about fourteen inches square, as neatly excavated as a ditcher could have made it with a spade; it was from twenty-five to thirty feet long, following the scope of the bank, and ending some two or three feet under the water. The branches were laid with their butts uppermost, and formed a complete thatching to the house, nearly weather-proof. The house itself was a vertical excavation into the bank, cylindrical in form and about three and a half feet in diameter; the slope of the bank, where it was cut, gave it the figure of a section of a cylinder of about four feet high on the side of the bank, and the height of the passage to the river, on the other, about fourteen inches. The bottom and walls of this room were smooth and hard as though they had been pressed or beaten, but not plastered. The circle was apparently perfect in form. I should have said, it was rather more than half way up the bank. Prevost said that the house was unfinished, and that, before winter, the whole interior earth and brush of the sides and roof would have been neatly plastered with clay so as to render it entirely weather-proof. The quantity of cotton-wood branches and saplings used in this structure was enormous; I suspect the measurement would have been three cords, or as many wagon loads, and so closely impacted that it was only after considerable labor that a breach was made. On the bank above was the area of *stump-land* where they had felled their timber, taking what was suitable from the most convenient distance. The large block presented this evening was cut from the largest log felled; the branches only were taken, leaving the trunk where it fell. Small saplings were taken entire. The smaller piece, which is cut at both ends, was the butt of a bough or sapling, which, in their attempt to drag to the bank, had become wedged among a clump of bushes in such a manner that they could not back it out again, owing to the resistance of the branches on the ground and of other bushes, so, like the sailor who throws overboard a portion of his cargo to enable him to save the rest, they cut off this piece that they might steer clear of the difficulty with the remnant of their treasure. The chips are from the larger specimen; in cutting them out they must work horizontally around the trunk, and when they have cut two grooves at the proper distance apart, they take hold of the isolated portion with their teeth, and split off portions *vertically*, and so in succession split off chips until they have girdled the tree; a second course is then removed from the bottom of this, and so on diminishing the size of the chips until the tree is only supported by a portion of its heart connecting the apices of two cones—one on the stump upright, the other on the butt of the log inverted. In this manner, also, the Indians cut down trees with their hatchets, leaving the same form of a cone on the butt of the log and on the stump, as their beaver neighbors have done before them."

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ART. XV.—*Note upon the Genus Graptolithus*, and description of some remarkable new forms from the shales of the Hudson River group, discovered in the investigations of the Geological Survey of Canada, under the direction of Sir W. E. Logan, F.R.S. By James Hall.

[Communicated to Sir W. E. Logan in April, 1855.]

[By the kind permission of Sir W. E. Logan, the Director of the Geological Survey, we publish the following description of new species of Graptolites, from his Report for 1857. He has placed at our disposal to accompany these descriptions, two plates which will shortly be published in the first decade of the fossils of Canada.—EDITORS.]

The discovery of some remarkable forms of this genus during the progress of the Canada Geological Survey, has given an opportunity of extending our knowledge of these interesting fossil remains. Hitherto our observations on the Graptolites have been directed to simple linear stipes, or to ramose forms, which except in branching, or rarely in having foliate forms, differ little from the linear stipes. In a few species, as *G. tenuis* (Hall), and one or two other American species, there is an indication of more complicated structure; but up to the present time this has remained of doubtful significance. The question whether these animals in their living state were free or attached, is one which has been discussed without result; and it would seem to be only in very recent times that naturalists have abandoned altogether the opinion that these bodies belonged to the Cephalopoda.

In the year 1847 I published a small paper on the Graptolites from the rocks of the Hudson River group in New York. To the number there given, two species have since been added from the shales of the Clinton group. Other species, yet unpublished, have been obtained from the Hudson River group; and since the period of my publication in 1847, large accessions have been made to our knowledge of this family of fossils, and to the number of species then known. The most important publications upon this

* An accident prevents us from giving the second plate, but it will appear in the next number.—EDS.

subject are, *Les Graptolites de Bohême*, par J. Barrande, 1850; *Synopsis of the Classification of British Rocks, and Descriptions of British Palæozoic Fossils*, by Rev. A. Sedgwick and Frederick McCoy, 1851; *Grauwacken Formation in Sachsen, etc.*, H. B. Geinitz, 1852.

The radix-like appendages, known in some of our American as well as in some European species, has been regarded as evidence that the animal in its living state was fixed; while Mr. J. Barrande, admitting the force of these facts, asserts his belief that other species were free. It does not however appear probable that in a family of fossils so closely allied as all the proper *Graptolitideæ*, any such great diversity in mode of growth would exist.

It will appear evident from what follows, that heretofore we have been compelled to content ourselves for the most part, with describing fragments of a fossil body, without knowing the original form or condition of the animal when living. Under such circumstances, it is not surprising that various opinions have been entertained, depending in a great measure upon the state of preservation of the fossils examined. The diminution in the dimensions, or perhaps we should rather say in the development, of the cellules or serrations of the axis towards the base, has given rise to the opinion advanced by Barrande, that the extension of the axis by growth was in that direction, and that these smaller cells were really in a state of increase and development. In opposition to this argument, we could before have advanced the evidence furnished by *G. bicornis*, *G. ramosus*, *G. sextans*, *G. furcatus*, *G. tenuis*, and others, which show that the stipes could not have increased in that direction. It is true that none of the species figured by Barrande indicate insuperable objections to this view; though in the figures of *G. serra* (Brong.), as given by Geinitz, the improbability of such a mode of growth is clearly shown.

It is not a little remarkable that with such additions to the number of species as have been made by Barrande, McCoy, and Geinitz, so few ramose forms have been discovered; and none so far as the writer is aware, approaching in the perfection of this character to the American species.

Maintaining as we do the above view of the subject, which is borne out by well-preserved specimens of several species, we cannot admit the proposed separation of the Graptolites into the genera *Monograpsus*, *Diplograpsus*, and *Cladograpsus*, for the reason that one and the same species, as shown in single indiv duals, may be *monoprionidean* or *diprionidean*, or both; and we shall see still farther objections to this division, as we progress, in the utter impossibility of distinguishing these characteristics under certain circumstances. We do not yet perceive sufficient reason to separate the branching forms from those supposed to be not branched, for it is not always possible to decide which have or have not been ramose, among the fragments found. Moreover, there are such various modes of branching, that such forms as *G. ramosus* present but little analogy with such as *G. gracilis.*

Mr. Geinitz introduces among the *Graptolitideæ* the genus *Nereograpsus*, to include *Nereites*, *Myrianites*, *Nemertites*, and *Nemapodia.* Admitting these to be organic remains, which the writer has elsewhere expressed his reasons for doubting, they are not related in structure, substance, or mode of occurrence, to the Graptolites, at least so far as regards American species; and the *Nemapodia* is not a fossil body, nor the imprint of one, but simply the *recent track of a slug* over the surface of the slates. The genus *Rastrites* of Barrande has not yet been recognized among American *Graptolitideæ.* These forms are by Geinitz united to his genus *Cladograpsus*, the propriety of which we are unable to decide.

The genus *Gladiolites* (*Retialites* of Barrande, 1850, *Graptophyllia* of Hall, 1849) occurs among American forms of the *Graptolitideæ*, in a single species in the Clinton group of New York. A form analagous, with the reticulated margins and straight midrib, has been obtained from the shales of the Hudson River group in Canada, suggesting an inquiry as to whether the separation of this genus on account of the reticulated structure alone, can be sustained. In the mean time we may add that the Canada collection sustains the opinion already expressed, that the *Dictyonema* will form a genus of the family *Graptolitideæ.* The same collection has brought to light other specimens of a character so unlike anything heretofore described, that another very distinct genus will thereby be added to this family. The Canadian specimens show that the Graptolites are far from always being simple or merely branching flattened stems.

The following diagnosis will express more accurately the character of the genus *Graptolithus*, as ascertained from an examination of perfect specimens in this collection.

## *Genus* GRAPTOLITHUS (Linn.).

*Description.*—Corallum or bryozoum fixed, (free ?) compound or simple ? the parts bi-laterally arranged, consisting of few or many simple or variously bifurcating branches, radiating more or less regularly from a centre, and united towards their base in a continuous thin corneous membrane or disk, formed by an expansion of the substance of the branches, and which in the living state may have been in some degree gelatinous. Branches with a single or double series of cellules or serratures, communicating with a common longitudinal canal, affixed by a slender radix or pedicle from the centre of the exterior side.

The fragments, either simple or variously branched, hitherto described as species of *Graptolithus*, are for the most part to be regarded as detached portions from the entire frond.

In its living state we may suppose it to have been concavo-convex (the upper being the concave side), or to have had the power to assume this form at will. In many specimens there is no evidence of a radix or point of attachment, and they have very much the appearance of bodies which may have floated free in the ocean.

### GRAPTOLITHUS LOGANI.

PLATE I. Fig. 1—6. PLATE II. Fig. 1, 2, 3, 4.

*Description.*—Frond composed of numerous branches nearly equally disposed on two sides of a central connecting stipe, and each again subdividing nearly equally, after which they bifurcate, always near the base, with greater or less regularity ; connecting membrane thin, composed of the same substance, and continuous with the branches, and extending from the centre to some distance beyond the bifurcations ; the branches after the third bifurcation become marked on the inner side by a row of cellules, and along the centre by an abruptly depressed line which follows the divarication of the branches ; cellules minute, not prominent towards the base of the branches, being compressed vertically, and appearing like a double series with a central depressed line, becoming developed as they recede from the base. The branches beyond the disk are turned on one side and laterally flattened, and present a single series of cellules or serrations, which are moderately deep, with the serratures acute at their extremities ; from twenty-four to twenty-eight in an inch. The substance of the branch upon the exterior surface near the centre, is marked by a depressed longitudinal line, which follows the ramifications, and gradually dies out as the branches become finally simple, when the surface on the same side is smooth or somewhat obliquely striated. The disk is smooth exteriorly, and from the centre is a small radicle from which the two sets of branches diverge.

This species, though in a general manner bi-lateral, and presenting four principal branches, is nevertheless, from the irregular division of these, usually unequal upon the two sides ; and we find on examination of those figured that they are as ten and ten, nine and eleven, eight and nine, ten and eleven, seven and ten, twelve and twelve, eight and eight, eight and ten, while the half which is figured on Plate II. has eleven rays.

Plate I. Fig. 1. An individual showing the exterior surface ; the central portions entire, with the impression of the connecting corneous membrane, some portions of which remain still attached to the arms. The extent and outline of the membrane are very distinctly preserved. Some of the arms are broken off at the termination of this membrane or disk, while others extend to some distance beyond its limits ; all however are imperfect.

The appearence of serratures is due to exfoliation, which shows the impression of the inner side upon the stone.

Fig. 2. Exterior view of another individual, in which some portions of the membrane still remain, the branches being all broken off just beyond the last bifurcation.

Fig. 3. The inner side showing the commencement of the cells, which appear in some places to be in a double series. The connecting membrane of the branches is removed in this specimen.

Fig. 4. Enlarged view of the exterior surface of the central portion of an individual.

Fig. 5. Enlarged view of the inner surface, exhibiting the appearance of a double series of cells, separated by a depressed line in the substance of the branch. In some instances these appear to be absolutely separate, while in others they are connected, showing that there is but a single series, and the apparent separation is due to the depression along the centre.

Fig. 6. An enlarged view of a fragment of a branch, showing serratures on one side, with a corresponding row of obscure, elevated ridges, which may perhaps be due to the foldings of the branch.

Plate II. Fig. 1. An individual preserving the connecting membrane almost entire, showing the sinuous outline.

Fig. 2. A specimen exhibiting the half of an individual, in which the disk is unequally extended between the rays. The margins are apparently entire between all of these; and from whatever cause or injury this inequality may be due, it existed in the animal while living.

Fig. 3. A fragment of slate preserving portions of three individuals. The connecting membrane had been removed by maceration before they were imbedded in the stony matter; but the branches are preserved to the length of more than seven inches. It does not appear that the portions preserved present the entire animal; on the other hand, it is almost certain from the condition of the specimens, that the branches were originally much longer. It will be observed that the branches do not all show the serrated margin at equal distances from the centre, but this is due to the accidental position assumed by the branches as they were imbedded; some present the exterior surface for a considerable distance, and, gradually turning, become flattened laterally.

Fig. 4. The exterior of the base of a specimen, showing the small node or radicle which proceeds from the centre of the vinculum or connecting stipe.

The preceding illustrations are of a single species in different degrees of preservation. The manner of branching, although subject to slight modifications, is still always reliable for the purposes of distinguishing the species.

*Locality and Formation.*—These specimens were obtained at Point Lévy, opposite to Quebec, in a band of bituminous shale, separating beds of grey limestone. These strata belong to the Lower Silurian series, and are of that part of the Hudson River Group which is sometimes designated as Eaton's sparry limestone, being near the summit of the group; they form also the rocks of Quebec.

*Collectors.*—J. Richardson, Sir W. E. Logan, and James Hall.

### Graptolithus abnormis.

*Description.*—This species, of which only imperfect specimens have been seen, presents four principal branches diverging from the centre, two from each extremity of the vinculum, and each one of these bifurcating and branching unequally, and at unequal distances from the centre.

The forms above described do not by any means exhaust the variety presented in this collection. With a single exception however, all the specimens which offer any new light in regard to the habit of the Graptolites, indicate that the mode of growth was in the manner described, in radiating branches from a centre, or in tufts joining in a central connecting substance.

The specimens from the Canadian locality afford further evidence in confirmation of what we have elsewhere observed, that, with few exceptions, the species have a limited geographical range. This locality has already, after very cursory examination, afforded eight new species of Graptolites, with one or two species which appear to be identical with those previously found in the State of New York. A comparison of specimens from more southern localities with those of New York, shows a large proportion of new species; and it now appears probable that the number of American species of *Graptolithus* previously known (about twenty) will soon be increased by an equal number of new ones.

*Locality and Formation.*—Point Lévy, Hudson River Group.

*Collectors.*—J. Richardson, Sir W. E. Logan, and James Hall.

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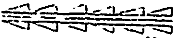
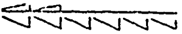
Since the date of the above communication, great numbers of Graptolites have been added to the Canada collection; and with an increased number of species, our knowledge of the structure of these animals has been very much extended. Had we at that time possessed all the materials which we now have, the subject might perhaps have been treated in a more natural order by presenting in the first place the more simple forms; but since the first two plates of the species were then engraved, I follow this note with the descriptions of others of the same character, which have been prepared since that time.

### GRAPTOLITHUS FLEXILIS.

*Description.* — Multibrachiate, bi-lateral; branches slender, flexile, bifurcating at irregular intervals; bifurcations of contiguous branches often opposite, repeated four times within one and a-half inches of the centre, having from thirty-two to forty or more branchlets at the extremities. Substance of branches thin, extremely compressed; non-celluliferous side smooth or faintly striated; celluliferous side with slight transverse indentations when compressed vertically, and with serratures when compressed laterally; serratures not deep, acute at the extremities, variable in prominence according to the position of the branch; about twenty-four in an inch. ' Branches often compressed in the direction of the cell to such a degree as to give an apparent double serrature, or serrature on each side of the axis. In this condition the edges of the cells are at right angles to the axis, very shallow, and not pointed.

When the celluliferous side, compressed in the direction of the cell, is uppermost on the surface of the shale, a line may be traced across the branch joining the edge of the serratures, thus showing that the two apparent serratures are but the single one, so compressed that its extremities project beyond the margin.

We have thus all gradations: the smooth surface of the branch with minute striations upon the outer side; the inner side when not compressed with serratures, showing as indented lines across the surface, ; the double serration, produced by more pressure in the same direction, ; and again, as the branch is turned around, these serratures disappearing from one side, and becoming more prominent upon the other ; finally showing their full breadth as the ray is compressed in its transverse or lateral direction.

This condition, which has not been understood with regard to many species, is the principal cause of the diminution and sometimes final disappearance of cells towards the base of a branch; even when both sides are serrated, a less degree of compression, which might very naturally result towards the base, would cause the serratures to be less prominent, as is seen in many of the figures in Barrande's *Graptolites de Bohême;* in the New York Palæontology, etc.

The serratures of this species differ essentially from those of any other in the Canadian collection, and from any in the New York collections or others that have come under my observation.

*Locality and Formation.*—Point Lévy, Hudson River Group.

*Collectors.*—J. Richardson and E. Billings.

GRAPTOLITHUS RIGIDUS.

*Description.*—Multibrachiate, bi-lateral; branches slender, cylindroid exteriorly; rigid, maintaining their width to the third bifurcation, and beyond this very gradually diminishing; bifurcations five in the space of one and a half inches; internodes unequal shorter near the base, and increasing towards the extremities; serratures undetermined.

In some specimens the branches are broader and flattened near the base, and the connecting bar or vinculum is broad and strong, with a small central node, the base of the radicle. Some portions of the corneous membrane or disk are preserved in a single specimen.

The subdivisions of each branch are from fifteen to twenty, or perhaps more numerous when entire; giving from sixty to eighty or more branchlets at the extremities of the frond.

A distinguishing feature of the species is its rigid and divergent bifurcation, and the almost uniform size of the branchlets.

All the specimens of this species examined are in a coarse arenaceous shale, and present the exterior or non-celluliferous side only. A single specimen has the extremities of the branches partially turned on one side, and gives some obscure indication of serratures. Individuals are extremely numerous in certain layers, and are spread out in profusion upon the surfaces of the slate, the bifurcating and interlocking branchlets presenting a net-work in which it is extremely difficult to trace the ramifications of each individual.

*Locality and Formation.*—Point Lévy, Hudson River Group.

*Collectors.*—J. Richardson and E. Billings.

### GRAPTOLITHUS OCTOBRACHIATUS.

*Description.*—Frond composed of eight simple undivided branchlets, arranged bi-laterally, and proceeding from the two extremities of a short strong vinculum, which is subdivided, and each part again divided near the base, giving origin to four equal rays or branchlets. Branchlets strong, linear, not sensibly diminishing in size as they recede from the centre; subangular, flattened upon the outer side, with a depressed line along the centre; obliquely striated; serratures short and strong, twenty in an inch, varying in depth according to the position of the branch, in one or two instances showing a deeper indentation.

This species presents the essential characteristic of eight simple arms or branchlets, which appear to have been subquadrangular in its living state, and when compressed laterally are scarcely broader, excepting the serratures, than when vertically compressed.

The branches are formed by the division of the vinculum at each extremity, first into two parts, making four; each of these is again subdivided almost immediately, and often so close as to present the appearance as if the four branchlets on each side originated from the same point. A careful examination however will show a little intervening space, and in one individual in its young state this feature is very characteristic.

The disk is a thick carbonaceous film, much stronger and coarser than in any of the preceding species, and corresponding in this respect to the stronger branches. It is moreover variable in form and extent in different specimens, and does not always appear to be in proportion to the size of the branches.

All the specimens yet examined present the exterior surface, so that the celluliferous face of the arms has not been seen. An impression of a short fragment of that surface of one of the branchlets shows strong, deep indentations. The vigorous aspect of this species contrasts with all others in this collection. In one specimen, where the frond is imperfect, one of the arms extends to a distance of more than eight and a-half inches from the centre, while two others are more than six inches each, and these are all broken at their extremities.

In its long linear branches, this species resembles the *G. sagittarius* (Hall, Pal. N. Y., Vol. I., pl. 74, fig. 1, perhaps not the European species of that name), but the branches are stronger and the serrations coarser; it is moreover associated with a group of species, all or nearly all of which are quite distinct from those of New York with which the *G. sagittarius* occurs.

*Locality and formation.*—Point Lévy, Hudson River Group.

*Collectors.*—J. Richardson and E. Billings.

### Graptolithus octonarius.

*Description.*—Frond composed of four principal branches, two diverging from each extremity of the short vinculum; each branch equally subdivided near the base, giving eight branchlets which continue simple to their extremities; branchlets gradually expanding from the base; serratures slightly inclined and truncated above almost rectangularly to the direction of the serratures and oblique to the rachis, giving a slightly obtuse extremity; about twenty-four in the space of an inch; substance of the branchlets thick; divisions between the cells marked by a strongly depressed line which extends from the base of the serrature downwards as far as the second serrature below, ending near the back or lower side of the branch.

The branchlets of this species resemble those of *G. bryonoides*, and the distance of the serratures is almost the same, while in some well-preserved specimens the obliquity of these parts is greater. There is also some difference in the form of the branchlets. In separate branches the characters are too nearly alike to offer the means of description, unless they are in a very perfect state of preservation.

From *G. octobrachiatus* it differs conspicuously in the form of its branchlets, and in the comparative number and form of the serratures.

*Locality and Formation.*—Point Lévy.

*Collector.*—J. Richardson.

### GRAPTOLITHUS QUADRIBRACHIATUS.

*Description.*—Frond composed of four simple undivided branches, arranged bi-lateraly, or two from each extremity of the vinculum; branches slender, linear, obliquely striated, usually somewhat incurved, serrated upon the inner side; serratures a little recurved, and mucronate at the tip; about twenty-four in an inch; indented to about one-third the width of the branch when completely flattened. Disk thick, strong, often extending along the branches and giving them a somewhat alate appearance; point of attachment of radicle obscure.

Almost all the specimens of this species are obscure, and all are fragmentary; in a few specimens only the serratures are exhibited with some degree of perfection. The branches are preserved in some specimens to an extent of two inches.

### GRAPTOLITHUS CRUCIFER.

*Description.*—Frond composed of four simple strong branches united by a small thickened disk; branches broad, connected by a short vinculum; serratures nearly vertical to the direction of the branch and sloping at an almost equal angle on each side, acute at the extremity, and apparently mucronate or setiferous; about twenty-four in an inch.

This species preserves the general character of G. *quadribrachiatus*, but the branches are much stronger, and about twice the width. The serratures are scarcely oblique to the rachis, and are very clearly mucronate at the tips, while some of them exhibit the appearance of long setæ. The imperfect preservation of the specimen examined renders it impossible to determine accurately the nature of these appendages.

In the specimen here described one of the branches is preserved to the extent of two and a half inches, with a width of three-sixteenths of an inch to the extremity of the points of the serratures, exclusive of the setæ; the branch to the base of the teeth being five-sixths of the whole width.

*Locality and Formation.*—Point Lévy, Hudson River Group.

*Collectors.*—J. Richardson, E. Billings.

GRAPTOLITHUS BRYONOIDES.

*Description.*—Frond composed of four short simple branches, united at the base by a vinculum, and terminating below in a minute radicle; branches short, comparatively broad, obliquely and strongly striated from the base of the serratures to the outer edge of branch; serratures moderately oblique, the outer and inner margins making very nearly a right angle; mucronate at the tip; about twenty-four to twenty-eight in an inch.

Of several specimens in the collection none of the branches exceed an inch in length, while they are almost one eighth of an inch in width from the tip of the solid part of the serratures to the outer edge. They are all strongly striated from the base of the serratures to the outer margin, the striæ sometimes a little curved. The serratures are usually slightly oblique, or with the longer sloping side directed towards the base of the branch, and the shorter side advanced a little beyond a right angle to the rachis. In one specimen, where the branches are less than five-eights of an inch in length, the serratures seem to be equally or nearly equally sloping on the two sides from the tip to the base.

The vinculum is obscure, and from the mode of imbedding in many specimens, this part might be inferred to be absent.

*Locality and Formation.*—Point Lévy, Hudson River Group.

*Collectors.*—J. Richardson, E. Billings, Sir W. E. Logan, James Hall.

(*To be continued in the next number*).

# Miscellaneous.

UNUSUAL MIGRATION OF WILD PIGEONS.—A correspondent in Barrie, C.W., sends us the following interesting facts, worthy of record among the other exceptional features of the past winter. We shall at all times be glad to receive short communications of this kind from any of our subscribers.—EDS.

On the afternoon of Friday, the 10th of March, immense flights of wild pigeons passed along the shores of Kempenfeldt Bay (an arm of Lake Simcoe) flying generally in a westerly and north-westerly direction. One flock at a fair computation was at least three miles long, and in the distance looked like a very large cloud rising gradually from below the horizon.

The pigeons during this day flew high, but in the pine woods some large flocks pitched. On Sunday the flocks were smaller, and flew very much lower, the birds then were to be found in the beech woods.

No one here ever remembers so early an arrival of these birds; April 21st, I believe, is the earliest date at which they have been seen.

The winter has however been peculiar; generally from December or the end of November till the beginning of April no birds are to be seen here but a few crows and a blue jay at intervals.

This year woodpeckers, blue tomtits, tree-creepers, and a small red-headed bird,* blue jays, and a small finch were seen almost every day. With the thermometer at 8°, I have seen them flying about.

With regard to the number of pigeons seen, I have often heard and read of the large flights of passenger pigeons on this continent, but never until now could have believed them possible.

Annual Report of the Canadian Institute of Toronto.—This society, much younger than the Natural History Society, is now a vigorous rival, and has in some respects much outgrown its older sister. Its labours in the past year have been highly creditable, embracing the reading and publication of a large number of valuable papers, the publication of the Canadian Journal, the collection of many books and specimens, and preparations toward the erection of a building. The number of members is said to amount to 614, the papers read to 37, and the Journal is distributed to 42 of the leading societies and sicentific institutes in Europe and America, bringing large returns by way of exchange. The following paragraphs show the view taken by the council of a portion of the institute and its causes.

"The constant accession of new members, the numerous and valuable donations presented to the Library and Museum, the comparatively large and increasing attendance at the meetings of the session, the character of the papers communicated to these meetings and finally the continued success of the Journal of the Institute, are each and all, it is submitted, legitimate subjects of

* Linaria minor ?

congratulation. Showing, as these facts most assuredly do, the honorable position accorded to the institute in the estimation of the Province.

"It is believed that the papers read will compare favorably with those of other years: more especially, as several have been deemed worthy of re-publication in some of the leading Scientific Journals of Europe. It is also gratifying to observe, with regard to those papers, that the appeals of preceding Councils for more active co-operation on the part of Members generally, has been to a great extent responded to. The present Council venture, therefore, to express a hope that a still more extended co-operation in this department, may be anticipated in the session now about to commence.

"Feeling strongly that the success of the Institute is dependent on, or at least largely influenced by, the success of its Journal, the Council have great satisfaction in alluding to the now fairly established and very marked success which has accompanied the issue of the new series of the "Canadian Journal," under the editorship of Dr. Wilson and a Committee appointed by the respective Councils of 1855 and 1856. The Council cannot allow this opportunity to pass without expressing an earnest desire that some special recognition on the part of the Members of the Institute, be devised to mark their sense of the zealous and valuable services of the chief editor."

Rejoicing as we do in the prosperity of the Canadian Institute, and recognising it as a worthy representative of Canadian Science, we are desirous of making its prosperity a reason why in the Natural History Society of Montreal similar vigour should be exhibited. We trace the rapid growth of the Institute, in the first place to the active exertions of a few leading scientific and literary men in Toronto, more especially of the Professors of University College. In the next place, to the regular publication of its Journal and the ability of the Society to give this publication to every member for a subscription, the whole amount of which is not more than the price of the Journal itself. Lastly, the large public aid received by the Institute, has given it the means thus liberally to repay its members their subscriptions and otherwise to extend its operations.

In the case of the Natural History Society of Montreal, we have now a body of active members fully able by their Scientific and Literary exertions to sustain the Society; and we have a

Journal, comparable in its peculiar field with that of the Canadian Insitute; but on the other hand not having any available means, except the annual subscriptions of members, this society is unable to give its Journal gratuitously to its members, or by means of exchanges to augment its library. The truth is, that Science in Toronto as represented by the Canadian Institute is liberally fostered by the Legislature, whereas Science in Montreal as represented by the Natural History Society receives only the pittance allotted to ordinary Mechanics' Institutes. We are very far from grudging the Institute the grant so well bestowed on it, and we admit in our own case that independence cultivates many rugged self-reliant virtues. Nor do we deny that, other things being equal, a Journal or publication unsupported by public aid will usually be better managed than one so supported. In the meantime however, as a stimulus to our membership, and for the wider circulation of the results of Canadian Science, we think it very desirable that the friends of Natural Science, in Lower Canada should endeavour to secure, for this its leading representative, some adequate share of legislative aid.

Effects of Foreign Pollen on Fruit.—The following on this curious subject is from Silliman's Journal, No. 73 :—In the last number of this Journal, p. 443, some facts were referred to, which led to the supposition that pollen applied to the stigma may exert some specific action upon the ovary itself, independent of its action upon the ovules determining the formation of the embryo. This was mentioned as furnishing the most probable clue to the explanation of the reputed fact that squashes are spoiled (that is the quality and appearance of the fruit altered) by pumpkins growing in their vicinity, and *vice versa*; and even that melons are spoiled by squashes; and this notwithstanding the fact, ascertained by Naudin, that distinct species of *Cucurbitaceæ* refuse to hybridize, although the various races of the same species cross with the greatest facility. It is generally agreed that the alteration of the character of the fruit is immediate, i. e., that it affects the ovary itself which has been contaminated by strange pollen. It might then equally affect the fruit whether the seeds were any of them fertilized or not; and in Naudin's experiments the application of pollen apparently caused the fruit to set, even when no ovules were fertilized.

Now a similar case of direct action of alien pollen upon the fruit, or grain, occurs in Indian corn, and is familiar to every farmer in the country, in the form of grains of different varieties on the same ear. A decisive instance is before us in a small ear of sweet corn, grown in the vicinity of a patch of the common hard, yellow variety; in consequence from three to six grains in every row have become yellow corn, while the rest retain the characteristic appearance of the sweet variety. It is not rare, where several sorts of maize are cultivated together, to find nearly all of them separately represented upon one ear. This must be the result either of cross-fertilization of the previous year showing itself, not in a blending of the characters of the fruit of the progeny, but in a complete separation into the constituent sorts in the fruit resulting from one seed, which would be a wonderful anomaly, but no impossibility; or else, of an immediate action of the pollen the present year, as is reputed of squashes and melons. But the occurence of three sorts of corn upon one ear goes far towards excluding the first supposition, since there can have been but two immediate parents to one embryo. (Prof. Gray).

Agassiz's Contributions to the Natural History of the United States.—The first two volumes of this work have made their appearance and are worthy of the high reputation of their author. We shall in a future number review the work at length, and in the meantime give the following summary of its contents.

Vol. I., Part I. *Essay on Classification.*

Chapter I. The fundamental relations of animals to one another and to the world in which they live, as the basis of the natural system of animals: under which head the author treats of —the actual foundation in nature of the true zoological system or classification,—the unity of plan throughout the diversified types —the distribution of the same types over widely diverse geographical regions, and as widely diverse geological ages,—the permanency of types and the immutability of species,—the relations between plants and animals and the surrounding world,—embryology a basis for determining the rank of species—succession in geological time a basis for deciding approximately upon rank;—all of which topics, besides others not here enumerated, are so handled as to bear directly on the question of creation by physical agencies, giving it a decided negative reply.

Chapter II. Leading groups of the existing system of animals —a philosophical disquisition on the true significance of the grades of subdivisions in the kingdoms of life, the nature of species, genera, families, orders and classes.

Chapter III. Notice of the principal systems of zoology, including observations on the systems of Aristotle and Linnæus; the *anatomical* systems of Cuvier, Lamarck, Ehrenberg, Burmeister, Owen, von Siebold and others; the *physio-philosophical* systems of Oken and McLeay; and the *embryological* systems of Dollinger, von Baer, Bogt, etc.

Part II. *North American Testudinata.*

Chapter I. The order of Testudinata, its rank, classification, general characters, anatomical structure, geographical distribution, geological history, etc.

Chapter II. The Families of Testudinata.

Chapter III. North American genera and species of Testudinata—their characters, distributions, etc., for the several families.

Part III. *Embryology of the Turtle.*

Chapter I. Development of the egg from its first appearance to the formation of the embryo.

Chapter II. Development of the embryo from the time the egg leaves the ovary to that of the hatching of the young, including the laying of the eggs,—the deposition of the albumen and formation of the shell,—the absorption of albumen into the yolk sac,—the transformations of the yolk in the fecundated egg,—segmentation of the yolk,—the whole egg is the embryo,—foldings of the embryonic disc and successive stages of growth of the turtle,—formation and development of the organs,—histology,—chronology of the development of the embryo.

The young of various species and the several successive phases in embryological development are illustrated with details in the plates, all of which are crowded full of figures.

Ascent of Chimborazo.—The Edinburgh New Philosophical Journal quotes the following interesting account of an ascent of Chimborazo by a French traveller, M. Jules Remy, and an English traveller, Mr. Brenchley:—

"On the 23d of June, 1802, the illustrious Humboldt, accompanied by his friend Bonpland, made the first attempt to ascend Chimborazo. On account of a pointed rock, which presented an insurmountable barrier, they were unable to ascend above 5909 metres of the mountain, then regarded as the highest in the world, and which still occupies a principal place among the colossi of America.

"Thirty years later, on the 16th of December, 1831, M. Boussingault, after a long and skilful examination of the Cordillera of the equator, endeavoured to accomplish the ascent in which his predecessor had failed. He reached the enormous height of 6004 metres, that is to say, 95 metres higher than the others; but he was arrested by rocks as they had been, and could not get beyond this limit, which was then the most elevated point ever attained by man on mountains.

"The accounts of these famous travellers had deprived us of all hope of reaching a height so considerable; but, after having observed the snowy and rounded summit of Chimborazo from Guayaquil, we could not help thinking that it was accessible from some point or other. M. Brenchley and myself were thus led to form the design of attempting a third ascent.

"On the 21st of July, 1856, as we crossed the plateau of the Andes on our way to Quito, we halted at the foot of this stupendous mountain. We employed two days in studying its outlines from a distance, with the view of discovering any peculiar places on the surface of its gigantic dome which might afford us a passage.

"The route followed by MM. Humboldt and Boussingault, seemed to us at first to be greatly the most easy and desirable on account of its regular declivity; but the barrier of rocks, which we readily distinguished, presented no outlet to the eye. When we had made nearly the entire circuit of this mighty mountain, and without success, we resumed our journey towards Quito, reserving the execution of our plan till we should be better fortified against the rigorous climate of the higher Cordilleras.

"After visiting Pichincha, Cotopaxi, and other giants of the Andes, we again found ourselves, on the 2d of November, at the foot of Chimborazo. We pitched our camp at a height of 4700 metres, a little below the line of perpetual snow, in a valley between Arenal and the point where the Riobamba route separates from that of Quito. We intended to spend the following day in collecting plants and hunting deer and birds, endeavoring, at the same time, to determine beforehand the places which might afford us the most easy access to the summit.

"We took up our quarters under a huge inclined rock, which afforded us sufficient protection against the northwest wind, but gave us no shelter in the event of rain. Rain had fallen in the afternoon. The weather cleared at night-fall, the sky became sprinkled with myriads of stars, and Chimborazo was delineated, in all its splendour, on the azure and sparkling vault of the firmament.

"On the morning of the 3d of November, at five o'clock, when day had not yet dawned in the equinoctial regions, we left our camp in charge of our people, and departed on our exploring expedition, carrying with us a coffee pot, two thermometers, a compass, matches, and tobacco. A steep hill, sandy and rough with pebbles, which separated us from the perpetual snow, occasioned us so much fatigue at our outset, that two of the natives who accompanied us became discouraged and turned back.

"When we had surmounted this hill, we descended on some soft sand to the bottom of a valley, which we followed, and from the extremity of which we distinguished very clearly the summit of the mountain, entirely free from snow.

"After walking half an hour on the snow, vegetation suddenly ceased, and we saw no other living thing but two large partridges, and on the rocks a few lichens of the families Idiothalamus and Hymenothalamus. At this point of our ascent we collected some dry branches of chuquiragua, and made a bundle of them, which we tied to our backs. We had still to scale an immense rock of trachyte, from the top of which the summit of Chimbarazo appeared to us so near, that we thought we could reach it in half an hour.

"Our ascent was so rapid, that we were soon obliged, from fatigue, to make frequent stoppages to recover our breath. Thirst also began to be severely felt, and in order to moderate it we almost always kept snow in our mouths. But we felt no symptoms of illness or any morbid affection, such as is spoken of by the majority of travellers who have ascended high mountains.

"After halting a few seconds, without even seating ourselves, we again started not only with renewed ardour, but even a kind of furious determination inspired by so near a view of the summit. It appeared evident to us, by this new instance confirming so many previous ones, that at those heights the atmospheric column is still sufficient to prevent any impediment to respiration, and that the shortness of breath and organic affections which are so generally complained of at considerable elevations, must be ascribed to some other cause.

"Always rapidly ascending, we now began to overlook the peaks of the Cordilleras, and to discover a distance furnished with immense valleys, when some light vapors, which at first appeared only like spiders webs on the sides of the mountain, soon began to detach themselves in the form of white flakes, stretching nearer and nearer to each other, till they at last arranged themselves like a girdle along the horizon.

"All of a sudden, about eight o'clock, this curtain enlarged itself, and approached Chimborazo; then in a few minutes it mounted to us, thin at first, but becoming perceptibly more dense. We no longer could perceive the summit. We continued, however, to mount upwards, enticed by the hope of attaining our object much more easily than we had supposed on leaving our encampment.

"The fog continued to increase; we could not see twenty paces from us. At half past nine, it had become so thick that it was almost as dark as night at the distance of a few metres. Confident of finding our footsteps again to guide our descent, we travelled on with additional stubborness; but we had every moment to examine the compass, in order to avoid a precipice which we had left on our right before reaching the terminal depression by which we resolved to gain the summit.

"It seemed to us that the declivity became less steep, we breathed more freely, and walked with less effort. Some dull detonations began at intervals to be heard in the distance. At first we ascribed them to the explosions of Cotopaxi; but soon reverberating peals, such as are heard only in the vicinity of the equator, convinced us that thunder was rolling in the lower regions. A terrible storm was in preparation.

"In the fear that the hail or snow would efface the marks of our feet, and thereby expose us to the risk of losing ourselves in the descent, we determined, with regret, to halt for a while. We hastened to kindle our chuquiragua wood, in order to melt the snow in our coffee-pot. At ten o'clock, the thermometer which, at five feet above the snow, indicated 1·7, was plunged in boiling water where the mercury stood at 77·5.

"At five minutes past ten, our observations terminated, and we began to descend with giant strides in order to regain our encampment as speedily as possible. We arrived there in the midst of the thick fog about an hour after noon. The thunder rolled almost without interruption, the flashes of lightning describing dazzling zigzags around us, never seen elsewhere so distinctly defined except in pictures.

"About three o'clock, a fearful tempest of rain, hail, and wind assailed us under our rock. It continued throughout a part of the night with a fury which seemed as if it could never be allayed. We were literally lying in water. On the morrow, at day break, our eyes rested everywhere on a vast field of hail.

"Certain indications of another tempest made us abandon the idea of trying again the ascent of Chimborazo, which we henceforth regarded as quite impracticable. We made all haste to break up our camp and make for Guaranda, where we arrived about three o'clock, travelling through a cold and dense fog, which prevented us for that day admiring one of the most beautiful views in the world.

"When we calculated our observations, we were not a little surprised to find that we had reached the summit of Chimborazo without being aware of it. According to personal researches, made at first in the Archipelago of Hawaii, and afterwards repeated among the Cordilleras of the equator, the co-efficient of a degree in the centigrade thermometer, reckoning between the point to which the mercury rises when the instrument is immersed in boiling water, and the boiling point of water at the level of the sea, is found to be 290·8; that is to say, each degree below 100 indicates a difference of level equal to 290·8 meters, or about 29 meters for the tenth of a degree, hence the formula

$$x = (100 - B)\ (290{\cdot}8)$$

which gives us 6543 meters for the absolute vertical height we had reached on Chimborazo. This figure places us quite on the summit, the altitude of which, above the sea level, according to Humboldt's triangulations, is 6544 metres. But whatever degree of confidence may be conceded to our calculations, the unquestionable fact resulting from our ascent is, that the summit of Chimborazo is accessible."

*Artesian Wells in Sahara*, (Athen., No. 1562).—The *Moniteur Algérien* brings an interesting report on the newly-bored Artesian wells in the Sahara Desert, in the province of Constantine. The first well was bored in the Oasis of Oued-Rir, near Tamerna, by a detachment of the Foreign Legion, conducted by the engineer, M. Jus. The works were begun in May, 1856, and, on the 19th of June, a quantity of water of 4,010 litres per minute, and of a temperature of 21° Réaumur, rushed forth from the bowels of the earth. The joy of the natives was unbounded; the news of the event spread towards the South with unexampled rapidity. People came from long distances in order to see the miracle; the Marabouts, with great solemnity, consecrated the newly-created well, and gave in the name of "the well of peace." The second well, in Temakin, yielded 35 litres, of 21° temperature, per minute, and from a depth of 85 metres; this well was called "the well of bliss." A third experiment, not far from the scene of the second, in the Oasis of Tamelhat, was crowned with the result of 120 litres of water per minute. The Marabouts, after having thanked the soldiers in the presence of the whole population, gave them a banquet, and escorted them in solemn procession to the frontier of Oasis. In another Oasis, that of Sidi-Nached, which had been completely ruined by the drought, the digging of "the well of gratitude" was accompanied by touching scenes. As soon as the rejoicing outcries of the soldiers had announced the rushing forth of the water, the natives drew near in crowds, plunged themselves into the blessed waves, and the mothers bathed their children therein. The old Emir could not master his feelings; tears in his eyes, he fell down upon his knees, and lifted his trembling hands, in order to thank God and the French. This well yields not less than 4,300 litres per minute, from a depth of 54 metres. A fifth well has been dug at Oum Thior, yielding 108 litres per minute, Here a part of the tribes of the neighborhood commenced at once the establishment of a village, planting at the same time hundreds of date-palms, and thus giving up their former nomandic life. The last well is that of Shegga, where soon an important agricultural centre will spring up. There is no doubt but that these wells will work in these parts a great social revolution. The tribes which, after the primeval custom of their ancestors, kept wandering from one place to another, will gather round these fertilizing springs, will exchange the herdsman's staff for the plough of the farmer, and thus take the first steps towards a civilization, which, no doubt, will make rapid progress in Northern Africa.

# MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF FEBRUARY, 1858.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

| Day of Month. | Barometer corrected and reduced to 32° F. (English inches.) | | | Temperature of the Air. F. | | | Tension of Aqueous Vapour. | | | Humidity of the Atmosphere. | | | Direction of Wind. | | | Mean Velocity in Miles per hour. | | | Amo'nt of Snow in inches. | Amo'nt of Rain in inches. | Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 a. m. | 2 p. m. | 10 p. m. | 6 a. m. | 2 p. m. | 10 p. m. | 6 a. m. | 2 p. m. | 10 p. m. | 6 a. m. | 2 p. m. | 10 p. m. | 6 a. m. | 2 p. m. | 10 p. m. | 6 a. m. | 2 p. m. | 10 p. m. | | | 6 a. m. | 2 p. m. | 10 p. m. |
| 1 | 30·185 | 29·972 | 30·005 | —9·2 | 10·1 | 3·0 | ·017 | ·045 | ·044 | ·57 | ·60 | ·85 | N. E. by E. | N. E. by E. | N. E. by E. | 0·71 | 1·78 | 9·96 | | | Clear. | Clear. | C. Str. 10. |
| 2 | 29·504 | 315 | 29·363 | 2·7 | 20·5 | 17·7 | ·038 | ·096 | ·086 | ·73 | ·85 | ·84 | N. E. by E. | N. E. by E. | N. E. by E. | 27·09 | 20·07 | 2·63 | | 9·80 | Snow. | Snow. | " 10. |
| 3 | 547 | 538 | 709 | 20·9 | 28·0 | 23·2 | ·075 | ·099 | ·100 | ·72 | ·64 | ·74 | W. S. W. | W. S. W. | N. W. | 13·08 | 19·60 | 12·61 | | | Cirr. Str. 4. | C. Str. 4. | " 10. |
| 4 | 863 | 800 | 898 | 6·4 | 23·0 | 15·0 | ·043 | ·088 | ·061 | ·75 | ·62 | ·73 | W. by S. | W. by S. | N. E. by E. | 7·95 | 6·15 | 5·77 | | | Clear. | Clear | " 10. |
| 5 | 894 | 858 | 875 | 1·0 | 12·4 | 7·0 | ·030 | ·051 | ·048 | ·69 | ·69 | ·77 | W. by N. | W. by N. | S. S. W. | 1·30 | 4·81 | 8·57 | | | " | C. Str. 4. | " 10. |
| 6 | 996 | 956 | 969 | —1·8 | 18·2 | 7·2 | ·034 | ·075 | ·040 | ·84 | ·71 | ·79 | W. S. W. | W. S. W. | S. S. E. | 0·20 | 7·46 | 1·40 | | | " | " 4. | Clear. |
| 7 | 765 | 627 | 698 | 8·6 | 21·0 | 22·0 | ·042 | ·070 | ·101 | ·68 | ·80 | ·86 | N. E. by E. | N. E. by E. | S. W. | 5·43 | 4·37 | 1·81 | | 0·75 | C. Str. 10. | C. Str. 10. | C. Str. 10. |
| 8 | 944 | 971 | 30·050 | 9·0 | 15·0 | —0·3 | ·051 | ·055 | ·034 | ·77 | ·68 | ·81 | N. W. | S. by W. | S. by W. | 19·71 | 10·50 | 1·31 | | | " 6. | Clear. | Clear. |
| 9 | 30·031 | 674 | 29·377 | —14·1 | 4·2 | 9·1 | ·012 | ·038 | ·051 | ·50 | ·73 | ·77 | N. E. by E. | N. E. by E. | N. E. by E. | 1·47 | 5·85 | 15·30 | | 3·10 | C. C. Str. 4. | Snow. | Snow. |
| 10 | 29·201 | 344 | 526 | 10·3 | 16·4 | —2·0 | ·054 | ·074 | ·030 | ·78 | ·83 | ·80 | W. by S. | W. by S. | W. | 14·85 | 14·05 | 23·05 | | 0·97 | C. Str. 4. | C. Str. 8. | C. Str. 4. |
| 11 | 787 | 910 | 30·044 | —15·7 | 1·0 | —13·4 | ·010 | ·032 | ·012 | ·45 | ·70 | ·54 | W. | W. | W. | 23·35 | 1·22 | 18·50 | | | Clear. | C. C. Str. 4. | Clear. |
| 12 | 30·120 | 30·124 | 183 | —26·3 | 9·8 | —11·9 | ·002 | ·054 | ·063 | ·18 | ·78 | ·81 | W. | W. | W. S. W. | 4·21 | 11·14 | 0·18 | | | C Str. 2. | Clear. | " |
| 13 | 330 | 310 | 236 | —30·2 | —3·0 | —15·5 | ·002 | ·025 | ·010 | ·20 | ·66 | ·46 | W. S. W. | W. | W. | 0·08 | 0·11 | 0·33 | | | Clear. | " | " |
| 14 | 010 | 29·952 | 29·876 | —14·7 | 0·0 | —0·3 | ·011 | ·034 | ·034 | ·48 | ·70 | ·80 | N. E. by E. | N. E. by E. | W. by S. | 3·12 | 4·69 | 3·50 | | Inapp. | C. C. Str. 8. | C. Str. 10. | " |
| 15 | 29·973 | 920 | 30·032 | —9·8 | 14·0 | 2·8 | ·019 | ·067 | ·036 | ·60 | ·81 | ·72 | W. S. W. | W. S. W. | W. S. W. | 0·32 | 3·15 | 12·47 | | | Cirr. 2. | Str. 4. | " |
| 16 | 886 | 724 | 29·885 | —9·3 | 11·9 | 2·2 | ·018 | ·051 | ·028 | ·58 | ·70 | ·67 | W. S. W. | W. by S. | W. by N. | 7·27 | 2·22 | 25·40 | | | Clear | Clear. | C. Str. 10. |
| 17 | 933 | 976 | 990 | —5·0 | 8·8 | 0·1 | ·022 | ·054 | ·036 | ·63 | ·78 | ·80 | E. by N. | W. by N. | W. by S. | 28·83 | 5·71 | 1·91 | | | C. Str. 4. | " | Clear. Aurora Borealis. |
| 18 | 983 | 918 | 30·079 | —5·4 | 5·0 | —4·0 | ·022 | ·037 | ·024 | ·63 | ·62 | ·65 | W. | W. | W. | 20·03 | 11·47 | 10·87 | | Inapp. | " 10. | " | " " " |
| 19 | 30·227 | 30·137 | 182 | —20·2 | 10·6 | —9·4 | ·006 | ·054 | ·022 | ·33 | ·78 | ·78 | W. S. W. | S. E. | E. N. E. | 1·13 | 0·11 | 0·13 | | | Clear. | " | C. Str. 4. |
| 20 | 29·958 | 29·748 | 29·701 | —10·9 | 12·0 | 10·6 | ·021 | ·063 | ·050 | ·77 | ·81 | ·70 | N. E. by E. | E. N. E. | W. | 4·90 | 7·97 | 1·10 | | | C. C. Str. 8. | C. C. Str. 10. | " 10. |
| 21 | 606 | 896 | 868 | 9·5 | 24·5 | 20·8 | ·081 | ·111 | ·085 | ·77 | ·81 | ·78 | S. W. | S. W. | W. by N. | 8·08 | 7·22 | 3·86 | | 0·46 | C. Str. 10. | C. Str. 10. | " 8. |
| 22 | 910 | 920 | 30·001 | —3·6 | 18·3 | —3·7 | ·025 | ·080 | ·025 | ·66 | ·79 | ·66 | W. by N. | W. S. W. | W. by N. | 9·46 | 1·64 | 4·72 | | | Clear. | Clear. | Clear. |
| 23 | 30·114 | 30·179 | 278 | —16·9 | 16·4 | 3·5 | ·009 | ·065 | ·032 | ·43 | ·74 | ·60 | S. W. by W. | S. S. W. | S. W. by S. | 0·02 | 0·40 | 8·17 | | | " | " | " |
| 24 | 156 | 29·928 | 29·728 | —5·3 | 28·5 | 14·8 | ·022 | ·111 | ·061 | ·65 | ·81 | ·73 | S. S. E. | N. E. by E. | N. N. E. | 1·63 | 2·25 | 1·22 | | | C. C. Str. 8. | C. Str. 10. | C. Str. 10. |
| 25 | 29·683 | 540 | 720 | 13·1 | 30·0 | 21·0 | ·063 | ·130 | ·090 | ·80 | ·78 | ·78 | E. by S. | S. | W. by N. | 0·01 | 3·35 | 10·06 | | | Nim. 10. | C. C. Str. 8. | " 4. |
| 26 | 796 | 781 | 763 | 7·0 | 34·9 | 13·2 | ·045 | ·155 | ·054 | ·76 | ·79 | ·72 | W. by S. | S. S. W. | S. | 2·06 | 1·07 | 2·96 | | | Clear. | Clear. | Clear. |
| 27 | 604 | 470 | 650 | 13·6 | 39·4 | 32·0 | ·063 | ·192 | ·169 | ·81 | ·82 | ·89 | S. by E. | S. by E. | S. by E. | 9·72 | 7·09 | 0·93 | Inapp. | | C. Str. 8. | C. Str. 8. | C. Str. 4. |
| 28 | 600 | 460 | 410 | 32·0 | 34·0 | 32·5 | ·162 | ·155 | ·156 | ·89 | ·99 | ·85 | S. S. E. | E. N. E. | W. by N. | 0·73 | 3·57 | 5·90 | | 2·90 | " 10. | Sleet. | Snow. |

## REPORT FOR THE MONTH OF MARCH, 1858.

| Day | Barometer 6 a. m. | 2 p. m. | 10 p. m. | Temp. 6 a. m. | 2 p. m. | 10 p. m. | Tension 6 a. m. | 2 p. m. | 10 p. m. | Humidity 6 a. m. | 2 p. m. | 10 p. m. | Wind 6 a. m. | 2 p. m. | 10 p. m. | Velocity 6 a. m. | 2 p. m. | 10 p. m. | | | Weather 6 a. m. | 2 p. m. | 10 p. m. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 29·562 | 29·642 | 29·780 | 22·0 | 36·3 | 21·0 | ·112 | ·171 | ·101 | ·93 | ·82 | ·86 | W. N. W. | E. S. E. | E. | 0·00 | 0·31 | 0·01 | | 0·30 | C. C. Str. 4. | C. Str. 10. | Snow. |
| 2 | 514 | 425 | 571 | 10·6 | 18·0 | 9·4 | ·054 | ·087 | 057 | ·78 | ·84 | ·88 | N. N. E. | W. | W. S. W. | 18·11 | 7·50 | 12·40 | | 1·00 | C. Str. 10. | Snow. | C. Str. 10. |
| 3 | 816 | 879 | 30·016 | —9·0 | 15·4 | —15·3 | ·019 | ·065 | ·016 | ·60 | ·74 | ·72 | W. S. W. | S. W. | E. S. E. | 7·17 | 3·31 | 1·48 | | | Clear. | Clear. | Clear. Aurora Borealis. |
| 4 | 30·112 | 30·052 | 125 | —21·9 | 18·0 | —3·2 | ·011 | ·067 | ·025 | ·63 | ·68 | ·66 | S. S. E. | S. | N. N. E. | 0·01 | 0·30 | 0·48 | | | " | " | " Aurora Borealis. |
| 5 | 110 | 29·797 | 29·714 | —15·8 | 11·8 | 8·1 | ·016 | ·051 | ·048 | ·70 | ·69 | ·71 | W. | W. | W. S. W. | 2·30 | 10·55 | 15·55 | | Inapp. | C. C. Str. 4. | " | C. Str. 4. |
| 6 | 29·762 | 743 | 700 | 3·0 | 9·0 | 0·2 | ·041 | ·051 | ·036 | ·74 | ·77 | ·84 | W. | W. by N. | W. N. W. | 14·03 | 4·10 | 9·43 | | 1·00 | Snow. | C. Str. 10. | Clear. |
| 7 | 626 | 500 | 371 | —5·0 | 11·1 | 10·1 | ·022 | ·057 | ·054 | ·62 | ·76 | ·78 | W. N. W. | W. N. W. | W. N. W. | 14·30 | 1·55 | 6·07 | | | Clear. | " 10. | C. C. Str. 8. |
| 8 | 565 | 464 | 464 | —1·1 | 26·9 | 2·9 | ·023 | ·117 | ·036 | ·61 | ·82 | ·72 | N. W. | S. W. | E. by S. | 7·10 | 0·70 | 0·06 | | | " | Clear. | Cir. Str. 10. |
| 9 | 211 | 134 | 238 | 2·5 | 16·0 | 12·0 | ·034 | ·065 | ·060 | ·71 | ·74 | ·80 | N. N. E. | N. W. by N. | W. by N. | 0·87 | 5·77 | 11·63 | | Inapp. | C. Str. 10. | C. Str. 4. | " 4. |
| 10 | 353 | 424 | 517 | 14·0 | 36·7 | 20·2 | ·051 | ·184 | ·076 | ·63 | ·85 | ·71 | W. | W. | W. | 5·17 | 6·22 | 28·16 | | Inapp. | " 8. | " 4. | Clear. |
| 11 | 257 | 226 | 539 | 15·7 | 31·0 | 20·6 | ·065 | ·155 | ·075 | ·74 | ·89 | ·70 | S. W. | W. | W. by N. | 1·31 | 8·57 | 14·48 | | 2·00 | " 10. | Sleet. | Snow. |
| 12 | 899 | 850 | 937 | 3·0 | 32·0 | 13·1 | ·036 | ·149 | ·048 | ·72 | ·84 | ·62 | W. S. W. | W. S. W. | E. | 17·71 | 10·47 | 5·08 | | | Clear. | C. Str. 4. | Str. 2. |
| 13 | 30·361 | 30·270 | 30·223 | 2·0 | 19·0 | 14·1 | ·034 | ·071 | ·051 | ·71 | ·69 | ·63 | E. by N. | S. W. | S. W. | 6·01 | 1·51 | 3·92 | | | " | Clear. | Clear. Aurora Borealis. |
| 14 | 29·958 | 29·850 | 29·999 | 7·1 | 24·1 | 17·5 | ·045 | ·094 | ·072 | ·75 | ·73 | ·75 | S. E. | N. | W. N. W. | 1·60 | 5·41 | 0·02 | | 0·90 | Snow. | C. Str, 10. | " Aurora Borealis. |
| 15 | 30·050 | 30·060 | 30·030 | 28·0 | 52·8 | 34·0 | ·135 | ·334 | ·175 | ·88 | ·86 | ·89 | S. W. | S. W. | W. | 1·05 | 0·01 | 0·21 | | | C. Str. 10. | " 10. | C. Str. 10. |
| 16 | 29·941 | 29·842 | 29·741 | 32·1 | 35·2 | 34·6 | ·162 | ·183 | ·175 | ·89 | ·90 | ·89 | N. E. | S. E. | W. by S. | 1·96 | 0·63 | 0·02 | | | " 10. | Rain. | Rain. |
| 17 | 847 | 471 | 334 | 38·0 | 52·4 | 40·3 | ·208 | ·334 | ·212 | ·91 | ·86 | ·82 | S. W. by W. | W. by S. | S. W. | 0·24 | 0·48 | 2·47 | 0·199 | | " 4. | C. Str. 4. | C. Str. 8. |
| 18 | 246 | 382 | 682 | 38·0 | 43·0 | 36·7 | ·216 | ·254 | ·195 | ·91 | ·84 | ·82 | S. W. | W. S. W. | W. by N. | 10·97 | 10·60 | 15·47 | 0·011 | | " 10. | " 10. | " 6. |
| 19 | 30·001 | 30·150 | 30·199 | 26·0 | 44·4 | 26·1 | ·117 | ·186 | ·105 | ·76 | ·67 | ·75 | N. N. W. | S. W. | S. S. W. | 12·63 | 1·71 | 0·26 | | | Clear. | Clear. | Clear. |
| 20 | 170 | 29·971 | 29·795 | 18·4 | 49·8 | 34·0 | ·075 | ·278 | ·155 | ·70 | ·71 | ·79 | S. S. W. | S. W. by W. | W. by S. | 0·01 | 0·01 | 0·28 | | | " | " | " |
| 21 | 29·180 | 021 | 110 | 32·1 | 44·2 | 34·1 | ·143 | ·241 | ·175 | ·79 | ·85 | ·89 | S. by E. | W. S. W. | W. S. W. | 8·20 | 13·85 | 9·41 | 0·045 | | Rain. | Rain. | C. Str. 8. |
| 22 | 489 | 682 | 782 | 25·5 | 24·4 | 20·4 | ·111 | ·083 | ·085 | ·81 | ·74 | ·78 | W. by N. | W. N. W. | N. W. | 34·61 | 23·85 | 27·52 | | | C. Str. 4. | Clear. | Clear. |
| 23 | 882 | 882 | 918 | 11·1 | 34·8 | 25·0 | ·048 | ·149 | ·105 | ·69 | ·74 | ·80 | N. W. | S. S. W. | N. by W. | 4·80 | 2·26 | 1·00 | | | Clear. | " | Cir. Cum. 4. Lunar Halo. |
| 24 | 963 | 863 | 984 | 11·4 | 40·6 | 24·6 | ·057 | ·188 | ·094 | ·79 | ·77 | ·73 | N. E. | S. S. W. | W. by N. | 12·72 | 0·72 | 8·57 | | | " | " | Clear. |
| 25 | 759 | 584 | 626 | 15·1 | 36·2 | 35·0 | ·065 | ·156 | ·162 | ·74 | ·75 | ·80 | W. by N. | S. S. W. | N. W. by W. | 1·46 | 1·70 | 7·11 | | | C. C. Str. 6. | C. C. Str. 2. | " |
| 26 | 675 | 584 | 770 | 32·1 | 36·2 | 26·1 | ·162 | ·156 | ·105 | ·89 | ·75 | ·75 | N. W. by W. | S. S. W. | W. N. W. | 11·97 | 13·77 | 1·20 | | | C. Str. 10. | Clear. | C. Str. 6. |
| 27 | 763 | 661 | 675 | 19·9 | 42·6 | 30·6 | ·075 | ·199 | ·148 | ·71 | ·74 | ·89 | W. N. W. | W. by N. | S. S. W. | 16·55 | 9·09 | 2·73 | | | " 8. | Cirr. Str. 4. | Clear. |
| 28 | 632 | 595 | 694 | 18·9 | 48·9 | 36·2 | ·071 | ·245 | ·170 | ·70 | ·80 | ·80 | W. by S. | S. W. by S. | S. W. by W. | 0·50 | 0·17 | 0·11 | | | Clear. – | Clear. | " |
| 29 | 754 | 737 | 830 | 31·0 | 55·0 | 40·0 | ·130 | ·349 | ·203 | ·74 | ·81 | ·82 | W. S. W. | S. W. by W. | N. by W. | 0·56 | 0·22 | 7·30 | | | " | " | C. C. Str. 4. |
| 30 | 950 | 937 | 995 | 32·4 | 53·2 | 38·7 | ·137 | ·269 | ·201 | ·74 | ·67 | ·86 | E. N. E. | W. S. W. | S. S. W. | 2·55 | 0·95 | 0·01 | | | " | " | C. Str. 8. |
| 31 | 30·002 | 964 | 959 | 30·0 | 61·6 | 40·6 | ·136 | ·383 | ·197 | ·83 | ·71 | ·78 | E. N. E. | S. by W. | S. by W. | 1·96 | 0·00 | 0·00 | | | " | " | Clear. Aurora Borealis. |

## REMARKS FOR FEBRUARY, 1858.

Barometer...... Highest, the 13th day, 30·330 inches. Lowest, the 10th day, 29·201 ". Monthly Mean, 29·809 inches. Monthly Range, 1·129 ".

Thermometer... Highest, the 27th day, 39°4. Lowest, the 13th day, —30°2. Monthly Mean, 7°56. Monthly Range, 69°6.

Greatest intensity of the Sun's rays, 62°1.
Lowest point of terrestrial radiation, —31°2.
Mean of humidity, [illegible].

Rain fell on 1 day; it was raining 15 minutes. Inappreciable Snow fell on 8 days: it was snowing 53 hours 45 minutes, and amounted to 17·58 inches.
Most prevalent wind, W. by S. Least prevalent wind, E.
Most windy day, the 10th day; mean miles per hour, 17·31.
Least windy day, the 13th day; miles per hour, 0·14.
Aurora Borealis visible on 1 night.
Moon Eclipse visible.
The Electrical state of the atmosphere has indicated high tension.
Ozone was in moderate quantity.

## REMARKS FOR MARCH, 1858.

Barometer...... Highest, the 13th day, 30·361 inches. Lowest, the 21st day, 29·021 ". Monthly Mean, 29·804 inches. Monthly Range, 1·340 ".

Thermometer. Highest, the 31st day, 61°6. Lowest, the 4th day, —21°9. Monthly Mean, 25°52. Monthly Range, 83°5.

Lowest point of terrestrial radiation, —22°1.
Mean of humidity, ·789.
Rain fell on 3 days; it was raining 19 hours, and amounted to 0·285 inches.

Snow fell on 8 days; it was snowing 20 hours 45 minutes, and amounted to 4·20 inches.
Most prevalent wind, W. by N. Least prevalent wind, N.
Most windy day, the 22nd day; mean miles per hour, 28·65.
Least windy day, the 28th day; mean miles per hour, 0·26.
Greatest intensity of the Sun's rays, 89°0.
Aurora Borealis visible on 4 nights. Lunar Halo visible 1 night.
Eclipse of the Sun invisible, owing to cloudy weather.
The Song Sparrow first heard on the 20th day.
The Electrical state of the atmosphere has indicated feeble intensity.
Ozone was in moderate quantity.